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Health and Economic Growth in Sub-Saharan Africa

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This study empirically examines the role of health on economic growth in Sub-Saharan Africa using a panel data from 1990 to 2014. The study employed a panel data analysis in which the random effects model was used to examine the relationships among variables. Each of the explanatory variables were tested for multicollinearity using the Variance Inflation Factor (VIF) which was not found among variables, and other tests such as the Hausman test which showed that the random effects model is the most preferred, the heteroskedasticity test which was also conducted using the Modified Wald test and found the presence of heteroskedasticity which was corrected in the model and the random effects test using the Breush-Pagan lagrange multiplier. The random effects model results show that health in terms of life expectancy has an inelastic and significant influence on gross domestic product per capita while in terms of the prevalence of HIV showed an inelastic but did not have a significant influence on gross domestic product per capita. Another important result is that economic growth had a positive relationship with gross fixed capita formation, secondary school enrolment and the prevalence of HIV while it had a negative relationship with total labour force and life expectancy. Thus, we conclude that although health in terms of mortality and morbidity had an inelastic relationship on gross domestic product per capita, mortality showed a significant influence while morbidity had no significant influence on economic growth in Sub-Saharan African.

Keywords: Health, Growth, SSA, Panel Data, JEL Classification:

INTRODUCTION

Health is pertinent to human capital which is one of the main inputs for economic growth and development. The World Health Organization (1946) defined health as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity". "Many factors combine together to affect the health of individuals and communities whether people are healthy or not, is determined by their circumstances and environment. To a large extent factors such as where we live, the state of our environment, genetics, our income and educational level, and our relationships with friends and family all have considerable impacts on health whereas the more commonly considered factors such as access and use of health care services often have less of an impact" (WHO, 2013).

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According to WHO (2013) the determinants of health include: the social and economic environment, the physical environment, and the person's individual characteristics and behaviour. Health also plays an important role in economic growth, as the saying goes 'Health is Wealth'. Health is a determinant of human capital as according to Barro (1996) health is 'a capital productive asset and an engine of economic growth'. Also, human capital formulation which consists of health and education leads to the attainment of economic growth as according to Grossman (1972), Bloom and Canning (2000) individuals who are healthy in terms of assimilating knowledge are more efficient and as a result of this obtain higher productivity (Rico, Turrbiates and Hernandez, 2005).

Out of the Eight Millennium Development Goals (MDGs) adopted by 189 countries following the signing of the United Nations Millennium Declaration in 2000, MDG 4, 5 and 6 relate directly to health which are: to reduce child mortality by two-thirds between 1990-2015, improve maternal health by three-quarters between 1990 and 2015 and combat HIV/AIDS (HIV means Human Immunodeficiency Virus while AIDS means Acquired Immune Deficiency Syndrome), malaria and other diseases by 2015. According to World Development Indicator (2013) looking at the MDG 4 which is to reduce child mortality, in developing countries the under-five mortality rate fell from an average of 95 per 1000 per live births in 1990 to 56 in 2011, but rates in Sub-Saharan Africa and south Asia remain much higher.

Also most children die from causes that are readily preventable and curable with existing interventions, such as pneumonia (18%), diarrhoea (11%) and malaria (7%). Almost 70% of deaths of children under age 5 occur in the first year of life, and 60% of those in the first month. Preterm birth complications account for 14% of deaths, and complications during birth another 9%.(UN Inter-Agency Group for Child Mortality Estimation, 2012; WDI, 2013). There is need to address the causes of neonatal and infant mortality such as inadequate antenatal, prenatal and after birth care, poor sanitation and malnutrition and high vulnerability rate to diseases. Also, lower infant and child mortality rates are, in turn, the largest contributors to higher life expectancy in most countries (World Development Indicators, 2013).

Sub-Saharan Africa remains the center of the HIV/AIDS epidemic, but the proportion of adults living with AIDS has begun to fall even as the survival rate of those with access to antiretroviral drugs has increased. By the year 2010, 6.5 million people worldwide were receiving antiretroviral drugs and this represented the largest one-year increase in coverage but still fell short of universal access. (UN, 2012; World Bank, 2013).

As Jack and Lewis (2009) in a view to investigate the determinants of health itself, particularly the evidence on the impact of public expenditure point out that in general there appears "to be growing evidence that the public policies only improve health when institutions are of sufficiently high quality, and that good institutions themselves are likely to have a more important direct effect on growth than growth through health".

'Institutions in health care are important but under studied. The lack of sound institutions undermines health investments and leads to ambiguous evidence relationship between health care services and health status. Accepted indicators of health care performance such as hospital infection rates, utilization statistics, or surgery survival rates are rarely collected even when required, for lack of some combination of oversight, regulation, and enforcement. This applies in middle income countries as well as poorer ones. Indirect indicators of poor performance that are increasingly relied on in the absence of more direct measures include provider absenteeism, lack of basic medical supplies and drugs, poor management of purchases, leakage of funds, and under-the-table payments by patients, all of which highlight the nature of the performance lapses that undermine effective service delivery' (Lewis, 2006; Jack and Lewis, 2009). Institutions with regards to health play an important role in achieving Economic growth as if institutions are unable to function, public spending on health will not improve health talk more of raising Economic growth. Therefore more attention should be paid to upgrading Health care institutions.

Health has been seen to have effects on economic development as it improves productivity and human capital. Good health improves the ability and capacity to learn and work while chronic illness undermines current productivity and promises future outcomes in output. According to Spring (2005) 'improvements in health have both level and growth effect on per capital income. Level effects from improved health results from increases in effective labour inputs. Improved health contributes to this in two ways: first by increasing the supply of labour inputs due to less time missed due to disease. Secondly by the increase in the efficiency in labour inputs due to improvements in the quality of labour when individuals are healthier. Growth rate occurs because a lower incidence of disease increases (the private and social) rates of return to human capital investments, which in turn leads to higher rates of economic growth".

Sorkin (1977); Rico et al. (2005) shows the various channels in developing nations through which economic development could be impacted through health. The gains from productivity and through the improvement in the hours of work are the first way through which health could impact economic development. Also, the development of previously unsettled regions is made possible. Lastly, this could also be seen through the turnaround in people's attitude through the improvement made in innovation and entrepreneurship. Good health plays an important role in the attainment of economic development.

Therefore, there is need for to establish and implement good health policies which aim at improving the health stock if sustainable development is to be attained.

2.0 Overview of Health in Sub-Saharan Africa

Looking at ten facts about Sub-Saharan Africa over time, between 1990 and 1999 the PPP GNI per capita growth was 17 percent ($1,087 to $1,278) and this has increased to 58 percent ($1298 to $2060) between 2000 and 2009; Also, there has been increase of international development assistance flows to countries in this region to fight HIV and other sexually transmitted diseases by 35 percent from 2007 to 2009; there have also been a decrease in the average number of children per woman from 7 to 5 in 1980 and 2009 respectively (Africa Development Indicators Factoids, 2011). According to the Macroeconomics and Health Commission Report (2001) three million people died of AIDS in the year 2000 and about 2.4 million of these deaths were in sub-Saharan Africa.

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Taking cognisance of some facts about Sub-Saharan Africa relative to the world, Sub-Saharan Africa has the second highest malnutrition rate of 42 percent, South Asia is the highest with 47 percent malnutrition rate and the lowest is North America with 4 percent malnutrition rate; Sub-Saharan Africa prevalence of HIV for people ages 15-49 is 5.4 percent relative to 0.8 percent for the World and this means that it is about 6.5 times the World prevalence; Child mortality rate has declined since 1990 by 33 percent and 28 percent in the world and Sub-Saharan Africa respectively; Although the average life expectancy at birth is 52.5 years for Sub-Saharan Africa relative to 71.5 years and 69.2 years for North Africa and the World respectively, the increase has been more (5 percent) compared to the World (3 percent) between 2000 and 2009; The rate of improvement of access to safe water between 1990 and 2008 in Sub-Saharan Africa has increased by nearly 22 percent compared to the World's 13 percent; Also, during the same period there has been increase in the rate of improvement of access to sanitation in the region by 15 percent while the rate of improvement for the World is 16 percent (Africa Development Indicators Factoids, 2011).

Health is a necessary and sufficient asset in the promotion of an individual's wellbeing as it

addresses the essential aspects of life and this can be seen in (WHO, 1946) definition of health as the complete physical, mental and social wellbeing and not only concerned about the presence and absence of diseases. The present state of health in Sub-Saharan Africa has been an issue that has drawn the interest of many researches, institutions and some countries as this not only affects Sub-Saharan countries but is a major global issue. This can also be seen in the UN's MDGs, where out of eight MDGs three were set aside to address the issue of health (reduce child mortality, improve maternal health and combat HIV/AIDS, malaria and other diseases by 2015).

Apart from the fact that health is a global concern, studies and reports have shown that majority of these health inefficiencies are found in this region of the world as there have been found to have the highest maternal mortality rates as according to (WHO, 2013) more than half of maternal deaths occur in Sub-Saharan Africa and a quarter in South Asia. This region has also been seen as the centre of HIV/AIDS epidemic and has also had high rate of child mortality as according to (WHO, 2013) child vaccination which is a way that has been proven to safeguard children from been susceptible to these diseases have been stagnated as the two highest mortality regions which are South Asia and Sub-Saharan Africa have stagnated over the last three years as there have been less than 80 percent coverage. This region has also been attributed with the lowest response rate and this has really stagnated the level of economic development therefore, there is need to address this issue if economic growth and development is to be actualised.

REVIEW OF LITERATURE

Health and Economic Growth

The relationship between health and economic growth is one that has drawn the interest of various researchers, institutions and nations as health being a very important human capital input is also a determinant of economic growth and development. A main feature of this relationship is the two way causation between health and the economy as better heath encourages economic growth through an increase in productivity as a healthy workforce is more efficient and also economic growth can also encourage more accumulation of health capital (Barro, 2013). In examining some works focusing on the relationship between health and economic growth, there tend to be a general consensus on a positive relationship as this can be seen in the works of Baker (1998), Weil (2006), Canning (2005), Rico et al. (2005) and others.

Despite the number of works done here, there have been some challenges. One of the challenges is that of measurement as most of the empirical studies on the impact of health on economic growth use life expectancy as a proxy variable of health and this has some limitations as it does not cover all dimensions or aspect of health since it only accounts for mortality while morbidity, disability and comfort are ignored and these are what affect the welfare and development of a nation. According to Rico et al. (2005) this becomes a problem despite the reliable link between health, productivity and economic growth and that looking at the Grossman's model in (1972) in which human capital depreciates overtime, the use of life expectancy as the only indicator stops this relationship from being binding since it only takes into account the lifetime of the stock of human capital with less regards for the quality of this human capital stock or labour force timing. In correcting this measurement problem, he extended the dimension of health using the four determinants as defined by the European commission of public health which includes health services, socio-economic conditions, lifestyles and environment.

Also, the challenge of endogenous causality that exist between health and income as according to Luft (1978); Rico et al. (2005) in an official way of explaining causality said that "a lot of people who otherwise wouldn't be poor are, simply because they are sick; however, few people who otherwise would be healthy are sick because they are poor ". A way of solving this problem is by the use of instrumental variables such as the percentage of land between the tropics or the distance from the equator as in Hamondi and Sachs (1999). According to Bloom et al. (2001) the instrumental variables technique must satisfy two criteria; it must be correlated with the endogenous

independent variables, i.e. variables that suffer from reverse causation and it must be uncorrelated with the error term, conditional on the instrumental variable's correlation with every other specified independent variable on the right hand side of the equation.

Health is a necessary factor for improvement in productivity as a healthier workforce is more efficient than a not-healthy one and education also improves productivity as it improves an individual's ability to adapt to modern technology. These two are connected in the sense that they have the same end which is to increase productivity and efficiency and this makes them very important focus points for any nation if a self-sustaining growth and development is to be achieved. Therefore, there is need for a simultaneous investment as a nation as one cannot focus on health (education) not considering education (health).

According to a prior knowledge an improvement in health and education leads to an improvement in income and vice-versa which shows the endogeneity presence since the consequence can produce the primary cause. Despite their relationship, higher income is not a sufficient condition for improved health and education. This means that human capital is also a concern to both developed or rapidly growing economies and developing economies if sustainable growth and development is to be achieved.

According to Todaro and Smith (2011) evidence has shown that income raised without proper improvement in health and education have failed in being used to invest in children's health and education and neither the market nor the choice of consumption by households can solve the challenge automatically. Therefore there is need for development policies to take into consideration the income elasticity of these goods which is the percentage change in the good consumed as a result of the percentage change in income.

Looking at the way in which health leads to income growth via human capital accumulation, Jack and Lewis (2009) identified two reasons. First, healthier and well nourished children are better learners and spend more time at school and this prepares them to earn higher incomes. Second, the human capital accumulation of children are affected by the health status of their parents as dead parents cannot invest in their children and even when these orphans receive support, they are often given less than if their parents where alive.

According to Research Analyst, DSAED (2010) economic development may lead to better health as wealthier countries have a greater chance and capability to invest in health care and public health measures, this relationship can be viewed the other way round as improvements in health can contribute to economic development through a number of path, channel or reasons such as an increase in productivity as better health improves or enhances workers productivity as days taken out of work due to illness are lesser and this brings about an increase in output. This can also be applied to a family setting where improved health of family members reduces the direct costs incurred as a result of the time lost to taking care of family members.

Another channel is through reduced family size as this reduces the number of dependants in the country leading to an increase in the workers to dependants' ratio and this increase the national savings and according to the Harrod-Domar growth model this ought to improve growth by providing more new investments. Increase in the level of investments is a channel by which health can contribute to economic development and this can be viewed via capital accumulation as healthier individuals tend to save more and this increases growth. Also, a healthy environment attracts tourist and this adds to the Gross Domestic Product (GDP) as According to the World Travel and Tourism Council, Tourism's direct contribution to Gross Domestic Product (GDP) in 2012 worldwide was USD2.1 trillion. Well educated or healthier workforce also serves as an incentive for companies to invest.

As the saying goes "prevention is better than cure", reduction in the cost of illness can be seen as a channel as it has been observed that the cost of preventing an illness is lesser than the cost incurred in curing it. This enhances efficiency as it makes available capital for other productive uses

in the future in which government can invest in. In all aspects, for any economic agent be it the individual, firm or government prevention is better than cure as it improves welfare and enhances efficiency. Increase in Human capital is another channel through which health could contribute to economic development as healthier children tend to profit more from schooling as they are less absent from school and also proper nutrition in the early stages of childhood enhances the mental ability.Health investments as seen above leads to economic development other things being equal and investing in health does not necessarily mean an increase in health care expenditure (public or private) but ensuring that those investments are made in an equitable and efficient manner in order to yield the desired result. Casasnovas, Rivera and Currais (2007) looked at some benefits of investing in health especially in developing nations where health care delivery and response has been low.

First, investing in health increases life expectancy therefore lowering the losses from infant mortality and this reduces birth rates and parents may not fear the need for a replacement in the family labour force and this result to an increase in per capita income since the population growth is not explosive and the existing one is productive since parents now have confidence to invest in their children's education since the investment would have a longer lasting impact.

Investment in health also leads to an outward shift in the production possibility curve/boundary/frontier of the society as workers are healthier, standard of living is increasing and the per capita income is also increasing.Investing in health in most developing world leads to higher labour productivity as the nation experiences a healthier workforce and this leads to efficiency and income as a result of lower absenteeism and reducing human capital losses for the economy.

Looking at investing in a population's health and its impact on the inflow of foreign capital, Bell and Lewis (2004) suggest that the high risk of environments as a result of some communicable disease such as SARS (severe acute respiratory syndrome) as it reduces the inflow of foreign capital through tourism since it wards off investors and visitors (Jack and Lewis, 2009). Health also increases productivity and success in education as healthy children are able to learn better, have better education, are less absent due to illness and also earn higher as adults.

Healthier workers are more energetic and robust in terms of physical and mental terms and this reduces the rate of absenteeism from work due to illness either of themselves or their families and this also makes them productive, earn higher wages and also attract foreign direct investment(Working Group 1 of the Commission on Macroeconomics and Health, 2002).

Healthy workers are more energetic in physical and mental terms and they are more productive and earn more wages because they are less likely to be absent from work due to illness while ill workers don't tend to earn more and this can be seen in most developing countries where hourly wages are being paid in manual labour and this consists a high proportion of the workforce compared to industrial countries (Bloom et al., 2004). Health can enhance workers productivity by increasing their physical capacities which include strength and endurance as well as their mental capacities such as cognitive functioning and reasoning ability (Bloom and Canning, 2005).

A positive relationship is expected between health and productivity for both skilled and unskilled workers as this can be seen at the microeconomic level in the works of (Schultz and Tansel, 1992; Strauss and Thomas, 1998; Savedoff and Schulttz, 2000), (Bloom and Canning, 2005). Strauss and Thomas (1998) also looking at the empirical fact of the relationship between health and productivity saw correlation between physical productivity and some health aspects such as nutrition. Bloom and Canning (2000); Rico et al. (2005) explains how due to the higher level of physical energy and mental clarity, healthy population tend to be more productive.

Various Health Challenges Prevailing in Sub-Saharan Africa: A Brief Evaluation of (Tuberculosis, Malaria and HIV/AIDS)

Health has been a key concern or issue in the world today and should not be overlooked as it is a great determinant for the welfare of nations.

Various health institutions, preventive and treatment measures have been developed to address the health challenges in the world today but despite these level of development some nations in particular developing nations are still been affected at a high rate by these challenges. The Sub-Saharan Africa region is not left out in this issue as relative to other regions of the world, evidence has shown that this region has shown low response.The various health challenges faced by developing countries according to WHO; Todaro and Smith, (2011) include: Absolute poverty, Malnutrition, HIV/AIDS, Malaria, Tuberculosis, Acute lower respiratory infections, Hepatitis B, Ascariasis, Cholera, Dengue, Leprosy (Hansen disease), Dracunculiasis (guinea worm disease), Chagas disease, Leishmaniasis, Lymphatic and filariasis (elephantiasis). Reducing or curbing the prevalence of these illnesses cannot happen on its own therefore there is need for a collective effort by both the affected areas and other donors to eradicate this global challenge.

It was calculated that if the donor countries where to contribute 0.1 percent of their GNP that is one penny for every $10 of income and if this is coupled with a good increase in the effort within the low income countries, about 8 million deaths per year could be prevented by the end of this decade (Working Group 1 of the Commission on Macroeconomics and Health, 2002). A brief description of tuberculosis, malaria and HIV/AIDS is shown below.

Tuberculosis (TB)

Infectious and parasitic diseases contribute or cause 80 percent of all communicable diseases and one of the most common and leading killer among these infectious diseases is tuberculosis and according to World Bank (1993) TB kills or weakens more adult from the age of 15-59 than any other disease (Working Group 1 of the Commission on Macroeconomics and Health, 2002).

According to WHO (2001), an estimate of about one-third of the world population is infected with TB bacillus and between 5-10% of people infected with TB become ill at some stage of their lives; also, if this is not controlled efficiently, about 35 million persons in the next 20 years will die (Working Group 1 of the Commission on Macroeconomics and Health, 2002).

It was observed that two factors have been seen to contribute greatly to this global emergency of tuberculosis. First, is the emergence of HIV/AIDS as TB is the leading cause of deaths of HIV-positive individuals as it accounts for one-third of AIDS deaths globally and also the chance of developing an active TB is about 5-10% while this rises to 30-50% for an HIV-infected person. The second factor is migration which involves cross-border movement of infected persons since some of these immigrants are not legal and therefore do not pass through any official care system and this increases the risk of spread of TB (Working Group 1 of the Commission on Macroeconomics and Health, 2002).

Malaria

Malaria is an infectious disease or a recurring illness that is caused by a parasite and it is transmitted by the bite of mosquitoes (Encarta Dictionaries, 2009). Malaria is common in tropical regions or countries and tropical diseases such as this have a high morbidity burden but a small effect on mortality. The burden as a result of malaria is not evenly distributed as it is highly concentrated in the lowest income countries with 90% of malaria mortality occurring in Sub-Saharan Africa. According to Bloom and Canning (2008), diseases such as malaria, schistosomiasis and intestinal worms can cause anaemia and decreased levels of energy and productivity and also when acquired by children can have significant long term effects. After allowing for the effect of life expectancy in each country, Gallup and Sachs (2001) found that growth significantly reduced between 1965 and 1900 in countries that were greatly burdened with malaria (Bloom and Canning, 2008).

There have also been long term effects on education and productivity outcomes for children who were presented from exposure to malaria via the DDT program which is an insecticide effective for the use against malaria-causing mosquitoes. Bleakley (2006) looking at the effect of childhood exposure to malaria on income level as an adult in four countries (United States, Mexico, Columbia and Brazil) saw that a very large effect was found as the removal of childhood malaria via the DDT

intervention increased adult earnings by about 50 percent and this was also extended by Cutler et al (2007) in India in the 1960s and significant effects was found based on the education outcomes of children that were prevented from malaria (Bloom and Canning, 2008)

HIV/AIDS

HIV/AIDS is now one of the world's leading killers of young adults of the age 15-59 and this has really reduced the expected life span of the highly infected regions. AIDS could reduce economic growth in the long run and could also lead to a high dependency ratio as deaths are highly concentrated among young men and women. The generation of AIDS orphan according to Bell, Derarajan and Gersback (2004) may result to low productivity in the future due to lack of education and proper care for the children (Bloom and Canning, 2008).

AIDS can also reduce the returns to capital especially human capital and this is because of the high mortality and limited or reduced life span due to AIDS. AIDS could also reduce the level of trust in a community and also according to Haacker (2004) could have long term consequences for social capital (Bloom and Canning, 2008). Examining the economic implications of HIV/AIDS we can evaluate that there could be a positive or negative implication though the negative significantly outweighs the positive. Looking at the negative implications, HIV/AIDS can increase the level of health spending thereby incurring a higher opportunity cost as it reduces the level of investments to be made to other growth-driven areas, education and infrastructure. It can also reduce the attractiveness of the economy to foreign investors as a result of low productivity and could also reduce the tax revenue. It could also increase the dependency level of the economy since a high mortality of the youths is experienced. On the other hand, HIV/AIDS could have positive implications for an economy as it reduces the rate of unemployment since workers who die as a result of this disease could be replaced by previously unemployed persons thereby opening up employment opportunities and reducing the proportions of the unemployed labour force. Also, although output can be decreased via HIV/AIDS mortality, the population is also reduced and this may not reduce the per capita productivity meaning that GDP per capita may not reduce (Working Group 1 of the Commission on Macroeconomics and Health, 2002). According to UNIAIDS (2000) evidence has shown that a rise in the prevalence rates of HIV/AIDS leads to a significant decline in both total and growth in GDP (Working Group 1 of the Commission on Macroeconomics and Health, 2002).

Various results have been gotten from several works on health and its relationships with labour productivity and economic growth using various health indicators such as life expectancy, adult survival rates and others at different levels and using different methods thus, this section gives a review of these works.

Barro (1996, 2013) in his empirical work suggested that health status as measured by life expectancy or other similar macro indicators is a better predictor and an important contributor to later growth than initial education. This shows the significance of health in attaining future growth. Also, Barro (1997) also showed that life expectancy is significantly correlated to subsequent economic growth as 1 percent increase of life expectancy could raise economic growth by 0.4 percent yearly(Working Group 1 of the Commission on Macroeconomics and Health, 2002). Weil (2001) using a calibration process measured the relationship between health proxy with adult survival rates and labour productivity across countries. His result showed that one percentage (1%) point increase in adult survival rates resulted into 1.68 percentage increase in labour productivity and that health differential which accounted for about 17 percent of the variation in output per worker across countries had roughly the same magnitude with respect to the differences accounted by physical capital (18 percent) and education (21 percent). This shows that health is a pertinent form of human capital and requires an equal attention as given to both physical capital and education in the development process (Bloom and Canning, 2005).

Bloom and Canning (2005) using a model of conditional convergence with a panel of countries observed confidence interval of 1.2 to 4.3 percent and this concurred with Weil (2001)

though the result is higher and it implies that health plays a larger role in explaining cross-country differences in the level of income per worker than education. Also, in reconciling the micro and macro evidence of health and economic growth they found out that the estimated macroeconomic effects of health are positive and not significantly different from the microeconomic estimates. Bloom et al., (2001) estimated the effect of health on economic growth using a panel data for 1960-1990 and showed that health has a positive and statistically significant effect on economic growth as one year improvement in population's life expectancy contributes a 4 percent increase in output. This makes their result consistent with the theoretical argument and microeconomic evidence.

Rico et al. (2005) conducted an empirical study of the impact of health capital on economic growth as it extended its definition to include the four determinants of health (health services, lifestyles, environment and socioeconomics) taking into account the impact of each of them and this is a unique contribution to previous studies. A panel data analysis for the years 1970-1980 and 1980-1990 was used and the result showed that health capital has a significant effect on economic growth and that health services was of greater significance than the rest of the determinants. Apart from the fact that the result concurred to the theoretical argument of health's relationship to growth, the definition of health was also broadened.

Weil (2006) in looking at how human capital in the form of health varies among countries use three health indicators which are average height of adult men, the adult survival rate (ASR) for men and the age of menarche (onset of menstruation) for women. Using ASR for men as his standard estimate and a measure of health, he found out that eliminating health gaps among countries would reduce the variance of log GDP per worker by 9.9 percent and he concluded that health is an important determinant of income variation and that the effect of health on income is economically significant.

Various studies have looked or examined and explained the impact of illness as proxied by malaria on the economies in Africa countries. Gallup and Sachs (2001: 91); Acemoglu and Johnson (2009) argued that Africa's per capita growth rate could increase by as much as 2.6 percent a year if malaria is wiped out in Sub-Saharan Africa and this also explains the consequences that some morbidity issues such as diseases have on an economy and their level of growth. Between 1965 and 1990, an average per capita GDP growth of 0.4% per year and 2.3% per year were experienced by countries with high malaria transmission and other countries respectively and this suggests that malaria plays a significant role in preventing long term economic growth and development (Working Group 1 of the Commission on Macroeconomics and Health, 2002) and this explains one of the significant reasons for the disparities in growth among countries. In the Abuja declaration of 2002 signed by 53 African heads of state it was noted that the growth in African countries have been slowed down by 1.3% per year as a result of malaria and this made the GDP for African countries to be 37% lower than it would have been if malaria were to be absent (Ashraf, Lester and Weil, 2009).

Some studies have also been done to examine the impact of HIV/AIDS in Africa. As found by studies carried out in Côte d'Ivoire and Rwanda, household consumption expenditures of families affected with AIDS have reduced due to health expenditures also, another study saw that although the population in Botswana may fall by 20%, the government expenditure in 2010 will be cut by 20% due to AIDS (UNAIDS, 2000; Commission on macroeconomics and health, 2002). Young (2005); Acemoglu and Johnson (2009) in evaluating the effect of the recent HIV/AIDS epidemic in Africa using micro estimates and calibration of the neoclassical growth model, notwithstanding the substantial disorder and painful experience caused by HIV/AIDS a reduction in population as a result of this disease may increase per capita income. This can be attributed to the influence that population has on the per capita income. Some other studies have looked at the impact of some illness on productivity and income. According to Luft (1999), in Indonesia anaemic men were found to be 20 percent less productive than men who were not anaemic and when these anaemic men were treated with iron, their productivity increased almost to those that were non-anaemic (Working

Group 1 of the Commission on Macroeconomics and Health, 2002). Case and Wilson (2001) in examining the relationship between chronic conditions such as heart trouble, stroke, asthma and cancer and income in South Africa found a negative correlation (Working Group 1 of the Commission on Macroeconomics and Health, 2002).

Under the methodological approach looking at the effect on health on economic growth, various studies and their methodological approach have been cited in the work of Bloom et al (2004) and they are stated below. Barro (1996) using data from three periods 1965-75, 1975-85 and 1985-95 estimated the effect of health on economic growth using the 3SLS (three stage least squares) using lagged values of some regressions as instruments, period random effects and life expectancy as the proxy for health and his result aligned with theoretical argument that health has a positive and statistically significant relationship with economic growth. Barro and Lee (1994) and Barro and Sala-I-martin (1995) using data from two periods 1965-75 and 1975-85, used the SUR (seemingly unrelated regression) estimator with country random effects and their result was consistent with theory and life expectancy was the proxy for health. Bharagava et al. (2001b) used a 25year panel at 5 intervals, 1965-90 in estimating the effect of health on economic growth and dynamic random effects was used in estimation with the Adult Survival Rate (ASR) as health variable and this also had a positive and significant relationship with growth. Bloom et al., (2000) using the same data period and life expectancy as the health indicator used the pooled OLS estimator and this was also consistent with theory.

Bloom and Malaney (1998), Bloom and Sachs (1998), Bloom and Williamson (1998), Gallup and Sachs (2000) and Sachs and Warner (1997) using life expectancy as the health variable and a 25 year cross sectional data used the OLS (ordinary least squares) method of estimation and their results concurred with the theoretical argument. This method of estimation can be inconsistent or inappropriate and can also render the estimates of the coefficients unreliable due to the presence of reverse causality which creates a correlation between the explanatory variables and the error term ε_{it}.

Caselli, Esquivel and Lefort (1996) using a 25-year panel at 5 year intervals from 1960-85 and with life expectancy as the health indicator used the GMM (generalized method of moments, Arellano bond method) estimator but the results showed that health as indicated by life expectancy had a negative and not significant relationship with economic growth as 1% increase in health will bring about 0.1% decrease in economic growth. This result do not concur with theory therefore there is either an explanation for this result or the there is need to question the methodology used. Also, Bloom, Canning and Sevilla (2001) estimated the effect of health on economic growth using a panel data for 1960-1990 via a non-linear two stage least squares (2SLS) estimates and this method can be used to correct the issue of endogeniety.
From the above works, all the studies that used life expectancy as the health indicator found a positive relationship between health (as indicated by life expectancy) and economic growth which was shown by the positive coefficients except in the work of Caselli et al. (1996) which had a negative coefficient of -0.001.

From the literature reviewed it is discovered that health as represented by various indicators shows a positive relationship with growth and it was also observed that there is measurement problems from various works on health due to its multidimensional nature.

Therefore, the use of only indicators such as life expectancy and adult survival rates are not adequate as they only take account of the mortality aspect of health leaving other aspects such as morbidity, disability and discomfort. Therefore, this study in improving or adding to existing works seeks to extend the proxies of health to take care of the both the mortality and the morbidity aspects of health.

METHODOLOGY

This research is rooted in many theories of economic growth and development. However the major theory of this research work is the Solow neoclassical growth model which can be seen as the best known model of economic growth and development.This model was developed by Robert

Solow of the Massachusetts Institute of Technology for which the Nobel prize was received can be seen as the best known model of economic growth and development.

The model implies that economies will conditionally converge to the same level of income if they have the same rates of savings, depreciation, labour force growth and productivity growth. The Solow growth model is a modification of the Harrod-Dormar growth model as it allows for substitution between capital and labour assuming that there are diminishing returns to these inputs.

The aggregate production function, Y= F (K, L) is assumed to be characterized by constant returns to scale and this can be seen in a Cobb-Douglas production function at any time t, below:

$$Y_{(t)} = K_{(t)}^{\alpha} (A_{(t)}.L_{(t)})^{1-\propto} \quad \text{..... (1)}$$

Where Y is the gross domestic product, K is the stock of capital (which consists of human capital and physical capital), L is labour, and A(t) represents the productivity of labour which grows at an exogenous rate over time.

This exogenous rate is said to be about 2% per year for developing countries and this depends on whether they are lagging or catching up with developed countries. The Solow neoclassical growth model is sometimes called an "exogenous" growth model because the rate of technological progress is exogenously determined or given.

Model Specification

This study is based deeply on the Solow neoclassical growth theory and draws from the model specification of Bloom et al (2004) who carried out a study on the effect of health on economic growth using a panel of countries observed every 10 years over 1960-1990.

Therefore the model for this study can be specified in an implicit or functional form below:

PCI = f (A, GCF, LAB, SSE, LFE, HIV)

Where PCI = Gross Domestic Product per capita as a proxy for economic growth A = level of total factor productivity GCF = Gross Fixed Capital Formation as a proxy for the stock of accumulated capital LAB = Labour force, total SSE = School enrolment, secondary (% gross) LFE = Life expectancy as a proxy for health taking into account the mortality aspect HIV = prevalence of HIV as a proxy for health taking into account the morbidity aspect

The model can be specified in an aggregate production function as used in the works of Bloom et al (2004):

$$PCI = AGCF^{\alpha}LAB^{\beta}e^{\phi 1SSE+ \phi 2LFE+ \phi 3HIV} \text{..... (3)}$$

Transforming equation (3) into a log-linear form we have an equation for the log of PCI at country i at time t,

$$LogPCI_{it} = a_{it} + \alpha logGCF_{it} + \beta logLAB_{it} + \phi_1 logSSE_{it} + \phi_2 logLFE_{it} + \phi_3 logHIV_{it} \text{.....(3a)}$$

Equation (3) expressed human capital outputs (i.e. SSE, LFE and HIV) as powers of exponential and the benefit of this functional form is that log PCI depend on the level of schooling and health which is proxied by LFE and HIV and in practice a_{it} which is the total factor productivity in country i and time t is not observed and is therefore treated as an error term in estimating the equation.

The model above can further be specified into either the fixed model as seen in equation (1) or the random effects model as specified in equation (2).

In a fixed effect model, the above model can be explicitly stated as:

$$LogPCI_{it} = a_i + \alpha logGCF_{it} + \beta logLAB_{it} + \phi_1 logSSE_{it} + \phi_2 logLFE_{it} + \phi_3 logHIV_{it}. + \mu_{it} \text{..... (4)}$$

Where i= 1, 2, ..., 38 which represents the entities (countries), t = 1, 2, ..., 21 which is the time period for the variables, $a_i$is the unobserved or heterogeneity intercept and μ_{it} is the error term which is normally distributed with a mean of zero and constant variance.

In a random effect model, the model can be stated as

$$LogPCI_{it} = a + \alpha logGCF_{it} + \beta logLAB_{it} + \phi_1 logSSE_{it} + \phi_2 logLFE_{it} + \phi_3 logHIV_{it}. + w_{it} \text{..... (5)}$$

Where $w_{it} = \varepsilon_i + \mu_{it}$

The composite error term w_{it} consists of two components $\varepsilon_i$which is the within-entity or individual specific error term while μ_{it} is the between-entity or the combined time series and cross-section error component.

The apriori expectation for the relationships between the explanatory variables and the dependent variables of the model based on economic theory as explained below. It is expected that $a > 0$, $\alpha > 0$, $\beta > 0$, $\phi_1 > 0$, $\phi_2 > 0$ while $\phi_3 < 0$.

Technique of Estimation

For the purpose of this study, the panel data analysis will be used to examine the role of health on economic growth in Sub-Saharan Africa and this as said before is because of the nature of the data which consists of different entities (countries) at different time periods.

Two methods of estimation are involved under the panel data analyses which are the fixed effects and the random effects. The former (fixed effects) assumes that there is need to control the unique characteristics of the entities and its impact or bias on the predictor variables. Therefore it reduces the effect that the time invariant characteristics may have on the predictor variables so that the net effect of the predictors can be seen. On the other hand, random effects assume that the variations across entities are random and do not correlate with the predictor variables in the model. This means that the time invariant variables are included in the model unlike in the fixed model where it is absorbed by the intercept.

To determine which model is suitable and efficient for the model which may either be the fixed or random effect, the Hausman's test will be run and this test whether the unique errors (u_i) are correlated with the regressors or not. Under the Hausman's test, the null hypothesis is that the model is random effects while the alternative is that the preferred model is fixed effects.

Other diagnostic tests include:-

1. The test for multicollinearity which checks whether there is correlation among the explanatory variables and this can be done using either the pair wise correlation (pwcorr) or variance inflation factor (vif).
2. The test for random effects using the Breusch-pagan LM test and this is used to check if there is a difference between the random effect and the pooled OLS.
3. The test for heteroskedasticity as to whether our residuals are normally distributed with a mean of zero and a constant variance.

Data Sources and Measurements

The variables for this study include: real Gross Domestic product per capita, Gross Fixed Capital Formation, Labour force, Secondary school enrolment (% gross), Life expectancy and prevalence of HIV. The panel data covers the period from 1990-2011. The table below shows the variables, measurement and sources.

TABLE 1 HERE

Empirical Analysis and Discussion of Results

This is the empirical part of the study in which the econometric analysis of the panel study is estimated and analysed. A number of tests would be run in order to estimate the results of this study such as the multicollinearity test, heteroskedasticity test, Hausman test and the random effects test.

Test for Multicollinearity

Multicollinearity is a situation in which there is linear dependence or relationship among the explanatory variables (lGCF, lLAB, lSSE, lLFE and lHIV).To do this, the variance inflation factor (Vif) is used which is a way of checking for the presence of multicollinearity. Also, before the above is done, we have to run the ordinary pooled OLS though this is not my interest as it does not take into effect the differences in countries as panel study takes into account the differences within and between countries. The rule of thumb here is that once the Vif is less than 5 (< 5) or when 1/Vif which is the tolerance is greater than 0.5 (> 0.5) then multicollinearity does not exist. The result is as shown below:

VIF (Variance Inflation Factor)

TABLE 2 HERE

Source: Author's Compilation with Stata SE 10

From the result above, since the Vif is < 5 and 1/Vif is > 0.5 for all the explanatory variables (lGCF, lLAB, lSSE, lLFE and lHIV), I can conclude that there is no linear dependence among the explanatory variables (lGCF, lLAB, lSSE, lLFE and lHIV).

Test for Heteroskedasticity

Heteroskedasticity is a violation of the assumption of the classical linear regression model and the opposite of homoskedasticity which means that the residuals are normally distributed with a mean of zero (0) and constant or equal variance. The problem of heteroskedasticity has a more tendency to be found in cross-sectional data than time series and since this is a panel study that involves both the latter and the former, this cannot be overruled.

To test for heteroskedasticity, the Modified Wald test for GroupWise heteroskedasticity in fixed effect regression model is used. The H_0 (null hypothesis) is that there is homoskedasticity or constant variance while H_1 (alternative hypothesis) is that there is heteroskedasticity. This test is done after running the fixed effect and the result is as shown below:

Table Modified Wald Test for GroupWise Heteroskedasticity in Fixed Effect Regression Model

TABLE 3 HERE

From the result above, since the prob>chi2 is highly significant (0.0000), we therefore reject the H_0 that there is homoskedasticity and accept H_1 concluding that there is heteroskedasticity. To correct or control for heteroskedasticity we robust both the fixed and random effects models.

Hausman Test

The Hausman test is used to decide or tell us the most efficient, consistent, preferred and reliable model for the study. It is used to choose between a fixed effects or random effects. Before running the Hausman test, the robust fixed and random effects will be run and stored.

For the Hausman test the H_0 is that the preferred model is random effect while H_1 is that the preferred model is fixed effects. The Hausman test tests whether the unique errors or time invariant variables are correlated with the regressors or not. The result is as shown below:

Table Hausman Test

TABLE 4 HERE

From the result above, since our prob>chi2 is not significant (0.8313), we do not reject H_0 and conclude that the most efficient, consistent, preferred and reliable model is the random effects model.

Table Random Effects Model

TABLE 5 HERE

Source: Author's Compilation with Stata SE 10

The above table shows the random effects model which is yet to control for heteroskedasticity as seen in table 4.3 and this could lead to a bias or misleading result as the standard errors could be overstated while the z values could be understated or the standard errors could be underestimated while the z values could be overstated. The results also showed that all explanatory variables (lGCF, lLAB, lSSE, lLFE and lHIV) had significant influence on lPCI. In order to control for heteroskedasticity, there is need to robust the random effects model and this is as shown in the table below.

Table Robust Random Effects Model

TABLE 6 HERE

Examining the coefficients of each of the explanatory variables (lGCF, lLAB, lSSE, lLFE and lHIV) as to whether it is elastic (when the coefficient value in absolute terms is > 1) or inelastic (when the coefficient value in absolute terms is < 1), we could see that lGCF is inelastic as the coefficient value in absolute terms (0.1779429) is < 1 therefore a change in lGCF across time and between countries will lead to a less than proportionate change in lPCI ceteris paribus. For lLAB, we could say that it is inelastic as the absolute of the coefficient (0.2450477) is < 1 therefore, a change in lLAB across time and between countries will lead to a less than proportionate change in lPCI others things being equal. For, lSSE it is inelastic as the absolute value of the coefficient (0.1867532) is < 1 and we can say that a change in lSSE across time and between countries will lead to a less than proportionate change in lPCI ceteris paribus. lLFE is inelastic since the absolute value of the coefficient (0.296871) is < 1 therefore, a change in lLFE across time and between countries will lead to a less than proportionate change in lPCI ceteris paribus. lHIV is inelastic since the absolute value of the coefficient (0.0352622) is < 1 therefore, a change in lHIV across time and between countries will lead

to a less than proportionate change in lPCI other things being equal.

Examining the z value and P>|z| given the rule of thumb that z value must be >1.96 and the P>|z| must be < 0.05 to show that the explanatory variables (lGCF, lLAB, lSSE, lLFE and lHIV) have a significant influence on the dependent variable and this also shows the extent of relevance of each explanatory variable. From the result shown above in table 4.6 looking at lGCF, since the z value is 6.09 and the P>|z| is 0.000 which means it is highly significant, we can conclude that lGCF has a significant influence on lPCI other things being equal. lLAB is also highly significant and has a significant influence on lPCI ceteris paribus since the z value in absolute terms is 3.48 and the P>|z| is 0.000. lSSE has a significant influence on lPCI since the z value is 4.22 and is also highly significant as the P>|z| is 0.000 other things being equal. lLFE has the z value in absolute terms as 2.27 and P>|z| as 0.023 which is significant at 5% therefore, we can conclude that lLFE has a significant influence on lPCI ceteris paribus. lHIV has the z value as 1.82 and the P>|z| as 0.068 and these do not meet the required standard for being significant, therefore, we can conclude that lHIV does not have a significant influence on lPCI other things being equal.

Looking at the [95% Conf.Interval] we could see that lGCF, lLAB, lSSE and lLFE were all significant since there is no zero between the two intervals while lHIV is not significant as 0 lies between -0.0026253 to 0.0731496. Looking at the rho which is the interclass correlation, we can see that 95.9% of variance is due to difference across panels.

Also, the R-squared also known as the coefficient of determination is a measure of the goodness of fit which shows the percentage of the total variation in the dependent variable (lPCI) that can be explained by the explanatory variables (lGCF, lLAB, lSSE, lLFE and lHIV) and from our result we can conclude that 45%, 44% and 45.7% of variation within, between and total respectively in lPCI is explained by the explanatory variables (lGCF, lLAB, lSSE, lLFE and lHIV).

Examining the Wald chi2(5) and Prob> chi2 which is 0.000 that is highly significant, we can conclude that our model is good and ok and this is used to check if all the coefficients in the model are different than zero. Lastly, the corr(u_i, X)=0 shows that the differences across units are uncorrelated with the regressors.

Comparing table 4.5 and table 4.6, we could see that the random effect model which is found in the former table showed a bias and misleading result as the standard errors was underestimated while the z values were over estimated. It also showed that all explanatory variables (lGCF, lLAB, lSSE, lLFE and lHIV) were significant while on the other hand, the latter table robust the random effects model because of the presence of heteroskedasticity as seen in table 4.3 and this gives us a better result as the robust standard errors were increased while the z values decreased although lGCF, lLAB, lSSE and lLFE were still significant, lHIV was not significant. The bias is as shown below:

TABLE 7 HERE

Testing for random effects using the Breush-Pagan Lagrange Multiplier (LM)

The test used in this study in testing for random effects is the Breush-Pagan Lagrange Multiplier (LM) test and this test is needed if the hausman test suggests random effect as the preferred model and it is used to check if there is a significant difference between random effects regression and the simple or ordinary pooled OLS. This test is run immediately after the random test.

The H_0 is that random effects is equal to the simple OLS regression that is, variances across both entities is zero meaning that there is no panel effect or significant difference across countries while H_1 is that the random effect significantly differs from a simple OLS regression. The result is as shown below:

Table Breusch and Pagan Lagrangian multiplier Test for Random Effects

TABLE 8 HERE

From the result above, since the prob>chi2 is highly significant (0.0000), we reject the H_0 and the H_1 concluding that there is a panel effect that is, the random effect significantly differs from a simple OLS regression.

Summary of Findings and Economic interpretation

The results of the robust random effects taking cognizance of both the degree of responsiveness which is the elasticity and the significance of each explanatory variable gross fixed capital formation (GCF), total labour force (LAB), secondary school enrolment (SSE), life expectancy (LFE) and the prevalence of HIV (HIV) on the dependent variable which is the gross domestic product per capita (PCI) will be explained. Also, its implications on Sub-Saharan Africa will be carefully examined. The model sought to investigate the impact of the explanatory variables in its logged form (lGCF, lLAB, lSSE, lLFE and lHIV) on the dependent variable lPCI. In general all the explanatory variables GCF, LAB, SSE, LFE and HIV were inelastic while all explanatory variables except HIV had significant influence on the dependent variable PCI.

Gross fixed capital formation was inelastic (0.1779429) and had a significant influence on the gross domestic product per capita in Sub-Saharan Africa and this significance is expected and aligns with theory and meets the priori expectation as an increase in gross fixed capita formation which is the stock of accumulated capital translates into future investments which will generate income that will have positive impact on the gross domestic product per capita as well as economic growth while the inelastic nature of this relationship can be attributed to the high labour intensive nature of economic activities in this region which makes a change in gross fixed capita formation to lead or bring about a less than proportionate change in gross domestic product per capita ceteris paribus.

Total labour force was inelastic (0.2450477) and had a significant influence on the level of gross domestic product per capita and this makes sense as since gross domestic product per capita is made up of the gross domestic product divided by population in which the total labour force is one of the major parts of it, the total labour force is expected to show a significant influence on gross domestic product per capita and also this fails to meet apriori expectation and this can be attributed to the low contributively nature of the labour force as a result of low productivity and high pressure on the available resources and this tends to reduce economic growth. On the other hand, the inelastic nature of this relationship could be attributed to the low level of labour productivity, high pressure on available resources, high level of morbidity in the total labour force found in this region which reduces the level of efficiency and thereby making a change in total labour force to bring about a less than proportionate change in gross domestic product per capita other things being equal. Secondary school enrolment was inelastic (0.1867532) and had a significant influence on gross domestic product per capita and this significant influence is expected as this aligns with the apriori expectations based on the theory as human capital in which education is one of its components increases the quality of labour force and this enhances economic growth as it increases the ability of the labour force to produce and also through an increase in the knowledge required for proper maintenance of health and this tends to improve the level of efficiency of the work force as a healthier work force has a higher level of productivity than a less healthy one. Life expectancy in Sub-Saharan Africa though it had a significant influence on the gross domestic product per capita was inelastic (0.296871) and this means that a change in life expectancy will about a less than proportionate change in gross domestic product per capita. Life expectancy does not meet apriori expectations and this can be attributed to the low contribution of the labour force which may be due to high rate of morbidity which reduces the level of efficiency or the or due to the high level of non-market activities such as subsistence farming which makes an increase in the length of life or life expectancy not to necessarily lead to an increase in the gross domestic product per capita as well as economic growth and also its significant influence can be explained looking at the apriori expectation based on economic theory as the higher the level of life expectancy, the larger the level of human capital formation, the lower the level of mortality, the lower the level of population growth which reduces the pressure on the available resources since people will not have the fear of the need for a replacement in the family labour force and these all translates to increase in economic growth.

The prevalence of HIV in Sub-Saharan Africa did not have a significant influence on the level of

gross domestic product per capita and was inelastic (0.0352622) which implies that a change in the level of prevalence of HIV will bring about a less than proportionate change in gross domestic product per capita and this can be attributed to the fact that given the high prevalence of HIV in this region various contributions and efforts made towards reducing this prevalence has experienced a decreasing returns to scale and does not have a significant influence on the level of gross domestic product per capita as this shows the effect morbidity could have on economic growth as since the infected individuals do not necessarily die but experience a decrease in efficiency and productivity. Also the prevalence of HIV does not meet apriori expectations and this can be attributed to the introduction of multiple antiretroviral drugs such as the highly active antiretroviral therapy (HAART) which increases the expected level of efficiency, helps in reducing the burden of the disease, and enhances the functioning of the immune system which prevents some likely diseases which would have been easily susceptible to the infected person and this can enhance the expected level of productivity and efficiency of the individual thereby leading to an increase in output, income and economic growth though not at a significant rate.

CONCLUSION AND RECOMMENDATION

This study examines the role of health on economic growth in Sub-Saharan Africa from the period of 1990-2011 and variables such as are gross fixed capital formation, total labour force, secondary school enrolment ratio, life expectancy and the prevalence of HIV were used as explanatory variables while gross domestic product per capita was used as the dependent variable.

The findings indicate that the relationship between life expectancy and economic growth is inelastic and significant as this could be attributed to the high rate of non-market activity which is not accounted as a contribution to gross domestic product despite their increase in longevity while the relationship between the prevalence of HIV and economic growth is inelastic and not significant and this decreasing returns to scale can be explained by the high rate of morbidity which decreases the level of efficiency, low coverage or equity in these health interventions, high cost of resources used as the resources are intensive and scarce which makes it difficult to cater for the majority of infected persons and also the side effects which could lead to further rise in the burden of HIV and deterioration in the state of health as a result of intolerance.

This study rejects the null hypothesis (H_0) and accepts the alternate hypothesis (H_1) in Hypothesis I that there is a significant relationship between life expectancy and economic growth in Sub-Saharan Africa and will fail to reject H_0 in Hypothesis II that there is no significant relationship between the prevalence of HIV and economic growth in Sub-Saharan Africa and reject H_1.

Based on the above findings the following recommendations can be given:-

1. Morbidity which is one of the aspects of health should be adequately reduced in Sub-Saharan Africa and this is due to the high rate of prevalence of diseases which reduces the quality of life of individuals found in this region therefore, governments of countries in this region should make sure that adequate priority is given to this morbidity issues so as to increase the level of welfare, productivity and efficiency among workers thereby increasing the rate of returns of these health interventions and leading to higher contributions to economic growth.
2. Also, the governments in the Sub-Saharan Africa should ensure that the level of non-market activities in these countries is reduced by increasing the level of participation rate and ensuring that the level of contribution of the subsistence economy is improved as this will increase the rate of returns that life expectancy will have on economic growth.
3. Lastly, proper attention should also be directed towards improving the efficiency of institutions in Sub-Saharan Africa as this will increase the level of efficiency and productivity of their government as well as ensure proper and optimal allocation of resources thereby increasing welfare, enhance the quality of the length of life or

life expectancy thereby promoting economic growth.

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APPENDIX

Table 1: variable, measurements and source

VARIABLE	MEASUREMENT	SOURCE
PCI	Gross Domestic Product per capita as a proxy for economic development	World Development Indicators (WDI) 2013
GCF	Gross Fixed Capital Formation as a proxy for the stock of accumulated capital.	World Development Indicators (WDI)2013
LAB	Labour force, total	World Development Indicators (WDI)2013
SSE	Secondary school enrollment (% gross)	World Development Indicators (WDI)2013
LFE	Life expectancy as a proxy for health taking into account the mortality aspect.	World Development Indicators (WDI)2013
HIV	Prevalence of HIV as a proxy for health taking into account the morbidity aspect.	World Development Indicators (WDI)2013

Table 2:
(Variance Inflation Factor)

Variable	VIF	1/VIF
Lsse	1.92	0.521326
Llfe	1.85	0.541377
Lhiv	1.45	0.688245
Llab	1.25	0.8007
Lgcf	1.25	0.801455
Mean VIF	1.54	

Table 3: Modified Wald Test for GroupWise Heteroskedasticity in Fixed Effect Regression Model

chi2 (38)	13116.79
Prob>chi2	0.0000

Table 4: Hausman Test

chi2(5)	2.13
Prob>chi2	0.8313

Table 5: Random Effects Model

lPCI	Coefficient	Standard error	Z	P>|z|	[95% Conf.Interval
lGCF	.1779429	.0140298	12.68	0.000	.1504449 to .2054408
lSSE	.1867532	.0283348	6.59	0.000	.131218 to .2422885
lLFE	-.296871	.1043153	-2.85	0.004	-.5013252 to -.0924168
lHIV	.0352622	.0145447	2.42	0.015	.0067552 to .0637692
_cons	7.048303	.7217039	9.77	0.000	5.63379 to 8.462817
sigma_u	.65873671				
Sigma_e	0.13682979				
rho	0.95863885				

Table: 6 Robust Random Effects Model

lPCI	Coefficient	Robust standard error	z	P>|z|	[95% Conf.Interval]
lGCF	.1779429	.0292014	6.09	0.000	.1207093 to .2351765
lLAB	-.2450477	.0703282	-3.48	0.000	-.3828884 to -0.1072071
lSSE	.1867532	.0442157	4.22	0.000	.100092 to .2734144
lLFE	-.296871	.1310557	-2.27	0.023	-.5537355 to -.0400065
lHIV	.0352622	.0193307	1.82	0.068	-.0026253 to .0731496
_cons	7.048303	1.057185	6.67	0.000	4.976259 to 9.120348
Sigma_u	.65873671				
Sigma_e	.13682979				
Rho	.95863885				

Table:7 Bias in the Standard error and z value

Standard error	Robust standard error	Bias	z	z(robust)	Bias
0.0140298	0.0292014	-0.0151716	12.68	6.09	6.59
0.0529756	0.0703282	-0.0173526	-4.63	-3.48	-1.15
0.0283348	0.0442157	-0.0158809	6.59	4.22	2.37
0.1043153	0.1310557	-0.0267404	-2.85	-2.27	-0.58
0.0145447	0.0193307	-0.004786	2.42	1.82	0.6
0.7217039	1.057185	-0.3354811	9.77	6.67	3.1

Table:8 Breusch and Pagan Lagrangian multiplier Test for Random Effects

chi2(1)	2355.71
Prob> chi2	0.0000