HEALTH AND REAL PER CAPITA GROSS DOMESTIC PRODUCT IN SUB SAHARAN AFRICA

Master of Arts (Economics) Thesis

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CANDIDATE'S DECLARATION

I declare that the work contained in this thesis is my original work and that it has not been presented for a degree in any University. Where work of others has been used, acknowledgement has been duly given.

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LAWRENCE NGWALANGWA

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CERTIFICATE OF APPROVAL

We declare that this thesis is from the student's own work and where he has used other sources of information, it has been duly acknowledged. This thesis has been submitted with our approval as supervisors.

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DEDICATION

To my beloved parents Mr. and Mrs. Ngwalangwa and my entire family.

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ABSTRACT

This paper examines the impact of health status (proxied by life expectancy at birth and infant mortality rate) and real per capita gross domestic product for a panel of twenty five Sub Saharan African countries over the years 1990 to 2005 with data observed once in every five years. The summary statistics of the health indicators in terms of life expectancy at birth, infant mortality rates and the prevalence of HIV and AIDS show a paradox that countries with high real per capita gross domestic product have their health indicators deteriorating. On the other hand, countries with lower real per capita gross domestic product have their health indicators improving. This result entails that wealthier nations are not necessarily healthier nations.

The study uses the fixed effects estimation technique that controls for unobserved country specific heterogeneity. The sample of countries used in this study was split into two groups on the basis of the prevalence of HIV and AIDS. The first group is Southern Africa, where the prevalence rate of HIV and AIDS is above 10 percent for all the countries in the sample. The second group comprised of the rest of the regions of the Sub Saharan Africa (East, Central and West) where the prevalence of HIV and AIDS is less than 10 percent for all the countries in the sample. The results indicate that for a sample of countries from East, Central and West Africa, infant mortality rate has a negative and statistically significant effect on real per capita gross domestic product. Life expectancy at birth was found to have a positive but statistically insignificant impact on real per capita gross domestic product. On the contrary, it was found that for a sample of Southern African countries, infant mortality rate has a positive and statistically significant impact on real per capita gross domestic product. Life expectancy at birth in this sample of countries (Southern Africa) was found to have a negative but statistically insignificant impact on real per capita gross domestic product. This result is attributed to the fact that most Southern African countries have high real per capita gross domestic product but deteriorating health indicators due to high prevalence of HIV and AIDS.

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LIST OF ACRONYMS

AIDS	Acquired Immune Deficiency Syndrome
GCF	Gross Capital Formation
HIV	Human Immuno Deficiency Virus
LEB	Life Expectancy at Birth
SER	Secondary Enrolment Rate
TLF	Total labour force
WHO	World Health Organization

CHAPTER 1

INTRODUCTION

1.0 General Background

The World Health Organization (WHO) defines health as a state of complete physical, mental and social well being and not merely the absence of disease or infirmity (Kimalu P et-al, 2004). According to WHO, the health of all people is fundamental to the attainment of peace and security and is dependent upon the fullest cooperation of all individuals and states. It is further advocated by WHO that the enjoyment of the highest attainable standards of health is one of the fundamental rights of every human being. Provision of good health services satisfies one of the basic human needs and contributes significantly towards maintaining and enhancing the productive potential of the people. Good health status is an important asset because it is associated with improved productive capacity which enables people especially the poor households in the less developed countries to emerge out of poverty.

Hamoudi and Sachs (1999) in Rico et-al (2005) argue that there is a cycle of simultaneous impact between health and wealth. This is also substantiated by Pritchet and Summers (1996) who argued that increased income causes better health and healthier workers are more productive hence wealthier implying a reverse causation between health and income. It is thus impossible to generate economic growth in the developing world without solving the central health problems faced by these countries and it is impossible to improve the health without generating economic growth. Improved health status is an important component of human capital which is an indispensable tool for sustained economic growth. This is the case because health individuals are productive and work harder, and more intensely. Higher levels of health and better education results into the availability of labour force that is capable of maintaining the state of continuous economic growth. Good health

status has also some important spillover effects in the sense that the resources that should have otherwise been used in taking care of the sick are freed for alternatives uses.

Health is one of the important assets the human being has because it permits individuals to fully develop their capacities and as such, the problems related to health status of individuals could be reflected as reductions or obstacles for economic progress. Good health raises levels of human capital, and this has a positive effect on individual productivity and on economic growth rates. Further, good health helps to forge improved levels of education by increasing levels of schooling and scholastic performance.

In the field of health economics, the endogenous causality between health and income has been the topic of several studies whose purpose is to establish the direction of the causality. Luft (1978) in Rico (2001) argues 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. Bloom and Canning (2000) explain this direction of the causality with education, indicating healthy people live more and have higher incentives to invest in their abilities since the present value of the human capital formation is higher. The higher education creates higher productivity and, consequently, higher income. This study looks closely at the relationship between health status (proxied as life expectancy at birth and infant mortality rate) and real per capita gross domestic product in the context of the Sub Saharan African region.

1.1 HIV and AIDS in Sub Saharan Africa

The proxies for health status to be used in this study are infant mortality rate and life expectancy at birth as indicated in section 1.0. These health indicators can be highly linked to HIV and AIDS in the Sub Saharan Africa. HIV and AIDS pandemic remains a very big threat for the Sub Saharan African region. Tabutin and Schoumaker (2004), using data from UNAIDS observed that the Sub Saharan African region is by far the most severely affected region in the world with close to 27 million people living with HIV/AIDS in 2003 (out of a total of 40 million in the world). It is also indicated that the

prevalence of HIV/AIDS is approximately 10 percent for the entire Sub Saharan Africa against less than 1 percent elsewhere in the world. The obvious consequence of HIV/AIDS pandemic has been a rise in mortality. UNAIDS (2006) reports that, HIV and AIDS are the greatest cause of adult mortality in Sub Saharan African region, more especially in Southern Africa where 34 percent of all the deaths in 2006 were related to HIV and AIDS. Child mortality has also significantly risen in Sub Saharan Africa. This implies that the HIV/AIDS pandemic has significantly reduced the life expectancy and the quality of life of the people of the region.

The Commission on Macroeconomics and health (2001) indicates that nearly three quarters of persons living with HIV and AIDS are in the Sub Saharan Africa and that three million people died of AIDS in 2000 of which, 2.4 million were in Sub Saharan Africa. Twelve million children have already been orphaned in Africa. The HIV and AIDS pandemic has thus serious negative implications on the economy of the Sub Saharan African region. The active age group is the one mostly affected by HIV and AIDS. This adversely affects the productivity of the people infected and affected and ultimately culminates into slow economic growth rate of the Sub Saharan African region. Unless brought under control, the disease will devastate and cripple economic development in Africa.

Most of the Sub Saharan African countries are in the tropical region where the prevalence of Malaria and Tuberculosis is rampant. This poses as the major threat for the survival and productivity of people in the region. Sachs (2001) argues that HIV/AIDS, Malaria and Tuberculosis account for a large proportion of avoidable mortality of the poor. Avoidable mortality is measured by comparing the death rates in the poor countries with the death rates experienced by non smokers in the richest countries on an age adjusted basis. Out of the growing international awareness of the tragic scope and destructiveness of these three diseases (HIV and AIDS, Malaria and Tuberculosis), arose the idea of the United Nations Global Fund to fight these three diseases. As part of the Millennium Development Goals to halt and begin to reverse the spread of HIV and AIDS, Malaria and other diseases, the United Nations Global Fund was established shortly after the Millennium Summit in 2000. The United Nations global fund generates and disburses funds for effective prevention and

treatment programmes in countries hardest hit by HIV and AIDS, Tuberculosis and Malaria. Table 1 gives us a picture of the HIV/AIDS in Sub Saharan Africa according to geographical sub regions for the years 2002 and 2005.

Table 1: HIV/AIDS Prevalence rate in Sub Saharan Africa (2002 and 2005/2006)

SUB REGION	**PREVALENCE RATE IN EARLY 2002(%)**	**PREVALENCE RATE 2005/2006(%)**
SOUTHERN AFRICA		
BOTSWANA	38.8	24.1
LESOTHO	31.0	23.2
NAMIBIA	22.5	19.6
SOUTH AFRICA	20.1	18.8
SWAZILAND	33.4	25.9
MALAWI	15.0	12.7
MOZAMBIQUE	13.0	16.1
ZAMBIA	21.5	17.0
ZIMBABWE	33.7	18.1
EAST AFRICA		
KENYA	15.0	6.1
UGANDA	5.0	6.7
TANZANIA	7.8	6.5
RWANDA	8.9	3.0
BURUNDI	8.3	3..3
ETHIOPIA	6.4	1.4
CENTRAL AFRICA		
ANGOLA	5..5	3.7

CAR	12.9	6. 2
CHAD	3.6	3. 5
CONGO	7. 2	5. 3
WEST AFRICA		
GAMBIA	1.6	2.4
GHANA	3.0	2. 3
NIGERIA	5.8	3. 9
SENEGAL	0.5	0. 7
SIERRA LEONE	7.0	1. 5

Sources; World Population Data Sheet of the Population Reference Bureau (2007), World Development indicators 2007 and Tabutin and Schoumaker (2004),

As can be observed from table 1, Southern Africa region is the worst hit with very high prevalence rates of HIV/AIDS, the highest being Botswana with the prevalence rate of 38.8 percent in 2002 and 24.1 percent in 2005. Western Africa countries are generally reported to have very low prevalence rates of HIV/AIDS with Senegal having the lowest rate of 0.5 percent in 2002 and 0.9 percent in 2005.

1.2 Infant Mortality rate in the Sub Saharan Africa

Since this study intends to use infant mortality rate as one of the indicators of health status, it is necessary that we show the trends in infant mortality for the Sub Saharan African region. This is the region of the world where infant mortality rate remains very high. Table 2 shows the trend and the percentage changes in infant mortality rate in Africa categorized by regions from 1972 to 2005. Generally, infant mortality rates have been going down though not at an impressive rate. The percentage change in infant mortality rate for Sub Saharan African region as a total has been declining. Over the past fifty years, all the sub regions of the Sub Saharan African countries have registered higher infant mortality rates than the rest of the parts of the world. This clearly manifests that the health status,

measured in terms of life expectancy and infant mortality rate of the Sub Saharan African countries has generally been poor.

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Table 2: Regional trends in Infant mortality rates in Sub Saharan Africa

	Infant Mortality Rate					Percentage change			
Region	**1952**	**1972**	**1992**	**2002**	**2005/06**	**1952-72**	**1972-92**	**1992-02**	**2002-06**
West	192	142	104	90	98	-26	-27	-13	8
Central	186	137	118	116	113	-26	-14	-2	-2
Southern	182	134	109	97	83	-26	-19	-11	-14
East	105	82	52	52	46	-21	-37	0	-12
Total	180	142	105	95	92	-26	-22	-9	-3

Sources; World Population Data Sheet of the Population Reference Bureau (2007) and Tabutin and Schoumaker (2004)

1.3 Trends in the Macroeconomic Indicators of the Sub Saharan Africa.

It is also important to look at the general macroeconomic indicators of the Sub Saharan Africa. This is the case because the overall macroeconomic condition can have an impact on the variables of interest in this study namely; real per capita gross domestic product and the health indicators (life expectancy at birth and infant mortality rate).

Growth in GDP per capita in low income countries in the Sub Saharan Africa has continued to lag behind most other regions of the world and has been negative for the period 1991 to 2000. Jamison et-al (2006) indicated that growth in the Sub-Saharan Africa accelerated during the first few years of the twenty-first century but still lagged behind all the other regions except Latin America and the Caribbean in 2004. As observed by Masanjala and

Papageorgiou (2007), one of the most intriguing questions in economic growth literature is why Sub- Saharan African growth has been so drastically low and drastically different from the rest of the world. The poor performance of the Sub Saharan African region does not only relate to the growth in per capita gross domestic product but also other macroeconomic indicators. Nouba (2004) argues that in general, the macroeconomic performance of Africa still fell below the levels required to significantly reduce poverty. Table 3 shows some of the macroeconomic indicators of Africa.

Table 3: Macroeconomic indicators of Africa (percent)

Indicators	**1974/79**	**1980/85**	**1986/90**	**1991/94**	**1995/98**	**2001**	**2004**
GDP growth	3.5	2.1	2.8	1.7	3.8	3.5	5.1
GDP per capita Growth	0.7	-0.8	-0.1	-1.2	1.1	1.3	2.7
Investment/GDP	26.8	23.4	20.7	20.2	19.4	-	-
Savings/GDP	26.2	19.3	16.4	17.4	16.7	20.9	23
Inflation	13.8	15.8	16.3	30.7	21.0	-	-
Fiscal deficit/GDP	-5.4	-5.9	-6.7	-5.9	-2.5		
Import growth	6.2	2.5	6.8	6.1	5.8	-	7.1
Export growth	2.6	1.0	6.8	6.1	-1.9	-	3.9
Terms of trade	1.0	4.2	-2.8	-3.5	-0.6	-	-

Sources: Nouba (2004) and African Development Indicators (2006)

Table 3 indicates a negative growth in GDP per capita. This is a clear manifestation of increasing levels of poverty in the African region. Savings as a percentage of GDP has also been going down. The decline in savings as a percentage of gross domestic product is an indication that African people are becoming poor and poorer. This is the case because

economic theory tells us that the poor dedicate a large proportion of their income to consumption and as such the saving rates go down.

There is a close link between the low economic growth and the low progress in reducing poverty in the Sub Saharan Africa region. According to World Bank (2007), even though there is progress in some countries to achieving one of the targets of the Millennium Development Goals (MDGs) to halve the proportion of people whose income is less than one United States dollar per day, many countries particularly those in the Sub Saharan Africa, where average poverty rates remain above 40 percent will most unlikely achieve this goal by 2015.

Jamison et-al (2006) argues that there is little doubt that the slow economic growth and increasing poverty in the Sub Saharan Africa region are closely related to the slow progress in the health outcomes. According to the report of World Health Organization's Commission on Macroeconomics and Health (2001), improving the health and longevity of the poor is a fundamental goal of economic development and also a means to achieving the other development goals relating to poverty reduction. The linkages of health to poverty reduction and to long-term economic growth are powerful, much stronger than is generally understood. The burden of disease in some low-income regions, especially Sub-Saharan Africa, stands as a stark barrier to economic growth and therefore must be addressed frontally and centrally in any comprehensive development strategy.

It is indicated in Sachs (2001) that an econometric study by Bloom and Sachs (1998) found that more than half of Africa's growth shortfall relative to high growth countries of East Asia could be explained statistically by the burden of disease, demography and Geography rather than more traditional macroeconomic variables and policy governance. High prevalence of diseases such as Malaria and HIV and AIDS are associated with persistent and large reductions in economic growth rates. This shows that good health status or low burden of diseases (in this case proxied by low infant mortality rates and high life expectancy at birth) is an indispensable tool for economic growth. Good health status of the population and education are the main components of human capital. Sustained growth depends on levels of human capital whose stocks increase with the better education and higher levels of health.

1.4 Problem Statement

Even though the role of human capital is important in the economic growth process, there has been a bias towards education as the component of human capital. The human capital component of health has not received considerable attention in as far as its relationship with economic growth is concerned. While identifying labour quality as a factor contributing significantly to human capital and, consequently, to economic growth, most studies stress on education instead of health. This practice ignores the reasons for considering health to be a crucial aspect of human capital. According to Arora (2001), theories of growth assign a pivotal role to human ability. But the pertinence of health to ability and to growth remains largely unexamined. A theoretical solid structure integrating health and economic growth has not been developed and this is attributed to the lack of interaction between the contributions of health economics and economic growth theory, and the bias towards the importance of schooling as a core component of human capital.

It is also important to realize that most of the studies that have been done on the relationship between health and economic growth were done using data for developed countries (see, e. g Arora, 2001; Malik, 2006 and Rivera and Currais, 2003). We are presently not aware of a study on the impact of health status (proxied by life expectancy at birth, infant mortality rate) and per capita gross national product in Sub Saharan Africa region. The study intends to fill this gap in the existing knowledge. The significance of this study is that it will examine the impact of health status on real per capita gross domestic product in Sub Saharan Africa, which has not been the case in the existing empirical studies.

1.5 Objectives of the Study

1.5.1 General Objective

The main objective of the study is to examine the impact of health status (which is proxied by life expectancy at birth and infant mortality rate) and real per capita gross domestic product in Sub Saharan Africa.

1.5.2 Specific Objectives

The study specifically intends to

- Examine the impact of life expectancy at birth on real per capita gross domestic product in Sub Saharan Africa.
- Examine the impact of infant mortality rate on real per capita gross domestic product in Sub Saharan Africa.

1.5.3 Study hypotheses

On the basis of the general and specific objectives outlined above the study will test the following hypotheses:

- Life expectancy at birth does not influence real per capita gross domestic product
- Infant mortality rate does not influence real per capita gross domestic product

1.6 Organization of the Study

The rest of the study will be organized as follows: Chapter two is the review of both theoretical and empirical literature. Chapter three discusses the methodology employed in the study and chapter four is the presentation of the results. Chapter five, the final chapter concludes the study, outlines the policy recommendations and points out the study limitations and the direction for future research.

CHAPTER 2

LITERATURE REVIEW

2.0 Theoretical Literature

2.1 The Solow Model

The Solow (1956) model is usually considered as the starting point for almost all the analysis of economic growth. Even the models that depart fundamentally from Solow are best understood through comparison with the Solow model. Thus understanding the model is essential to understanding the theories of growth. The Solow model is the Neo-classical growth model and is an expansion of the Harrod Domar model which simply states that the rate of growth of Gross National Product is determined jointly by the national savings ratio and the national capital output ratio. According to the Harrod Domar model, in order to grow, economies must save and invest. The more countries save and invest, the faster their rate of growth in GNP. The growth rate is however negatively related with the capital to output ratio which implies that the higher the capital to output ratio, the lower will be the rate of growth in GNP per capita.

According to Romer (2001), the Solow model focuses on four variables output (Y), capital (K), labour (L) and knowledge or the effectiveness of labour (A). The Solow model thus adds another factor labour and also introduced a third variable technology which is considered as exogenous to the growth equation. The production function takes the form

$$Y(t) = F(K(t), A(t)L(t)) \quad (1)$$

Where, t denotes time.

The models' critical assumption is that it has constant returns to scale in its two arguments, capital and effective labour. The production function is thus homogenous of first degree. This implies that multiplying the quantities of capital and labour by any non negative constant c causes output to change by the same factor. Thus:

$$F(cK,cAL)= cF(K,AL) \text{ for all } c\geq 0 \quad (2)$$

Constant returns to scale seems to be a natural assumption to make in the theory of growth because the scarce resources like land would lead to decreasing returns in both capital and labour.The assumption of constant returns to scale allows us to work with the production function in intensive form. Setting c=1/AL in the above equation yields

$$F[K/AL,1] = 1/AL\ F(K,AL) \quad (3)$$

Where K/AL is the amount of capital per unit of effective labour and F(K,AL)/AL is the same as Y/AL which is output per effective labour .We then define k= K/AL, y=Y/AL and f(k)= F(k,1).

Equation 3 can thus be written as:

$$y = f(k) \quad (4)$$

The above production function is assumed to satisfy the following conditions:

f (0) = 0, f `(k) > 0,f ``(k)<0 and this implies that the marginal product of capital is positive but it declines as capital per unit of effective labour rises. The initial levels of capital, labour and knowledge are taken as given and labour and knowledge grow at constant rates. Thus

$$dL(t)/dt= nL(t) \quad (5)$$

$$dA(t)/dt=gA(t) \quad (6)$$

The growth rate of the variable is equal to the rate of change of its natural log. Thus

$$\ln L(t) = [\ln L(0)] + nt \quad (7)$$

$\ln A(t) = [\ln A(0)] + gt$ (8)

where L(0) and A(0) are values at time 0.Taking exponentials of both sides of equations 7 and 8 gives us:

$$L(t) = L(0)e^{nt} \quad (9)$$

$$A(t) = A(0)e^{gt} \quad (10)$$

Output is either consumed or invested. We denote *s* as the proportion of output that is invested and this is assumed to be exogenous and constant. On top of this, the existing capital stock depreciates at a rate ∂. Investment which is a change in capital stock is given as:

$$dK(t)/dt = sY(t) - \partial K(t) \quad (11)$$

The Solow model assumes that the rate of savings *s*, depreciation rate ∂, population growth and rate of technical progress are constant. In the Solow model, per capita production depends mainly on capital per effective labour ratio *k*. The accumulation of capital per effective labour ratio is given by

$$\overset{*}{k}(t) = \frac{\overset{*}{K}(t)}{A(t)L(t)} - \frac{K(t)}{[A(t)L(t)]^2}\left[A(t)\overset{*}{L}(t) + L(t) + \overset{*}{A}(t)\right] \quad (12)$$

$$= \frac{\overset{*}{K}(t)}{A(t)L(t)} - \frac{K(t)}{A(t)L(t)}\frac{\overset{*}{L}(t)}{L(t)} - \frac{K(t)}{A(t)L(t)}\frac{\overset{*}{A}(t)}{A(t)} \quad (13)$$

But $\frac{K}{AL} = k, \frac{\overset{*}{L}}{L} = n$ and $\frac{\overset{*}{A}}{A} = g$ hence

$$\overset{*}{k}(t) = s\frac{Y(t)}{A(t)L(t)} - \partial k(t) - nk(t) - gk(t) \quad (14)$$

Since $\frac{Y}{AL}$ is given by $f(k)$,we then have

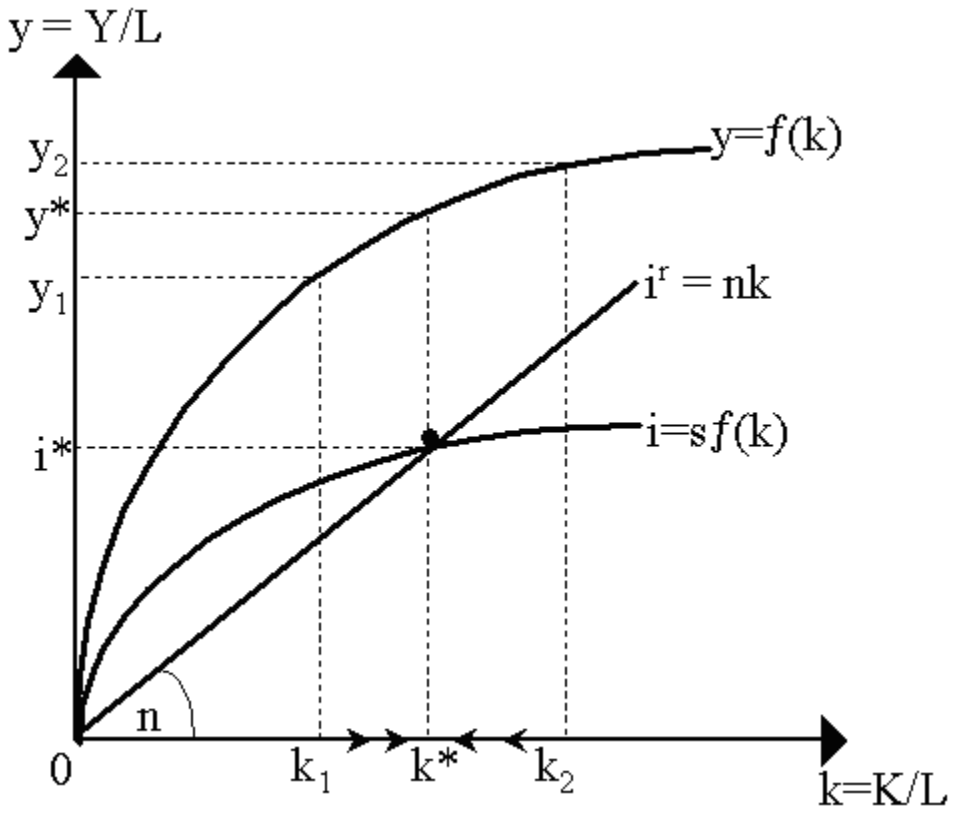
$$\dot{k}(t) = sf(k(t)) - (n + g + \delta)k(t) \quad (15)$$

The above equation is the key equation of the Solow model which states that the rate of change in capital stock per unit of effective labour is the difference between actual investment per unit of effective labour, sf(k) and the break even investment,(n+g+∂)k.

When $\dot{k}(t)$=0, it implies that $sf(k(t)) = (n + g + \partial)k(t)$

If actual investment per unit of effective labour, $sf(k(t))$ is greater than $(n+g+\partial)k(t)$ it means that capital per unit of effective labour must be rising. If $sf(k(t)$ is less than $(n+g+\partial)k(t)$, it means that capital per unit of effective labour must be falling. We denote k* to represent a point where actual investment per unit of effective labour equals the breakeven investment. Figure 1 below illustrates the above dynamics.

Figure 1. An Illustration of the Solow Model



$y = f(k)$ is the production function, $sf(k)$ is the actual investment per unit of effective labour and i^r is the breakeven investment. The point i*k* is where the actual to the breakeven investment.

This model is criticized for being too simplistic in a number of ways like having only a single good; the absence of government; ignoring the fluctuations in employment and having a production function with only three inputs capital, labour and knowledge or the effectiveness of labour. It is also argued that for one to analyze the growth rates of several countries using the model, it has to be assumed that the countries have similar production functions and this is very unrealistic. The model thus ignored many features that are important for economic growth. Nonetheless the model is very important in the economic growth literature.

According to Barro and Sala-i-Martin (1996), a nation's economic growth is dependent on the current gdp and the gdp in steady state:

$$dY/dt = f(Y, Y^*) \quad (16)$$

where dY/dt is the rate of growth of GDP;

Y is the current GDP;

Y* is the steady state GDP.

dY/dt is declining in Y and increasing in Y*.

This follows from the diminishing returns to capital. An implication of this model is that as Y increases the rate of growth will be lower in the long run in the absence of new innovations and ideas and technology not being constant. According to this model the countries which start at low levels of initial gross national income will be on higher growth paths as compared to the countries which are at higher levels of initial income.

Thus countries which have less capital per worker tend to have higher rates of return and higher growth rates. In the neoclassical model as well the concept of capital is broadened to include human capital in the form of education and health. Malik (2006) indicates that the

Neo-classical growth models also predict that growth must eventually cease unless there are improvements in technology.

2.2 Endogenous Growth Model

The other important growth model which is also relevant for this study is the endogenous growth model. The endogenous growth models resemble the neoclassical growth models. However, the most significant differences arise from the factors such as: The endogenous growth model discards the assumption of exogenous technological progress and the diminishing returns to capital. Central to the endogenous growth model is the idea that technology is endogenous to the growth process. The endogenous growth model also allows increasing returns to scale in aggregate production and the role of externalities in determining capital return on capital investment. The concept of technology in these models depends on economic factors such as the capital labour relationship. An increase in this ratio not only explains an increase in income but also but also the ability to maintain a higher level of economic growth in the long run. Todaro (2000) argues that, by assuming that public and private investment in human capital generates externalities and productivity improvements that generate natural tendency of diminishing marginal returns, endogenous growth theories seek to explain the existence of increasing returns and the divergent long term patterns among countries.

2.3 The Grossman Model

The Grossman (1972) model is very influential to the modeling of demand for Health care. Grossman (1972) came up with a theory of demand for health care which draws heavily from human capital theory. According to the human capital theory, increase in a persons stock of knowledge or human capital raises his productivity in the market sector economy where he produces money earnings and in the non market or household sector where he

produces commodities that enter his utility function. Grossman views an individual as a producer and not simply a consumer of health. This model looks at how individuals allocate their resources both in terms of time and money to produce good health. The demand for health care is derived from the demand for health. This entails that people do not want health care not for its own sake but for the sake of good health status that health care can produce. Sick days are generally a source of disutility. An increase in the stock of health reduces the amount of time lost due to ill health and the monetary value of this reduction is considered as an index of the return to an investment in health. In the model, an individual is born with initial stock of health that depreciates with age and can be increased by investment in health. Investment in health can be produced for health inputs such as medical care utilization, diet, income, exercise, cigarette smoking and alcohol consumption. In addition, the production function is affected by efficiency or productivity of a given consumer. This efficiency is defined as the amount of health obtained from a given amount of health inputs. It is argued that years of formal school completed plays a major role in determining the efficiency in health investment. The Grossman model goes beyond the traditional demand analysis and has been extremely influential in health economics. However the model is criticized because it assumes that health care is the constant life time investment and that it also ignores the role of insurance markets.

2.4 Empirical literature

A lot of empirical studies have been undertaken to investigate the relationship between health and income and various results have been found using different methodologies, variables and data sets.

Malik (2006) examined the relationship between health and economic growth for India. The rate of growth was measured using gross national income (GNI) and health status was measured using infant mortality rate, life expectancy and crude death rate. The relationships were measured using a multivariate framework controlling for other background variables. The linkage between health status and economic growth was further

tested using a regression model which tests causality between the variables of interest. The results show that the health indicators do not have a significant effect on gross national income and that there was no high correlation between the different health indicators and gross national income in the sample year of 2002.

Arora (2001) investigates the influence of health on the growth paths of ten industrialized countries over the course of 100 to 125 years. The results indicated that changes in health increased the countries' pace of growth by 30 to 40 percent, altering permanently the slope of their growth paths. This finding is robust across five measures of long-term health and it remains largely unchanged when controlled for investment in physical capital. Health-related variables correlate positively with years of schooling. However, schooling variables by themselves do not replicate the results obtained from health-related measures. The study concluded that health improvements thus do not merely follow economic progress.

Rivera and Currais (2003) in a paper titled, "The Effect of Health Investment on Growth: A Causality Analysis," analyzed the effect of health investment on productivity as an important variable associated with human capital accumulation. The authors also study the possible existence of endogeneity by using instrumental variables estimation. The results that were obtained may be interpreted as evidence of the positive impact of health expenditure on income growth. Furthermore, the authors looked at the bounded gains of health status and divided the sample according to the median of total health expenditure and found that the countries with lower levels of health spending obtain larger benefits when the other determinants of growth are held constant.

Pritchett and Summers (1996) estimated the effect of income on health using cross-country, time- series data on health (infant and child mortality and life expectancy) and income per capita. They used instrumental variables estimates using exogenous determinants of income growth to identify the pure income effect on health, isolated from reverse causation or incidental association. They found that the long-run income elasticity of infant and child mortality in developing countries lies between -0.2 and -0.4.Using these estimates they calculated that over half million child deaths in the developing world in 1990 can be attributed to poor economic performance in the 1980's.This paper confirmed that increase in the countries income will tend to raise the health status.

Nouba (2004) used the econometrics of panel data to estimate the traditional production function of the health services. The results of the estimates show that GNP per capita is an important determinant of health outcome. The study concludes that wealthier nations are not always healthier nations, but wealth (income) matters for health. Income inequality and inequality in health status were also found to be strongly correlated with the health status indicators. At the end of the day, the study shows that income and inequalities are important determinants of human development in Africa.

In an empirical study of the impact of health capital on economic growth, Rico (2005) used an index that includes four determinants of health defined by the European Commission of Public Health and these are health services, social economic conditions, lifestyle and the environment. The model was estimated initially using growth rates in absolute levels and then re-estimated using growth rates in per capita levels with ordinary least squares. Apart from the variables in the health index, other variables that were included in the model are capital, labour and schooling. The aim was to see which determinants have the greatest impact on economic growth. The model was finally estimated using generalized least squares and found that all the variables were significant.

Bloom et-al (2001) extended production function models of economic growth to account for two additional variables that micro economists have identified as fundamental components of human capital: work experience and health. They used panel data of 102 countries observed every 10 years from 1960 to 1990. The main result was that good health has a positive, sizable, and statistically significant effect on aggregate output. They found little variation across countries in average work experience and concluded that differentials in work experience account for little variation in rates of economic growth. The study also found that the effects of average schooling on national output are consistent with microeconomic estimates of the effects of individual schooling on earnings, suggesting that education creates no discernible externalities.

In an attempt to estimate a health production function for the United States, Thornton J (2002) reported some new evidence on the impact of medical care, social economic status,

lifestyle and environmental factors on the status of the population of US. The study adopted (Grossman: 1972's) argument that not only does health depend on medical care and income but medical care and income also depends on health: thus healthier population demand less medical care and generate greater money earning. The study used two stage least squares (2SLS) estimation procedure. The results show that additional medical care utilization is relatively ineffective in lowering mortality and increasing life expectancy. The most important factors that influence death rates in this study were related to social economic status and lifestyle. As a policy implication, the study suggested that health care policy which focus primarily on the provision of medical care services and ignores larger economic and social considerations may do little to benefit the nation's health. If the primary goal of the health care policy is to maintain and improve the health status of the population, then greater recognition should be given to the role of socioeconomic and lifestyle factors in preventing disease and improving life expectancy. Policies that strengthen the education system can promote sustained income growth and social stability and may also be highly effective in promoting the nations health status and other important social goals.

Berger M and Jodi Messer (2002) estimated the effects of public financing of health expenditures, insurance and health outcomes using panel data of twenty Organization for Economic Cooperation and Development (OECD) countries for the years 1960 to 1992. In this study, increases in publicly financed share of health expenditures are associated with increase in mortality rates which was a dependent variable. The explanatory variables included in the model include gross domestic product per capita (GDP), health expenditure per capita, tobacco and alcohol consumption, gini coefficient and female labour force participation rates among others. The study suggested that as countries increase the level of health expenditure, they should avoid increasing the proportion of their expenditure that is publicly financed.

As can be seen from the reviewed literature, most of the empirical studies done on the relationship between health status and economic growth are for the developed countries. Such studies have not been extensively done for Sub Saharan Africa. Therefore, it is important to analyze the relationship between health status (proxied as life expectancy at

birth and infant mortality rate) and per capita gross national income in the context of the Sub Saharan Africa.

CHAPTER 3

STUDY METHODOLOGY

The aim of this chapter is to outline the methodology that will be followed in this study. The conceptual framework of the determinants of HIV and AIDS prevalence and the factors influencing infant mortality rate and life expectancy at birth will firstly be highlighted. Then, the economic or behavioral model alongside the economics behind the model will be presented. Thereafter, the chapter presents the estimation procedure and a brief discussion on the data and the data sources. Then any other empirical issues that may arise will be discussed.

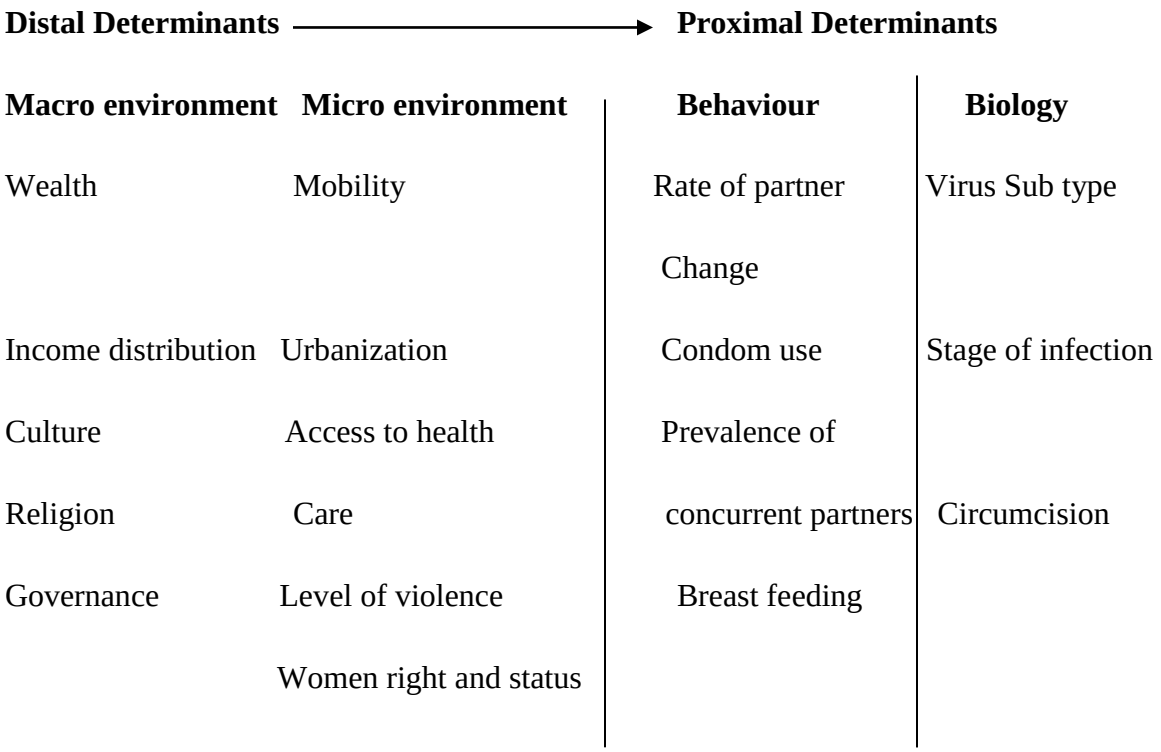
3.0 Conceptual framework

3.1 HIV and AIDS prevalence

There are several factors that determine the health status of a particular nation. Some factors are distal determinants while others are proximal determinants. There is a causal cycle between HIV and AIDS and poverty in the sense that poverty increases the spread of HIV which causes AIDS and AIDS in turn increases poverty. Whiteside (2002) shows some of the factors that could have an influence on HIV and AIDS. Whiteside disaggregated both the distal and the proximal determinants of HIV and AIDS. The distal determinants are classified into those at the macro environment and those at the micro environment. The proximal determinants are classified into those that are linked to behavior and those that are linked to Biology. It is shown in figure 1 that the causal chain runs from the macro factors which result in poverty through the community, household and individuals into the capacity of an individual's immune system. One can use the conceptual framework in figure 1 in various ways to explain the interaction of factors that can result

into the spread of HIV and AIDS. As an example, some cultural norms can make women not freely exercise their right. This can then make the women unable to make their independent decisions on safe sex practices like condom use. This inability to exercise their right coupled with low status can also make women unable to condemn their spouses if they have multiple sex partners. The result of this is the spread of HIV and AIDS virus which eventually weaken the people's immune system.

Figure 2: The HIV and AIDS conceptual framework



Source: Whiteside (2005)

3.2Infant mortality rate and life expectancy at birth

Using the same reasoning, there are also several determinants of infant mortality rate and life expectancy at birth. These determinants can be both at the macroeconomic and the microeconomic level. Below is the highlight of some of the determinants of infant mortality rate and life expectancy at birth. The determinants of infant mortality rate and life expectancy at birth can be viewed from the social economic, political, environmental and even people's lifestyles perspective. Figure 2 shows some of the determinants of infant mortality rate and life expectancy at birth. It has to be noted that there are inter linkages in the factors determining life expectancy at birth and infant mortality rates of different countries.

Figure 3: Infant mortality rate and life expectancy at birth conceptual framework

Socio economic Factors	**Political Factors**	**Environmental Factors**	**Lifestyle factors**
Education	Political Will	Urbanization	Alcoholism
Income	Government's commitment	Climatic conditions	Cigarette smoking
Culture		Access to health facilities	Exercise
Religion	Effective public health programs		Diet
Gender			
Status of women			

There is thus interplay of social economic, political, environmental and lifestyle factors in determining infant mortality rate and life expectancy at birth. For example, education affects the people's lifestyle in form of diet, exercises and the quickness to access health care when they fall sick. This may ultimately have an impact on the number of years one is expected to live. Climatic condition can also have an influence on life expectancy at birth and infant mortality rate. Most Sub Saharan African countries lie in the tropical region where the prevalence of Malaria is high. Masanjala and Papegeorgiou (2007) argues that since African countries are more tightly wrapped around the equator, it is not surprising that 92 percent of Sub Saharan African land area lies between the tropics of cancer and Capricorn and malaria is endemic in 88 percent of the countries. It has to be noted however that due the heterogeneity of countries, some factors that are very important in determining life expectancy at birth and infant mortality rate in one country may not be very important or relevant to the other countries.

3.3 Measurement of health

Health is a multi-dimensional concept and is usually measured in terms of: (i) absence of physical pain, physical disability, or a condition that is likely to cause death, (ii) emotional well-being, and iii) satisfactory social functioning. Some have advocated including the quality of an individual's physical environment in the definition of health (see, e.g. Rico 2005). However there is no single "standard" measure of health status for individuals or the entire population. Individual health status may be measured by an observer (e.g., a physician), who performs an examination and rates the individual along any of several dimensions, including presence or absence of life-threatening illness, risk factors for premature death, severity of disease, and overall health. Individual health status may also be assessed by asking the person to report his/her health perceptions in the domains of interest, such as physical functioning, emotional well-being, pain or discomfort, and overall perception of health. Although it is theoretically attractive to argue that the measurement of health should consist of the combination of both an objective component plus the

individual's subjective impressions, no such measure has been developed. The health of an entire population is determined by aggregating data collected on individuals. The health of an individual is easier to define than the health of a population. However it is difficult to compare the health of individuals because of the diversity of health conditions that different people have at a particular point in time.

In the absence of comprehensive or absolute measures of the health of a population, the average lifespan or life expectancy at birth, mortality rates, the prevalence of preventable diseases or deaths and availability of health services serve as indicators of health status. Judgments regarding the level of health of a particular population are usually made by comparing one population to another, or by studying the trends in a health indicator within a population over time. This study will use infant mortality rates and life expectancy at birth as determinants of health status of a nation. This is the case because such measures are easily comparable and the data of the above indicators are readily available across the countries over several time points.

3.4 The Economic Model

This study seeks to investigate the impact of health on real per capita gross domestic product in Sub Saharan Africa. Suppose each country's production function is represented by:

$$Y_{it} = AK_{it}^{\beta_1} L_{it}^{\beta_2} H_{it}^{\beta_3} U_{it}^{\beta_4} ED_{it}^{\beta_5} \qquad (1)$$

Where

Y= real per capita gross domestic product for country *i* in period *t.*

A= a measure of overall productivity.

K= the capital stock, or quantity of capital used for country *i* in period *t.*

L= the labour force for country *i* in period *t.*

H= the health indicator (proxied by life expectancy at birth and infant mortality rate) for country *i* in period *t.*

U= Urbanization rate for country *i* in period *t.*

ED= a measure of education for country *i* in period *t,* to be proxied by secondary enrolment rate.

According to equation (1) above, the amount of output Y that an economy can produce during any period of time depends on the size of capital stock (K) and the number of workers L. The symbol A in the equation is the measure of the overall effectiveness with which capital and labour are used and is referred to as total factor productivity. We have extended the Cobb-Douglas production function to include the components of human capital in form of health and education. This is the case because human capital in form of health and education plays a very important role in the determination of income and economic growth. As argued by Bloom and Sevilla (2001) that healthier workers are physically and mentally more energetic and robust. They are more productive and earn higher wages. They are also less likely to be absent from work because of illness (or illness in their family). This is particularly relevant in developing countries, where a higher proportion of the work force is engaged in manual labor than in industrial countries.

3.5 Model Specification

Taking the logarithms of the above production function in equation (1) yields the following log-linear model which will be used in this study.

$$LNGDP_{it} = \beta_0 + \beta_1 LHs_{i_t} + \beta_2 LGCF_{it} + \beta_3 LURB_{i_t} + \beta_4 LTLF_{i_t} + \beta_5 LEDU_{i_t} + \varepsilon_{it} \quad (2)$$

3.6 Definition of Variables

$LNGDP_{it}$ is the logarithm of real per capita gross domestic product for country *i*, in time period *t*. This is based on constant prices for the year 2000. LHs_{it} is the logarithm of an indicator of health status namely life expectancy at birth and infant mortality rate for country *i* ,in time period *t.* Life expectancy at birth is the number of years a new born infant would live if prevailing patterns of mortality at the time of birth were to stay the same throughout its life. Infant mortality rate is the number of deaths of infants under one year of age during the indicated year per 1000 live births during the same year. $LGCF_{it}$ is the logarithm of gross stock of capital as a percentage of gross national product for country *i* in time period *t*. This variable is used as a proxy for capital. $LTLF_{it}$ is the logarithm of total labour force for country *i* in time period *t*, which proxies for labour in the production function. $LEDU_{it}$ is the logarithm of secondary enrolment rate to proxy for education. Secondary enrolment ratio refers to the ratio of the total enrolment to the population of the relevant age group that officially corresponds to the secondary level education. This includes the provision of general or specialized instruction at middle, secondary, or high school, teacher training schools and vocational or technical schools; this level of education is based on at least four years of instruction at primary level. $LURB_{it}$ is the logarithm of urbanization rate which is calculated as the number of people in the urban areas as the percentage of total population. Urbanization shows the share of the total population living in areas defined as urban in each country.

3.7 Justification of the model

Specification of the model as equation (2) is important because the model is in the form of log linear equation. The advantage of using the log linear equation is that the estimated coefficients from the model can easily be interpreted as elasticities and this is very vital for

policy formulation because it tells us by how much a one percent change in a particular variable will result into a change in the real per capita gross domestic product.

3.8 Apriori Expectations

The coefficient of life expectancy at birth is expected to be positive because as people live longer, they are motivated to save part of their present income for future consumption. The savings will make resources available for investment which will lead to an increase in real per capita gross domestic product. Barro (1996) also found a positive and statistically significant impact of life expectancy at birth and growth rate in real per capita gross domestic product and argues that life expectancy proxies not only for health status, but also the quality of human capital. On the other hand, we expect the coefficient of infant mortality rate to be negative because a decline in infant mortality rate is an indicator of improved health status. Grossman (1972) argues that improved health status results into the improvement in labour productivity and less days lost due to ill health. This ultimately results into an increase in real per capita gross domestic product.

We also expect the coefficient of urbanization to be positive because an increase in the urbanization rate is an indication of industrialization which induces people to move from the rural areas to the urban areas in the search for employment. The growth in industries contributes positively to economic growth.

The coefficient of labour is expected to be positive because as more and more people are joining the labour force, output will increase and demand will be stimulated. This ultimately leads to economic growth. Labour is one of the important variables in the production functions for examples Solow's (1956). The coefficient of education is expected to be positive because education increases labour productivity and efficiency which increases output and ultimately economic growth (see, e.g. Barro 1996). We also expect the

3.9 Data and Data Sources

The study will use panel data for 25 Sub Saharan African countries observed once in every six years for the periods 1990, 1995, 2000 and 2005. The data for real per capita gross domestic product are from Heston and Summers (2006). Since the data from Heston (2006) runs only up to the year 2004, the additional data for real per capita gross domestic product for the year 2005 are from the United Nations Common Database. The data for infant mortality rate; life expectancy at birth; urbanization rate; secondary enrolment rate; gross capital formation, total labour force and HIV and AIDS prevalence rate come from the various World Bank annual publications of the African Development indicators (1996 to 2006) and World Development indicators (2007). However, it has been not possible to obtain data for HIV and AIDS prevalence rate for the year 1990 for all the countries in this study. Due to this data limitation, we are not able to run a separate regression model on the impact of HIV and AIDS prevalence rate on real per capita gross domestic product. However the prevalence of HIV and AIDS has been extensively used in this study because of its impact on life expectancy and infant mortality rate in Sub Saharan Africa.

3.10 Other Empirical issues

One of the central empirical issues in panel data analysis is the choice between fixed effects and random effects estimation techniques. Fixed effects regression is the model to use when you want to control for omitted variables that differ between cross sectional units but are constant over time. It lets you use the changes in the variables over time to estimate the effects of the independent variables on your dependent variable, and is the main technique used for analysis of panel data. When we can not consider the observations to be randomly drawn from a very large population, it often makes sense to estimate the parameters of the unobserved effect and hence fixed effects method would be more appropriate.

If you have reasons to believe that some omitted variables may be constant over time but vary between cases, and others may be fixed between cases but vary over time, then you

can include both types by using random effects. The generally accepted way of choosing between fixed and random effects is running a Hausman test. To run a Hausman test comparing fixed with random effects in Stata, you need to first estimate the fixed effects model, save the coefficients so that you can compare them with the results of the next model (the random effects model). Then estimate the random effects model and also save the coefficients. Finally, do the comparison of the coefficients obtained from the fixed effects and the random effects models.

The Hausman specification test tests the null hypothesis that the coefficients estimated by the efficient random effects estimator are the same as the ones estimated by the consistent fixed effects estimator. Thus the null hypothesis tells as that the difference in the coefficients obtained from the fixed effects method and the random effects method is not systematic. If they are insignificant (P-value, Prob>chi2 larger than .05) then it is safe to use random effects. If you get a significant P-value, however, you should use fixed effects. The results of the Hausman test are thus presented below.

3.10.1 The Hausman test

Table 4 below gives us the results of the Hausman test which tests the null hypothesis that the coefficients estimated by the efficient random effects estimator are the same as the ones estimated by the consistent fixed effects estimator.

Table 4: Results of the model specification test

Variable	Coefficients			
	Fixed	**Random**	**Difference**	**Standard error**
LNGCF	0.12808	0.1681951	-0.0401151	.
LNSER	0.2707776	0.3478397	-0.0770621	0.0320745
LNIMR	-0.0020579	-0.2701515	0.2680936	0.0804538
LNLEB	-0.1430371	-0.066308	-0.0767291	0.1232659
LNURB	0.0191029	0.0546386	-0.0355356	0.0646938
LNTLF	-0.0010633	-0.0441226	0.0430593	0.0073468

The null hypothesis above also tests that the error term is not correlated with the regressors. The above Hausman test yielded the following p-value;

Prob>chi2 = 0.0454

Since the p-value is significant at 5 percent level of significance, we thus reject the null hypothesis that the difference in the coefficients is not significant. We are thus justified to use the fixed effects estimation technique. The advantage of the fixed effect estimator is that it controls the time invariant country specific omitted variables. Thus the fixed effect estimation technique controls the problem of heterogeneity in our panel data regression model.

We also check for multicollinearity among the explanatory variables using the correlation matrix. The suggested rule of thumb is that if the pair wise or zero order correlation coefficient between the regressors is high in excess 0.8, then multicollinearity is a serious problem. Appendix 1 on page 49 displays the correlation matrix. Through out the correlation matrix, the pair wise correlation coefficients between the regressors is less than 0.8 and this suggests that multicollinearity is not a serious problem in this study.

CHAPTER 4

PRESENTATION AND INTERPRETATION OF THE RESULTS

The aim of this chapter is to present and interpret the results of the study. At the out set of this chapter is the presentation of the descriptive statistics of the data that has been used in this study. Thereafter is the presentation of the results of the panel data regression models on the impact of health status on real per capita gross domestic product in Sub Saharan Africa. The regression models were estimated using Stata 10, regressing real per capita gross domestic product on life expectancy at birth, infant mortality rate, secondary enrolment rate, gross stock of capital, total labour force and urbanization rate.

4.0 Summary Statistics.

Table 5 below shows the summary statistics of the variables that have been used in this study. The variable that have been used include real per capita gross domestic product (PCGDP), secondary Enrolment rate (SER), infant mortality rate (IMR), life expectancy at birth (LEB), urbanization (URB), total labour force (TLF), gross stock of capital (GCF), per capita health expenditure (PCHE) and HIV and AIDS prevalence rate (HIVPR).

It is shown in table 5 that the average real per capita gross domestic product (PCGDP) is rising over time. The average growth rate in real per capita gross domestic product between the years 1995 and 2000 is 0.132 and that between 2000 and 2005 is 0.2155.However PCGDP is not stable enough because the standard deviation is greater than the mean for all the years (1995, 2000 and 2005). This shows that there is great disparity in real per capita income in sub Saharan African countries. One surprising thing about real per capita gross domestic product that can be observed from the table above is that the minimum value of real per capita gross domestic product has been declining, instead of rising over the years while the maximum values of real per capita gross domestic product has ever been rising.

This indicates that the gap between the rich and the poor is increasing in the Sub Saharan Africa region.

Table 5: The Summary Statistics for the variables used in the study

Variable	Mean			Std.Dev			Min			Max		
	95	**00**	**05**	**95**	**00**	**05**	**95**	**00**	**05**	**95**	**00**	**05**
PCGDP	1627	1842	2239	1749	2047	2584	485	359	420	7397	8517	9192
SER	26	27	30	21	20	17	5	6	9	98	93	75
IMR	94	92	90	28	24	24	50	50	46	176	159	150
LEB	49	46	45	6.7	5.7	6.9	32	38	35	60	57	57
URB	28.4	30.8	31.7	11.2	11.5	13.3	6.1	6.2	10	45	50.3	57
TLF	5.4	6.44	7.38	5.53	6.77	7.55	0.32	0.38	0.3	25.45	28	31.6
GCF	19	19	21	10	8	6	6	6.4	12.1	60.5	42.2	40.7
PCHE	29	26	48	35	34	80	5	3.4	4	135	130	37
HIVPR	6.4	11.4	8.4	5.56	9.2	8.3	0.1	0.1	0.5	18.1	36.1	25.9

Source: Own Calculations

Table 5 also shows that life expectancy at birth (LEB) has been decreasing over the years. The possible explanation for the decline in life expectancy is the HIV and AIDS pandemic which have had a devastating impact on the sub Saharan African countries. As reported by UNAIDS (2006), HIV and AIDS is the greatest cause of adult mortality in the Sub Saharan African region more especially in the Southern Africa where 34 percent of deaths in 2005 were related to HIV and AIDS. This can also be confirmed from the table above which shows that the HIV and AIDS prevalence rate (HIVPR) has been rising over the years. Infant mortality rate on the other has been going down. However, the rate of the decline in infant mortality rate (IMR) between the years 1995 and 2000 and between 2000 and 2005

was only -0.02 percent. This indicates that the Sub Saharan African countries are not doing very well in attempting to reduce the death of children. It is thus very unlikely that most Sub Saharan African countries will meet the target number five of the Millennium Development Goals to reduce child mortality by two thirds by the year 2015.

The average secondary enrolment rate (SER) has been rising over the years. This is an indication of the recognition of education as an important input to economic growth and development. This is because education brings about strong externalities of raising the productivity of both physical and human capital. Per capita health expenditure (PCHE) has also been rising over the years. However the standard deviation of per capita health expenditure has always been greater than its average over the years (1995, 2000 and 2005). This indicates that there is a great disparity among the Sub Saharan countries in terms of the amount of money spent per person. Urbanization (URB) and total labour force (TLF) has also been increasing over the years. The increasing number of people moving to the urban areas to the rural areas may indication some degree of industrialization. The increase in total labour force on the other hand reflects the increasing population in the Sub Saharan African countries.

We have grouped the countries according to whether they are below or above the median real per capita gross domestic product of 1065.68 United States Dollars. Out of the 25 countries in our sample, only ten countries have real per capita gross domestic product that lies above the median and the rest have real per capita gross domestic product that is below the median. If we group the countries in our sample according to the mean real per capita gross domestic product, it is surprising to observe that only five out of the twenty six countries have their real per capita gross domestic product above the mean. This is a clear manifestation of inequality in the distribution of income among the Sub Saharan African countries.

The table 6 gives the summary statistics of the health indicators according to whether they are below or above the median real per capita gross domestic product.

Table 6: Health Indicators according to the Median Real Per Capita GDP (PCGDP)

Indicator	Above the median PCGDP			Below the median PCGDP		
	Mean			Mean		
	1995	2000	2005	1995	2000	2005
Infant Mortality Rate	71.8	77.5	80	108.62	102.12	94.05
Life Expectancy	54.4	48.2	44.2	45.18	45.37	46.41
HIV Prevalence	6.51	15.81	12.67	15	8.6	6.54

Source: Own calculations

The tables above indicate that countries whose real per capita gross domestic product is above the median have on average lower infant mortality rates and higher life expectancy at birth than those below the median real per capita gross domestic product. However, it is surprising to note that despite having lower infant mortality rates and higher life expectancy on average, these health indicators are deteriorating for the countries above the median per capita real gross domestic product. On the other hand, the health indicators for countries below the median per capita real gross domestic product are improving. It is also surprising to observe that countries with the real per capita gross domestic product above the median are the ones that are registering increase in the prevalence rate of HIV and AIDS over the years. The average HIV and AIDS prevalence rate in the countries with real per capita real gross domestic product above the median is almost twice that of the countries with real per capita gross domestic above the median for the years 2000 and 2005. This is particularly the case because among the countries whose real per capita gross domestic product is above the median include Botswana, Lesotho, Namibia, and Swaziland whose HIV and AIDS prevalence rates were, 24.1, 23.2 19.6 and 25.9 percent respectively (refer to table 1 on page 8). These rates are among the highest in the world.

4.1 Results of the fixed effects estimation.

The regression models were estimated using Stata 10. We have used table 2 on page 4 to split the countries into two on the basis of the prevalence of HIV and AIDS. The first group comprised of southern African countries whose HIV and AIDS prevalence rate is above 10 percent. The other group comprises of the rest of the Sub Saharan Africa regions (East, Central and West). We have first run the regression for southern African countries, and then we have also run the regression for the rest of the Sub Saharan African regions. The dependent variable in the regressions is the logarithm of real per capita gross domestic product. The independent variables are the logarithms of infant mortality rate as an indicator of health, secondary enrolment rate, gross stock of capital, total labour force and urbanization rate. Thereafter, we also regressed the logarithm of real per capita gross domestic product on life expectancy at birth as another indicator of health and the rest of the variables are the same. This entails that we have four regressions whose results are presented by Tables 7 to 10.

Table 7: Regression output for Southern Africa with life expectancy at birth as an indicator of health

Dependent variable: Logarithm of real per capita gross domestic product

Variable	Coefficient	Std. Error	t-Statistic	Probability
LNLEB	-0.17993	0.64928	-0.28	0.788
LNSER	0.97232	0.37097	2.62	0.028**
LNGCF	0.05883	0.32434	0.18	0.860
LNURB	0.02748	0.53661	0.05	0.960
LNTLF	0.18106	0.61343	0.30	0.775
R-squared	0.7166			
Probability (F-Statistic)	0.0240			

** Indicates significance at 5 percent level

Table 8: Regression output for Southern Africa with infant mortality rate as an Indicator of Health

Dependent variable: Logarithm of real per capita gross domestic product

Variable	Coefficient	Std. Error	t-Statistic	Probability
LNIMR	0.95967	0.50355	1.91	0.089*
LNSER	0.667558	0.36487	1.83	0.101
LNGCF	0.00219	0.27224	0.01	0.994
LNURB	-0.36990	0.49395	-0.75	0.473
LNTLF	0.04848	0.40667	0.12	0.908
R-squared	0.8176			
Probability (F-Statistic)	0.0038			

- *Indicates statistical significance at 10 percent

Table 7 shows the results of the regression model of the Southern African countries with life expectancy at birth as an indicator of health. The R-squared which measures the goodness of fit of this regression model is 0.7166. This implies that the model on average explains over 71 percent of the variation in the logarithm of real per capita gross domestic product.

The results indicate that life expectancy at birth (LNLEB) is negatively related to real per capita gross domestic product. A one percent decline in the life expectancy at birth on average lead to a 0.17993 percent increase in real per capita gross domestic product holding other variables constant. This is contrary to the apriori expectation. However, among the possible explanations to this result include the prevalence of HIV and AIDS. As already

indicated, the Southern African countries are ones hardest hit by the prevalence of HIV and AIDS and this has resulted into deaths of millions of people. However despite the high prevalence rate of HIV and AIDS, most of the countries in Southern Africa have high real per capita gross domestic product. Such countries include Botswana, Swaziland, Lesotho and Namibia. Another possible explanation is the decline in the population that comes about due to the decline in life expectancy at birth. A decline in population with a constant or increasing real gross domestic product translates into an increase in real per capita gross domestic product. The result is however not statistically significant.

As expected, the coefficient of secondary enrolment rate (LNSER) is positive and statistically significant. A one percent increase in secondary enrolment rate will on average lead to a 0.97232 increase in real per capita gross domestic product holding the other variables constant. This result underscores the importance of education in improving the real per capita incomes of people in the Sub Saharan Africa. This result is not surprising because education increases the productive capacity and efficiency of people. This ultimately impacts positively on their incomes. Similar results were found by Bloom and Sevilla (2001). Masanjala and Papegeorgiou (2007) also argue that there is something in reading and writing that is essential to development.

The coefficient of gross capital stock (LNGCF) is positive. A one percent increase in gross capital stock will on average lead to a 0.05883 increase in real per capita gross domestic product. The result is consistent with the apriori expectation because capital is one of the important factors of production. Increasing capital results into an increase in output. The result is however not statistically significant.

We also find the coefficient of urbanization rate (LNURB) having a positive sign as expected. A one percent increase in urbanization rate will on average lead to a 0.02748 increase in the real per capita gross domestic product holding the other variables constant. This is in line with conventional thinking that urbanization is associated with industrialization. It is the industrialization that induces people to move from rural areas to urban areas in search for employment. Industrialization thus contributes positively to the increase in real per capita gross domestic product. The result is however not statistically significant.

The results of the regression model also find the coefficient of labour (LNTLF) positive but not statistically significant. A one percent increase in the total labour force on average lead to a 0.18106 increase in real per capita gross domestic product holding the other variables constant. This result is not surprising because labour is one of the important factors of production. Theory says that increasing the input labour in the production process tends to increase output and the proportionate increase depends on whether the production function exhibits constant returns, increasing returns or decreasing returns to scale.

Table 8 shows the results regression model for the Southern African region using infant mortality rate as an indicator of health. The results of this model are similar to the results from table 7. R-squared which measures goodness of fit of regression model is 0.8176. This entails that the model on average explains 82 percent of the variation in real per capita gross domestic product.

The results show that infant mortality rate (LNIMR) is positively and statistically significantly related to real per capita gross domestic product. A one percent increase in infant mortality rate on average lead to 0.95967 increase in real per capita gross domestic product. This is contrary to the apriori expectation. Just like the case with life expectancy at birth, the result can be justified on the basis of the devastating impact of HIV and AIDS in the Southern African region despite the fact that most of these countries have high real per capita gross domestic product.

The results also indicate that secondary enrolment rate has a positive though not statistically significant impact on real per capita gross domestic product. A one percent increase in secondary enrolment rate will on average result into a 0.66755 percent increase in real per capita gross domestic product holding other variables constant.

The coefficient of gross capital stock is also positive indicating the positive impact of capital on real per capita gross domestic product. A one percent increase in gross stock of capital will on average lead to a 0.0029 increase in real per capita gross domestic product holding other variables constant. The result is however not statistically significant.

Labour is also shown to have a positive impact on real per capita gross domestic product. A one percent increase in total labour force will on average lead to a 0.0488 increase in real

per capita gross domestic product holding other variables constant. The result is however not statistically significant.

The only exception is that urbanization rate is found to have a negative and statistically significant impact on real per capita gross domestic product. A one percent increase in urbanization rate will on average lead to a 0.3699 decline in real per capita gross domestic. This is a surprising result because urbanization is related to industrialization which increases the real gross domestic product of a country. However, Masanjala and Papegeorgiou (2007) found a similar result where Africans growth was significantly and negatively affected by the degree of urbanization.

Table 9: Regression output for the rest of the Sub Saharan African regions with Life Expectancy at birth as an indicator of Health.

Dependent variable: Logarithm of real per capita gross domestic product.

Variable	Coefficient	Std. Error	t-Statistic	Probability
LNLEB	0.75021	0.52698	1.42	0.169
LNSER	0.09716	0.09883	0.98	0.336
LNGCF	0.11347	0.08909	1.27	0.216
LNURB	0.29677	0.11771	2.52	0.019***
LNTLF	0.02237	0.04263	0.52	0.605
R-squared	0.4122			
Probability (F-Statistic)	0.0293			

- ***Indicates statistical significance at 1 percent

Table 10: Regression output for the rest of the African regions with Infant Mortality Rate as an indicator of Health.

Dependent variable: Logarithm of real per capita gross domestic product

Variable	Coefficient	Std. Error	t-Statistic	Probability
LNIMR	-1.16514	0.58041	-2.01	0.057*
LNSER	0.04849	0.09573	0.51	0.617
LNGCF	0.13175	0.08131	1.62	0.119
LNURB	0.28661	0.11323	2.53	0.019***
LNTLF	0.02636	0.04061	0.65	0.523
R-squared	0.4565			
Probability (F-Statistic)	0.0140			

- ***Indicates statistical significance at 1 percent
- * Indicates statistical significance at percent

Table 9 shows the results of the regression model for the other African regions (East, Central and West) where the prevalence of HIV and AIDS is lower (less than 10 percent), using life expectancy at birth as an indicator of health status. The table shows that R-squared is 0.4122 implying that the model on average explains 41 percent of the variation in real per capita gross domestic product.

The results from table 9 indicate that life expectancy at birth has a positive though not statistically significant impact on real per capita gross domestic product. A one percent increase in life expectancy at birth on average results into a 0.7502 increase in real per capita gross domestic product holding other variables constant. This result is consistent with the apriori expectation. This result is expected because as people live longer they tend to save and accumulate income. Weil (2006) argues that improvement in life expectancy

may induce people to save for retirement thus raising the level of investment and physical capital per worker. This result is also consistent with Bloom and Sevilla (2001) who used life expectancy as an indicator of health status and found that it has a positive and statistically significant effect on economic growth. Barro (1996) also found a positive and statistically significant impact of life expectancy at birth on growth rate in real per capita gross domestic product and argues that life expectancy proxies not only for health status, but also the quality of human capital.

Similar to the results from the other regression model in tables 8 and 9, we find secondary enrolment rate to have a positive impact on real per capita gross domestic product. A one percent increase in secondary enrolment rate will on average result into a 0.09716 increase in real per capita gross domestic product holding other variables constant. The result is however not statistically significant.

We also find gross capital stock to have a positive though not statistically significant impact on real per capita gross domestic product. A one percent increase in gross capital stock will on average lead to a 0.11347 increase in real per capita gross domestic product holding other variables constant. Labour force is found to be positively but not statistically significant impact on real per capita gross domestic product. A one percent increase in labour force will on average lead to a 0.02237 increase in real per capita gross domestic product holding other variables constant.

It is also shown in the results that urbanization rate has a positive and statistically significant impact on real per capita gross domestic product. A one percent increase in urbanization rate will on average lead to a 0.2967 increase in real per capita gross domestic product. This result is line with conventional knowledge that urbanization is associated with industrialization. It is industrialization that induces people to move from the rural areas to the urban areas in search for employment. Industrialization thus contributes positively to the increase in real per capita gross domestic product.

Table 10 is the presentation of the results of the regression model for the other African regions (East, Central and West) using infant mortality rate as an indicator of health status.

The table shows that R-squared is 0.4565 implying that the model on average explains 45.65 percent of the variation in real per capita gross domestic product.

As expected, the coefficient of infant mortality rate is negative and statistically significant. This implies that infant mortality rate has a negative impact on real per capita gross domestic product. A one percent decline in infant mortality rate will on average lead to 1.1651 percent increase in real per capita gross domestic product. A decline in infant mortality rate reflects an improvement in health of the entire population. Improved health status of people is an important component of human capital because healthier individuals are productive and work harder and more intensely. This ultimately results into an increase in real per capita gross domestic product.

Similar to the preceding results, gross capital stock is found to have a positively though not statistically significant impact on real per capita gross domestic product. A one percent increase in gross stock of capital on average lead to a 0.1317 increase in real per capita gross domestic product, holding other variables constant.

Secondary enrolment rate is also positively but not statistically significantly related to real per capita gross domestic product. A one percent increase in secondary enrolment rate will on average lead to a 0.0489 increase in real per capita gross domestic product holding other variables constant. Total labour force is found to have a positive though not statistically significant impact on real per capita gross domestic product. A one percent increase in total labour force will average lead to a 0.02636 increase in real per capita gross domestic product holding other variables constant. We also find urbanization rate to have a positive and statistically significant impact on real per capita gross domestic product. A one percent increase in the urbanization rate will on average lead to a 0.2866 increase in real per capita gross domestic product.

On the basis of the p-value of the overall model, all the regression models pass the F-test of overall significance at 5 percent level of significance. We reject the null hypothesis that the coefficients of the models are jointly equal to zero. This implies that the coefficients in the regression models are jointly significant.

CHAPTER FIVE

CONCLUSION AND POLICY RECOMMENDATIONS

5.0 Conclusion

The study set out to look at the impact of health proxied by life expectancy at birth and infant mortality rate on real per capita gross domestic product and in the Sub Saharan African region. The hypotheses that this study intended to test were two fold namely; Life expectancy at birth does not influence real per capita gross domestic product and Infant Mortality rate does not influence real per capita gross domestic product. A panel of twenty five Sub Saharan African countries was used in this study with data observed once in every five years for the years 1990 to 1995, 1995 to 2000 and 2000 to 2005. The countries in the sample were split into two groups on the basis of the prevalence of HIV and AIDS pandemic. These groups are the Southern African region where the prevalence of HIV and AIDS is above 10 percent for the countries in the sample and the rest of the Sub Saharan African regions (East, Central and West Africa) where the prevalence of HIV and AIDS is less than 10 percent for the countries in the sample. The models were estimated using fixed effects technique to control for country specific heterogeneity. An augmented Cobb Douglas production function transformed into a log linear function for ease of interpreting the coefficients as elasticities has been used in the study. Apart from life expectancy at birth and infant mortality rate, the other variables that have been used in this study include; secondary enrolment rate that captures education; gross capital stock; total labour force and urbanization rate.

The results of the regression models for Southern African countries indicate that life expectancy at birth has a negative but not statistically significant effect on real per capita gross domestic product. It has also been found that infant mortality rate has a positive and statistically significant impact on real per capita gross domestic product. On the contrary,

the regression models for the rest of the Sub Saharan African regions (East, Central and West Africa) indicate that life expectancy at birth has a positive but not statistically significant impact on real per capita gross domestic product. It has also been found that infant mortality rate has a negative and statistically significant effect on real per capita gross domestic product. The study has attributed the surprising relationship between the health indicators (life expectancy at birth and infant mortality) for Southern African countries to the high prevalence of HIV and AIDS in this region despite their high levels of real per capita gross domestic product.

The positive impact of life expectancy at birth on real per capita gross domestic product in the rest of the Sub Saharan African region is an indication that if people are expected to live longer, they tend to save their income thus raising the level of investment and physical capital per person. Higher life expectancy also induces people to invest in human capital. The increase in physical and human capital eventually results into an increase in real per capita gross domestic product. On the other hand, the negative impact of infant mortality rate on real per capita gross domestic indicates that improvement in the health status of the population result into an increase in people's productive capacity and this ultimately raises the real per capita gross domestic product.

It has also been found in all the regressions that secondary enrolment rate education has a positive effect on real per capita gross domestic product. The result is statistically significant in one of the regression. This result indicates that education is an important factor in determining the level of real per capita gross domestic product in the Sub Saharan African countries. This is because of the externalities related to productivity and efficiency that are associated with education.

The results also indicate that urbanization rate has a positive and statistically significant impact on real per capita gross domestic product for the two regression of the rest of the Sub Saharan regions. This result is also positive but not statistically significant for the regression model of Southern Africa where life expectancy at birth is an indicator of health. This confirms the conventional thinking that relates urbanization to industrialization. However, we have found a negative impact of urbanization rate on real per capita gross domestic product for the regression model of Southern Africa with infant mortality rate as a

health indicator. This is a surprising result and worthy its own investigation. Finally, the results also indicate the positive impact of total labour force and gross capital stock on real per capita gross domestic product. These results are however not statistically significant.

Policy Implications

Based on the findings of this study, there are several issues that need to be attended to by the policy makers to improve the real income per person in the Sub Saharan African region there by reducing the wide spread poverty that is prevalent among the people of the Sub Saharan African region. Improving real per capita gross domestic product is an important policy objective to undertake because this is in tandem with the first Millennium Development Goal (MDG) of eradicating poverty and extreme hunger, more particularly the target number one of the MDGs to halve between 1990 and 2015 the proportion of people whose income is less than 1 US dollar per day. The following are some of the policies that this study suggests should be undertaken in order to improve real per capita income of the people of the Sub Saharan African region.

One of the major findings of the study is that a decline in infant mortality rate is significant in improving the real per capita gross domestic especially for the other regions of the Sub Saharan Africa (East, Central and West). This study therefore recommends the need to put in place mechanisms that should reduce both infant and child mortality. It is necessary for policy makers to train a lot of health care personnel to provide both anti natal and post natal health care services to the expectant mothers. It is also important to ensure that most of the births are attended to by the trained midwives or the traditional birth attendants who have some basic knowledge and skill on child delivery. There is also a need for policy makers to consider making health care services accessible to the poor by constructing a network of health care facilities that should have drugs and other medical supplies readily available.

There is need for policy makers to put in place mechanisms that ensure that people live a longer and a productive life. Since it has been argued in literature, that the spread of HIV and AIDS in Sub Saharan Africa is the one that has reversed the decades of the

improvement in life expectancy, there is a need to make the life prolonging anti retro viral drugs available and accessible to all the people affected and in need of the drugs. There is also a need for the dissemination of information on HIV and AIDS to all the people of the Sub Saharan Africa so that they are equipped with the knowledge and services needed to avoid the infection. It is also imperative for the government to put in place voluntary counseling and HIV and AIDS testing centers so that people can know their HIV and AIDS status and adjust accordingly so that they live longer and productively.

The major finding of this study is the role of education in improving the real per capita gross domestic product of the Sub Saharan African countries. There thus a great need for the provision of quality education to all people in the region. Although the study only used secondary enrolment rate to capture education, the quality education should be provided and made accessible at all levels even at the very basic primary level. There is a great need for Sub Saharan African governments to ensure that all their citizen are at least able to read and write because this is not only essential for economic development but also an indispensable tool for people to emerge out of poverty.

Study Limitations and Direction for future Research

There are some areas where this study has fallen short. First is the issue of possible existence of endogeneity between real per capita gross domestic product and the indicators of health more especially life expectancy at birth. However since study involve a lot of countries, Weil (2006) argues that at the level of countries, it is difficult to find an empirically usable source of variation in health, either in cross section or time series, that is not correlated with the error term in the equation determining income. Thus it is difficult to find an instrument of health status that will easily apply in a cross country time series study like this one. It has also been difficult to use the prevalence of HIV and AIDS as an indicator of health status in our regression model because it was not possible to find this data for all the countries in our sample for the year 1995. This study has also not been able to fully explain why most of the Southern African countries have high HIV

and AIDS that result into high infant mortality rate and a decline in life expectancy despite their high real per capita gross domestic product. This shortcoming however is a possible area for future research.

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APPENDICES

APPENDIX 1: The correlation matrix for the regressors used in the study

	PCHE	SER	IMR	LEB	URB	TLF	GCF
PCHE	1.0000						
SER	0.7314	1.0000					
IMR	-0.3931	-0.5639	1.0000				
LEB	0.1603	0.3327	-0.5266	1.0000			
URB	0.4195	0.5760	-0.5099	0.4809	1.0000		
TLF	-0.3204	-0.2428	0.0793	-0.1926	-0.2351	1.0000	
GCF	0.3471	0.3580	-0.4514	0.2232	0.2661	-0.1709	1.0000

APPENDIX 2 : Regression output for all the countries in the sample with infant mortality rate as an indicator of Health

Dependent variable: Growth rate in real per capita gross domestic product

Variable	Coefficient	Std. Error	t-Statistic	Probability
LNSER	0.05831	0.07677	0.76	0.452
LNIMR	-0.39932	0.15637	-2.55	0.015***
LNGCF	0.17179	0.07051	2.44	0.020***
LNURB	0.10470	0.094328	1.11	0.274
LNPCHE	0.02791	0.06231	0.45	0.657
LNTLF	0.18743	0.06317	2.97	0.005***
R-squared	0.4365			
Probability (F-Statistic)	0.0008			

*** Indicates significance at 1 percent level

APPENDIX 3 : Regression output for all the countries in the sample with life expectancy at birth as an indicator of Health

Dependent variable: Growth rate in real per capita gross domestic product

Variable	Coefficient	Std. Error	t-Statistic	Probability
LNSER	0.06335	0.07933	0.80	0.430
LNLEB	-0.48767	0.18855	-2.59	0.014***
LNGCF	0.21082	0.07195	2.93	0.006***
LNURB	0.06643	0.09368	0.71	0.483
LNPCHE	0.01269	0.06384	0.20	0.843
LNTLF	0.18912	0.06297	3.00	0.005***
R-squared	0.4132			
Probability (F-Statistic)	0.0016			

*** Indicates significance at 1 percent level

APPENDIX 4: Regression output for all the countries in the sample with Infant Mortality rate as an indicator of health.

Dependent variable: Logarithm of real per capita gross domestic product.

Variable	Coefficient	Std. Error	t-Statistic	Probability
LNSER	0.19175	0.10898	1.76	0.087*
LNIMR	0.55611	0.21959	2.53	0.016***
LNGCF	0.15849	0.10012	1.58	0.122
LNURB	0.18867	0.14574	1.29	0.203
LNPCHE	0.21738	0.08721	2.49	0.017***
LNTLF	0.14183	0.07198	1.97	0.056**
R-squared	0.6103			
Probability (F-Statistic)	0.0000			

*** Indicates significance at 1 percent level

** Indicates significance at 5 percent level

* Indicates significance at 10 percent level

APPENDIX 5: Regression output for all the countries in the sample with life expectancy at birth as an indicator of health.

Dependent variable: Logarithm of real per capita gross domestic product

Variable	Coefficient	Std. Error	t-Statistic	Probability
LNSER	0.1591005	0.1062186	1.50	0.142
LNLEB	0.8383834	0.2626365	3.19	0.003***
LNGCF	0.1174062	0.0968026	1.21	0.233
LNURB	0.1901716	0.137129	1.39	0.174
LNPCHE	0.2498531	0.0847615	2.95	0.005***
LNTLF	0.1373661	0.0687949	2.00	0.053*
R-squared	0.6410			
Probability (F-Statistic)	0.0000			

*** Indicates significance at 1 percent level

* Indicates significance at 10 percent level