THE ROLE OF HEALTH ON ECONOMIC GROWTH IN SUB-SAHARAN AFRICA

(1990-2011)

UZOMA OBINNA AUSTIN

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MAY 2014

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BY

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A RESEARCH PROJECT SUBMITTED TO THE

DEPARTMENT OF ECONOMICS AND DEVELOPMENT STUDIES,

SCHOOL OF SOCIAL SCIENCES,

COLLEGE OF DEVELOPMENTAL STUDIES

COVENANT UNIVERSITY

OTA, OGUN STATE

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE BACHELOR OF SCIENCE (HONOURS) DEGREE IN ECONOMICS

MAY 2014

DECLARATION

I declare that this research project is based on an original study undertaken by me UZOMA OBINNA AUSTIN in the Department of Economics and Development Studies, School of Social Sciences, College of Developmental Studies, Covenant University, Ota, Ogun State under the supervision of Mrs. O. Ogundipe. The ideas and views of the research project are outcomes of the research conducted by me, where the ideas and views of other researchers have been expressed, they have been duly acknowledged.

CERTIFICATION

I hereby certify that this research project, written by UZOMA OBINNA AUSTIN was supervised by me and submitted to the Department of Economics and Development Studies, School of Social Sciences, College of Developmental Studies, Covenant University, Ota, Ogun State.

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MRS .O. OGUNDIPE
Project Supervisor

Signature and Date

……..

Dr. P. O. ALEGE
Head of Department

Signature and Date

DEDICATION

I dedicate this research work to the glory of the only wise and gracious loving God who had brought my humble self this far in my academic pursuit and also to my lovely and highly efficient parents, Chief and Mrs. A. O Uzoma.

ACKNOWLEDGEMENTS

I use this privilege to acknowledge the Almighty God for His mercies, grace and faithfulness in my life and also the Holy Spirit for His divine direction.

The completion of this work is dependent on a lot of people aside my humble self and I wish to acknowledge a few of these people who had contributed immensely.

The Chancellor, Dr. David Oyedepo, whose great life inspiring words and success strategies I am currently building and walking in and also for diligently pursuing the vision of Covenant University, which I am a beneficiary. The Vice-Chancellor, Prof. C. K. Ayo whose succinct words have inspired me to greatness. The Dean, College of Developmental Studies, Prof. O. Olurinola, who's efficient teaching style has improved my analytical and life skills, may the Almighty God reward you greatly Sir. The Head of Department, Economics and Development Studies, Dr. P. O. Alege whose practical and effective teachings has really exposed my attitude of thinking to real life phenomenon(s), thank you Sir.

To my supervisor, Mrs. O. Ogundipe, who through her patience and encouragement saw that this research work is efficiently completed, Ma, I appreciate the life lessons, advice, support, and warm hospitality you showed throughout, it has really been a great, impactful and lovely experience working under your supervision. I am deeply and candidly grateful and thankful to God for your life. May God bless you Ma and increase you in every area of your life. I also want to thank my fellow supervisees Rebecca, Ohunma and Esther for their co-operation and support as a team throughout this research work.

To my lecturers, Dr. Okodua who has highly impacted my life as an economist, Mr. Ogundipe who through his econometric skills saw that this research work is completed, Dr. Ewetan, Dr. Urhie, Dr. Campbell, Dr. Adewole, Mr. Stephen, Mr. Alejo, Mrs. Matthew, Mr. John and all other lecturers and staff of the Economics Department for all your inputs during my stay here, I am candidly and deeply grateful.

My first economists, my parents, Chief and Mrs. Austin .O. Uzoma, I will forever remain grateful and thankful for all the love, prayers, decisions, support, encouragement, efforts, time, resources and good qualities instilled in me to see that your small boy becomes a great man, I love you both deeply and beyond your expectations. My two wise brothers, Dozie and Chidera and my lovely sisters, chinenye and chidinma who have really encouraged and made me smile, I say thank you and I love you all. To my great uncles, Anayo, Sunday and Emeka whom has always believed in me even when there seems to be nothing, I am grateful and also my Aunties, Ngozi, Uche, Alice, Mercy and Charity I want to say thank you for all your good wishes and kind words. To my cousins, Nnaemeka, Izunna, Chiamaka, Nneka, Chioma, Uche and Ike I say thank you for all your support. To my brother in-law, Engr. Ogbonnaya Igboke, I am truly grateful for your words of encouragement and support, may God reward you.

To my F.G.C Okposi family, Okonkwo Chibuzor, Lotachukwu, Ogonna John, Udochukwu, Chinonso, Amos, Praise, Kosi and also my friends especially, Chidindu, Comfort, Amaechi, Ukachi, Chidi, Chimaobi, Favour, Rhoda, Nonye and others, thank you all for your support, advice and prayers, I am really grateful.

To my teachers, Mrs. S.E. Amiara, Mr. Nwakile, Mrs. Ozougwu, Mr. Victor Ani and Mr Legacy whom through their great teaching and discipline saw that this small boy is where he is today, I owe you all and I am truly grateful for all your efforts, support and hard work towards me.

I am deeply grateful to Akinola Oluuwafemi who had really being my spiritual father and a great friend and has always seen that my light never goes down. I also appreciate the significant contributions of my friends, Afolabi Oluwasegun (A man of great talents), Amarie Michael, Umezinne Izunna, and Iyangbe Ehiremen to both my academic pursuit and my life in Covenant University. I also want to use this medium to say a big thank you to Akinmuda Simileoluwa who had

through her smart ideas, thoughts and supports seen that this research work is accomplished. Also, I want to thank Ukonu Paul for all his support throughout my stay here.

To my fellow students in economics, Radiance, Jachike, Adimekwe Uchenna, Ajayi Jide, Omobola, Tunde, Jumoke, Daniel, Amaka, Joses, Nchedo, Nneoma, Chima, Nkwocha Paul, Egwede, Tosin, Bisola, Amaka, Michelle, Woroma, Tomi, Jonathan, Binga, Seun, Shem, Elvis, kachi, Tobi (TH), Jibola, Fisayo, Jerry, Bestman, Ifeanyi, Kolapo and others who in one way or the other supported and highly contributed in my success and also saw that God's will for my humble life is fulfilled, thank you all.

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ABSTRACT

This study empirically examines the role of health on economic growth in Sub-Saharan Africa using a panel data from 1990 to 2011. The study employed a panel data analysis in which the random effects model was used to examine the relationships among variables. Each of the explanatory variables were tested for multicollinearity using the Variance Inflation Factor (VIF) which was not found among variables, and other tests such as the Hausman test which showed that the random effects model is the most preferred, the heteroskedasticity test which was also conducted using the Modified Wald test and found the presence of heteroskedasticity which was corrected in the model and the random effects test using the Breush-Pagan lagrange multiplier. The random effects model results show that health in terms of life expectancy has an inelastic and significant influence on gross domestic product per capita while in terms of the prevalence of HIV showed an inelastic but did not have a significant influence on gross domestic product per capita. Another important result is that economic growth had a positive relationship with gross fixed capita formation, secondary school enrolment and the prevalence of HIV while it had a negative relationship with total labour force and life expectancy. Thus, we conclude that although health in terms of mortality and morbidity had an inelastic relationship on gross domestic product per capita, mortality showed a significant influence while morbidity had no significant influence on economic growth in Sub-Saharan African.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

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

According to WHO (2013) the determinants of health include: the social and economic environment, the physical environment, and the person's individual characteristics and behaviour. The Sub-Sahara Countries in Africa include most of the countries located south of the Sahara, which is most of Africa. According to Afro Central (2013), "these countries are considered extremely rural with little or no power generation to the sparse communities, making health care a luxury often unheard of or not even thought about. Much of the culture is steeped in ancient rituals and tradition and are non believers in modern medicine and general health care". This describes the attitude of people towards modern Health care services as they still prefer their traditional and ancient health care services. Health also plays an important role in economic growth, as the saying goes 'Health is Wealth'. Health is a determinant of human capital as according to Barro (1996) health is 'a capital productive asset and an engine of economic growth'. Also, human capital formulation which consists of health and education leads to the attainment of economic growth as according to Grossman (1972), Bloom

and Canning (2000) individuals who are healthy in terms of assimilating knowledge are more efficient and as a result of this obtain higher productivity (Rico, Turrbiates and Hernandez, 2005).

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

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

According to WDI (2013) an estimated 287,000 maternal deaths occurred worldwide in 2010, all but 1,700 of them in developing countries, that is, about 285300 maternal deaths occurred in developing countries. More than half of maternal deaths occur in Sub-Saharan Africa and a quarter in South Asia. Reducing maternal mortality requires an understandable approach to the reproductive health of

women which ranges from adequate family planning and access to the use of contraception. According to WDI (2013) women who give birth at an early age are likely to bear more children and are at greater risk of death and serious complications from pregnancy. The adolescent birth rate is highest in Sub-Saharan Africa and is declining slowly.

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

In recent decades, the Sub-Saharan Africa has attracted global attention as international institutions have come together in order to curb or combat the major problems facing it. From the facts above, it is clear that apart from the fact that these problems exist in Sub-Sahara Africa they also have the lowest response rate and this brings to play the role of institutions in the attainment of economic development via health. In order to ensure that growth and development takes place in an economy, economic stability and certainty have to be guaranteed in a society in order to attract investors and this can only be achieved in a society with good governance and political stability. It is now the role of institutions to direct the activities and transactions carried out by different players with respect to their economic, political and social environment if development is to take place.

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

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

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

Sorkin (1977); Rico et al. (2005) shows the various channels in developing nations through which economic development could be impacted through health. The gains from productivity and through

the improvement in the hours of work are the first way through which health could impact economic development. Also, the development of previously unsettled regions is made possible. Lastly, this could also be seen through the turnaround in people's attitude through the improvement made in innovation and entrepreneurship. Good health plays an important role in the attainment of economic development.

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

1.1.1 Overview of Health in Sub-Saharan Africa

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

According to the Macroeconomics and Health Commission Report (2001) three million people died of AIDS in the year 2000 and about 2.4 million of these deaths were in sub-Saharan Africa.

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

According to World Development Indicator (2013) looking at the MDG 4 which is to reduce child mortality, in developing countries the under-five mortality rate fell from an average of 95 per 1000

per live births in 1990 to 56 in 2011, but rates in Sub-Saharan Africa and South Asia remain much higher.

According to WDI (2013) an estimated 287,000 maternal deaths occurred worldwide in 2010, all but 1,700 of them in developing countries. More than half of maternal deaths occur in Sub-Saharan Africa and a quarter in South Asia.

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

1.2 Statement of the Research Problem

Health is a necessary and sufficient asset in the promotion of an individual's wellbeing as it addresses the essential aspects of life and this can be seen in (WHO, 1946) definition of health as the complete physical, mental and social wellbeing and not only concerned about the presence and absence of diseases. The present state of health in Sub-Saharan Africa has been an issue that has drawn the interest of many researches, institutions and some countries as this not only affects Sub-

Saharan countries but is a major global issue. This can also be seen in the UN's MDGs, where out of eight MDGs three were set aside to address the issue of health (reduce child mortality, improve maternal health and combat HIV/AIDS, malaria and other diseases by 2015).

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

The question that comes to mind is if proper attention and priority has been given to this region due to the high prevalence of this health challenges, why has it not significantly increased? Why has it responded relatively low? Why has the inefficiency rate been high? From, previous studies health has been represented by indicators such as life expectancy, under-5 mortality rate, infant mortality rate and adult survival rates but this tend to show the mortality while little or no regard has been placed on the morbidity rate which is the frequency or presence of illness in one's life time and this issue or gap though suggested as further studies in various research works has not really been addressed. Therefore, since Economic growth is all about the increase in the output and the efficiency to which these outputs are produced, in order to examine the role of health on economic growth in Sub-Saharan Africa there is a great necessity to take into cognizance both the mortality and morbidity of the populace.

There is need to address these morbidity issues as well as mortality issues so as to come out with appropriate policies to be implemented which aim at achieving sustainable growth and development in Sub-Saharan Africa.

1.3 Scope and Limitation of the Study

This study seeks to examine the role of Health on Economic growth in Sub-Saharan Africa. Therefore, the scope of this study is limited to 38 out of 44 countries found in the Sub-Saharan Africa region from 1990-2011 and these countries are Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo, Rep. , Cote d'Ivoire, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Kenya, Lesotho, Madagascar, Malawi, Mali, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, South Africa, Swaziland, Tanzania, Togo, Uganda, Zambia and Zimbabwe.

1.4 Research Questions

This research work attempts to give answers to the following questions:

1. To what extent has life expectancy contributed to the economic growth in Sub-Saharan Africa?
2. In what way has the prevalence of HIV/AIDS impacted economic growth in Sub-Saharan Africa?
3. Why has the state of health been relatively low despite the policy and efforts made towards this goal in Sub-Saharan Africa?

1.5 Objectives of the Study

The main purpose of this study is to provide an empirical investigation of the general consensus that good Health often leads to economic growth as the role of health on economic growth in Sub-

Saharan Africa taking cognizance of both mortality and morbidity would be examined. This can be narrowed down into specific objectives as follows:

1. To examine the extent to which life expectancy has contributed to economic growth in Sub-Saharan Africa.
2. To measure the impact the prevalence of HIV/AIDS will have on economic growth in Sub-Saharan Africa.
3. To identify the reasons for the slow response towards the improvement in the state of health in Sub-Saharan Africa.

1.6 Hypothesis of the Study

The research hypotheses to be tested in this study are as follows:

Hypothesis I

H_0: There is no significant relationship between life expectancy and economic growth in Sub-Saharan Africa

H_1: There is a significant relationship between life expectancy and economic growth in Sub-Saharan Africa

Hypothesis II

H_0: There is no significant relationship between the prevalence of HIV/AIDS and economic growth in Sub-Saharan Africa

H_1: There is a significant relationship between the prevalence of HIV/AIDS and economic growth in Sub-Saharan Africa

Where H_0 is the null hypothesis while H_1 is the alternative hypothesis

1.7 Definition of Terms

The following terms used during the study are explained below:

1. **Economic Growth**

Economic Growth can be defined as a quantitative sustained increase in the per capita output or income of a country supplemented by an increase in labour force and capital.

2. **Health**

Health for the purpose of this study refers to a complete state of an individual's wellbeing taking into consideration both the mortality and the morbidity aspect.

3. **Life Expectancy**

Life expectancy in this study captures the mortality aspect of health and it refers to the average length or number of years a newborn is expected to live given the prevailing mortality rate.

4. **Morbidity**

Morbidity can be defined as the presence or frequency of illness in an individual's life time, that is it accounts for the quality of one's life.

5. **Prevalence of HIV**

According to WDI (2011), Prevalence of HIV is 'the percentage of people ages 15–49 who are infected with HIV'. It captures the morbidity aspect of health.

1.8 Significance of Study

The state of health in Sub-Saharan Africa is an issue being addressed; yet, progress made towards substantial improvement in health in this region has had relatively low response. Therefore, this study is aimed at examining the role of health on the economic growth of Sub-Saharan Africa and will aid

policy makers in recommending the policy geared towards increasing the likelihood of the chance of living through increased life expectancy as well as reducing the morbidity rate through the reduction of the prevalence of HIV as this will not only see that the role of health on economic growth in Sub-Saharan Africa is actualized but will also contribute in the direction of driving the MDGs (4, 5 & 6).

1.9 Methodology

A panel data analysis covering the period 1990-2011 would be used in estimation as this would be looking at the 38 countries in Sub-Saharan Africa. In addition to this the STATA 10 statistical software would be used for the econometrics part of this research work.

1.10 Data Sources

The secondary source of data will be used as data would be gotten from World Development Indicators database. Other sources would be updated during the course and on completion of the research project.

1.11 Outline of Chapters

Chapter one deals with the general introduction of the study with focus on the background to the study, statement of the problem, research questions, objectives of the study, hypothesis of the study, scope of the study, definition of terms, significance of the study, methodology of the study, sources of data, as well as a brief synopsis of each chapter.

Chapter two will focus on review of conceptual, theoretical, empirical and methodological issues with respect to the role of Health on Economic Growth in Sub-Saharan Africa.

Chapter three focuses on theoretical framework, nature of research method, model specification, and introduction of variables to be used in the estimation technique as well as the research instruments employed.

Chapter four constitutes the empirical analysis – data presentation and statistical analysis using Panel Data Analysis, and presentation of results, as well as interpretation of results obtained via prescribed research instruments.

Lastly, **Chapter five** will present the summary, conclusion and policy recommendations to be adopted, and suggestions for further study. The limitations to the study will also be cited.

CHAPTER TWO

LITERATURE REVEIW

2.0 Introduction

Health is a very important, germane and vital human capital input necessary for the attainment of economic growth and development as it deals with almost all aspects of the human life be it physical, mental, social or economical, therefore its role in achieving a sustainable growth and development cannot be overlooked.

Human capital in the past has been viewed as being made up of education until recently where various works, nations and institutions tend to focus on the subject matter of health. Health has become a global issue as it deals with the welfare and productivity of individuals thereby attracting attention as can be seen in the Millennium Development Goals (MDGs) adopted by 189 countries following the signing of the United Nations Millennium Declaration in 2000 where out of 8, MDG 4, 5 and 6 where directly related to health. The Sub-Saharan Africa region due to the high prevalence of illness has attracted the highest attention so as to attain these goals but despite these efforts made towards attaining these goals, it has been observed that relative to other regions this region has shown the slowest response and has limited the level of progress.

This chapter seeks to look into the definitional/conceptual issues, the theoretical issues and the empirical/methodological issues on the role of health on economic growth in Sub-Saharan Africa.

2.1 Review of Definitional/Conceptual Issues

2.1.1 Health and Economic Growth

The relationship between health and economic growth is one that has drawn the interest of various researchers, institutions and nations as health being a very important human capital input is also a determinant of economic growth and development. A main feature of this relationship is the two way

causation between health and the economy as better heath encourages economic growth through an increase in productivity as a healthy workforce is more efficient and also economic growth can also encourage more accumulation of health capital (Barro, 2013). In examining some works focusing on the relationship between health and economic growth, there tend to be a general consensus on a positive relationship as this can be seen in the works of Baker (1998), Weil (2006), Canning (2005), Rico et al. (2005) and others.

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

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

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

2.1.2 **Human Capital and Economic Development**

Human capital refers to those human capacities that aid or is required to enhance productivity and economic development. Human capital majorly consists of health and education and these are vital inputs to the aggregate production function and are essential components of growth and development. The role of human capital as a major catalyst for long term growth and development as universally regarded cannot be overemphasized; therefore proper consideration should be given to the human capital inputs if sustainable growth and development is to be actualised. Poor countries or developing countries find great difficulty in competing with highly developed countries due to their low human capital stock and if this is to be actualised, there must be an increase in the human capital stock towards the direction of these developed countries.

The study of human capital has been attributed or directed to schooling (education) factor until recently where studies now tend to direct or focus on health as a variable of interest and an important human capital input. Some researchers such as Gallego (2000) have explained this neglect of health as a result of the lack of combination or integration between health economics and economic growth (Rico et al., 2005).

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

Therefore, there is need for a simultaneous investment as a nation as one cannot focus on health (education) not considering education (health).

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

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

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

2.1.3 Health linkages to Economic Development

According to Research Analyst, DSAED (2010) economic development may lead to better health as wealthier countries have a greater chance and capability to invest in health care and public health measures, this relationship can be viewed the other way round as improvements in health can

contribute to economic development through a number of path, channel or reasons such as an increase in productivity as better health improves or enhances workers productivity as days taken out of work due to illness are lesser and this brings about an increase in output. This can also be applied to a family setting where improved health of family members reduces the direct costs incurred as a result of the time lost to taking care of family members.

Another channel is through reduced family size as this reduces the number of dependants in the country leading to an increase in the workers to dependants' ratio and this increase the national savings and according to the Harrod-Domar growth model this ought to improve growth by providing more new investments.

Increase in the level of investments is a channel by which health can contribute to economic development and this can be viewed via capital accumulation as healthier individuals tend to save more and this increases growth. Also, a healthy environment attracts tourist and this adds to the Gross Domestic Product (GDP) as According to the World Travel and Tourism Council, Tourism's direct contribution to Gross Domestic Product (GDP) in 2012 worldwide was USD2.1 trillion. Well educated or healthier workforce also serves as an incentive for companies to invest.

As the saying goes "prevention is better than cure", reduction in the cost of illness can be seen as a channel as it has been observed that the cost of preventing an illness is lesser than the cost incurred in curing it. This enhances efficiency as it makes available capital for other productive uses in the future in which government can invest in. In all aspects, for any economic agent be it the individual, firm or government prevention is better than cure as it improves welfare and enhances efficiency. Increase in Human capital is another channel through which health could contribute to economic development as healthier children tend to profit more from schooling as they are less absent from school and also proper nutrition in the early stages of childhood enhances the mental ability.

Health investments as seen above leads to economic development other things being equal and investing in health does not necessarily mean an increase in health care expenditure (public or private) but ensuring that those investments are made in an equitable and efficient manner in order to yield the desired result. Casasnovas, Rivera and Currais (2007) looked at some benefits of investing in health especially in developing nations where health care delivery and response has been low.

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

Investment in health also leads to an outward shift in the production possibility curve/boundary/frontier of the society as workers are healthier, standard of living is increasing and the per capita income is also increasing.

Investing in health in most developing world leads to higher labour productivity as the nation experiences a healthier workforce and this leads to efficiency and income as a result of lower absenteeism and reducing human capital losses for the economy.

Looking at investing in a population's health and its impact on the inflow of foreign capital, Bell and Lewis (2004) suggest that the high risk of environments as a result of some communicable disease such as SARS (severe acute respiratory syndrome) as it reduces the inflow of foreign capital through tourism since it wards off investors and visitors (Jack and Lewis, 2009).

2.1.4 Health and Labour Productivity

A labour force lacking a minimum level of health and education cannot maintain a continuous or sustainable growth therefore; there is a need to improve the quality of the labour force via human capital development in order to enhance labour productivity and efficiency. Health also increases

productivity and success in education as healthy children are able to learn better, have better education, are less absent due to illness and also earn higher as adults.

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

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

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

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

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

measures have been developed to address the health challenges in the world today but despite these level of development some nations in particular developing nations are still been affected at a high rate by these challenges. The Sub-Saharan Africa region is not left out in this issue as relative to other regions of the world, evidence has shown that this region has shown low response.

The various health challenges faced by developing countries according to WHO; Todaro and Smith, (2011) include: Absolute poverty, Malnutrition, HIV/AIDS, Malaria, Tuberculosis, Acute lower respiratory infections, Hepatitis B, Ascariasis, Cholera, Dengue, Leprosy (Hansen disease), Dracunculiasis (guinea worm disease), Chagas disease, Leishmaniasis, Lymphatic and filariasis (elephantiasis). Reducing or curbing the prevalence of these illnesses cannot happen on its own therefore there is need for a collective effort by both the affected areas and other donors to eradicate this global challenge.

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

2.1.5.1 Tuberculosis (TB)

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

According to WHO (2001), an estimate of about one-third of the world population is infected with TB bacillus and between 5-10% of people infected with TB become ill at some stage of their lives;

also, if this is not controlled efficiently, about 35 million persons in the next 20 years will die (Working Group 1 of the Commission on Macroeconomics and Health, 2002).

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

2.1.5.2 Malaria

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

There have also been long term effects on education and productivity outcomes for children who were presented from exposure to malaria via the DDT program which is an insecticide effective for the use against malaria-causing mosquitoes. Bleakley (2006) looking at the effect of childhood

exposure to malaria on income level as an adult in four countries (United States, Mexico, Columbia and Brazil) saw that a very large effect was found as the removal of childhood malaria via the DDT intervention increased adult earnings by about 50 percent and this was also extended by Cutler et al (2007) in India in the 1960s and significant effects was found based on the education outcomes of children that were prevented from malaria (Bloom and Canning, 2008)

2.1.5.3 HIV/AIDS

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

AIDS can also reduce the returns to capital especially human capital and this is because of the high mortality and limited or reduced life span due to AIDS. AIDS could also reduce the level of trust in a community and also according to Haacker (2004) could have long term consequences for social capital (Bloom and Canning, 2008).

Examining the economic implications of HIV/AIDS we can evaluate that there could be a positive or negative implication though the negative significantly outweighs the positive. Looking at the negative implications, HIV/AIDS can increase the level of health spending thereby incurring a higher opportunity cost as it reduces the level of investments to be made to other growth-driven areas, education and infrastructure. It can also reduce the attractiveness of the economy to foreign investors as a result of low productivity and could also reduce the tax revenue. It could also increase the dependency level of the economy since a high mortality of the youths is experienced. On the other hand, HIV/AIDS could have positive implications for an economy as it reduces the rate of

unemployment since workers who die as a result of this disease could be replaced by previously unemployed persons thereby opening up employment opportunities and reducing the proportions of the unemployed labour force. Also, although output can be decreased via HIV/AIDS mortality, the population is also reduced and this may not reduce the per capita productivity meaning that GDP per capita may not reduce (Working Group 1 of the Commission on Macroeconomics and Health, 2002).

According to UNIAIDS (2000) evidence has shown that a rise in the prevalence rates of HIV/AIDS leads to a significant decline in both total and growth in GDP (Working Group 1 of the Commission on Macroeconomics and Health, 2002).

2.2 Review of Theoretical Issues

Based on theory, Grossman (1972), Mankiw et al. (1992), Barro (1996) have developed models in which health capital is seen as a significant variable for economic growth. The various theories relating to the issue of health and economic growth are shown below.

Grossman theory of the demand for health care

Grossmann (1972) developed a theory of the demand for health care that was concerned with the way by which individual resources are allocated to produce health and also has the idea that individuals are not only consumers but also producers of health. The model also has the idea of investing in human capital which consists of health and education. Health here is seen as a capital good that can depreciate at a non-constant rate. The role of variables such as age, income and education on the demand for health care was recognised as ageing raises the depreciation rate thereby increasing the cost or price of human capital causing individuals to reduce the demand for health care but the demand for health care can also increase due to the inelastic demand curve for health. Education plays a germane role in contributing to the efficiency of human capital which raises the demand for health care and also the health stock since better educated persons demand more health care due to the presence of knowledge and awareness about the value. Income also increases the ability of an

individual to demand for health care as they have more resources to devote to healthcare and other activities.

Some key assumptions to this model are: individuals value their health but their behaviour does not show that they have it above every other thing else if not, they would not smoke too much, drive too fast or drink too much. The second assumption is that individuals have limited income to finance both health and other goods or activities. The third assumption is that individuals have much control over their health as they can influence their way of consumption, the way they utilize their health and their environment. Grossman's model on the demand for health also viewed health demand as comprised of two elements which are the consumption and investment effects. The consumption effects has a direct effect or satisfaction and are mostly short term in nature for example one may eat good food just to feel better and healthier while the investment effect has a long term effect or an indirect utility for example one may engage in good exercise just for increased life span.

According to Dolan (2003) some of the criticisms of the model include the assumption that health care is a constant life time investment, the insurance markets were not recognised, perfect information is assumed on the part of consumers about the MEC (marginal efficiency of capital) of health care, depreciation and interest rate now and in the future and it is also deterministic by bringing in the choice of when to die.

The Solow neoclassical growth model

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

The model implies that economies will conditionally converge to the same level of income if they have the same rates of savings, depreciation, labour force growth and productivity growth. The Solow growth model is a modification of the Harrod-Dormar growth model as it allows for

substitution between capital and labour assuming that there are diminishing returns to these inputs. Also, the long run rate of growth is exogenously determined.

Mankiw et al. (1992) added human capital as a variable that has a significant impact on economic growth and this was an improvement on the Solow growth model. This was also found in the works of (Rico et al., 2005) and (Bloom et al., 2004) used the Solow growth model with human capital added to it.

In 1996, Barro developed a growth model where physical capital inputs, the level of education, health capital and the quantity of hours worked where included and he also observed that a rise in health indicators and human capital raises the incentives to invest in education and lowers the rate of depreciation on health respectively and this shows the existence of a diminishing marginal returns to investment in health (Gallego, 2000; Rico et al., 2005).

Some of the criticisms of the Solow neoclassical growth model include: lack of strong empirical support for the model as it has been observed that developed economies have grown faster than developing countries and this contradicts the convergence expectation except for exceptional countries like Japan that appear to have converged with developed economies, failure to take account of innovation or entrepreneurship and the strength of institutions which helps in driving growth. It also does not explain how or why technological progress occurs.

The endogenous growth theory

This theory assumes that long-run economic growth rate is determined by internal forces in the system. This is measured by the growth rate of output per person and depends on the growth rate of total factor productivity (TFP) which is determined in turn by the rate of technological progress.

The endogenous growth theory made some suggestions on the links through which the rate of technical progress i.e. the long run rate of economic growth can be influenced by economic factors

such as the innovation mechanism through which technological progress takes place and this could be in the form of new products processes and markets.

This first version of the endogenous growth theory was AK theory by Frankel (1962) which lacked a clear separation between accumulations of capital and technological progress. The second version was the "innovation –based" growth theory which took into cognizance intellectual capital as a source of technological progress as separation was made between physical and human capital which were accumulated through schooling and saving, and intellectual capital which was through innovation. This version was developed by Romer (1990). Another version is the 'Schumpeterian' theory developed by Aghion and Howitt (1992) and Grossman and Helpman (1991) where imperfect markets and research and development were added to the model.

There are various criticisms to this model but one major one is the lack of empirical literature to explain the conditional convergence and this can be seen in Paul Krugman's critic of the endogenous growth theory that "too much of it involved making assumptions about how un-measurable things affected other un-measurable things".

2.3 Review of Methodological and Empirical Issues

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

2.3.1 Empirical issues

Barro (1996, 2013) in his empirical work suggested that health status as measured by life expectancy or other similar macro indicators is a better predictor and an important contributor to later growth than initial education. This shows the significance of health in attaining future growth. Also, Barro (1997) also showed that life expectancy is significantly correlated to subsequent economic growth as

1 percent increase of life expectancy could raise economic growth by 0.4 percent yearly(Working Group 1 of the Commission on Macroeconomics and Health, 2002). Weil (2001) using a calibration process measured the relationship between health proxy with adult survival rates and labour productivity across countries. His result showed that one percentage (1%) point increase in adult survival rates resulted into 1.68 percentage increase in labour productivity and that health differential which accounted for about 17 percent of the variation in output per worker across countries had roughly the same magnitude with respect to the differences accounted by physical capital (18 percent) and education (21 percent). This shows that health is a pertinent form of human capital and requires an equal attention as given to both physical capital and education in the development process (Bloom and Canning, 2005).

Bloom and Canning (2005) using a model of conditional convergence with a panel of countries observed confidence interval of 1.2 to 4.3 percent and this concurred with Weil (2001) though the result is higher and it implies that health plays a larger role in explaining cross-country differences in the level of income per worker than education. Also, in reconciling the micro and macro evidence of health and economic growth they found out that the estimated macroeconomic effects of health are positive and not significantly different from the microeconomic estimates. Bloom et al., (2001) estimated the effect of health on economic growth using a panel data for 1960-1990 and showed that health has a positive and statistically significant effect on economic growth as one year improvement in population's life expectancy contributes a 4 percent increase in output. This makes their result consistent with the theoretical argument and microeconomic evidence.

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

health services was of greater significance than the rest of the determinants. Apart from the fact that the result concurred to the theoretical argument of health's relationship to growth, the definition of health was also broadened.

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

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

Some studies have also been done to examine the impact of HIV/AIDS in Africa. As found by studies carried out in Côte d'Ivoire and Rwanda, household consumption expenditures of families

affected with AIDS have reduced due to health expenditures also, another study saw that although the population in Botswana may fall by 20%, the government expenditure in 2010 will be cut by 20% due to AIDS (UNAIDS, 2000; Commission on macroeconomics and health, 2002). Young (2005); Acemoglu and Johnson (2009) in evaluating the effect of the recent HIV/AIDS epidemic in Africa using micro estimates and calibration of the neoclassical growth model, notwithstanding the substantial disorder and painful experience caused by HIV/AIDS a reduction in population as a result of this disease may increase per capita income. This can be attributed to the influence that population has on the per capita income.

Some other studies have looked at the impact of some illness on productivity and income. According to Luft (1999), in Indonesia anaemic men were found to be 20 percent less productive than men who were not anaemic and when these anaemic men were treated with iron, their productivity increased almost to those that were non-anaemic (Working Group 1 of the Commission on Macroeconomics and Health, 2002).

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

2.3.2 Methodological issues

Under the methodological approach looking at the effect on health on economic growth, various studies and their methodological approach have been cited in the work of Bloom et al (2004) and they are stated below.

Barro (1996) using data from three periods 1965-75, 1975-85 and 1985-95 estimated the effect of health on economic growth using the 3SLS (three stage least squares) using lagged values of some regressions as instruments, period random effects and life expectancy as the proxy for health and his

result aligned with theoretical argument that health has a positive and statistically significant relationship with economic growth.

Barro and Lee (1994) and Barro and Sala-I-martin (1995) using data from two periods 1965-75 and 1975-85, used the SUR (seemingly unrelated regression) estimator with country random effects and their result was consistent with theory and life expectancy was the proxy for health.

Bharagava et al. (2001b) used a 25year panel at 5 intervals, 1965-90 in estimating the effect of health on economic growth and dynamic random effects was used in estimation with the Adult Survival Rate (ASR) as health variable and this also had a positive and significant relationship with growth. Bloom et al., (2000) using the same data period and life expectancy as the health indicator used the pooled OLS estimator and this was also consistent with theory.

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

Caselli, Esquivel and Lefort (1996) using a 25-year panel at 5 year intervals from 1960-85 and with life expectancy as the health indicator used the GMM (generalized method of moments, Arellano bond method) estimator but the results showed that health as indicated by life expectancy had a negative and not significant relationship with economic growth as 1% increase in health will bring about 0.1% decrease in economic growth. This result do not concur with theory therefore there is either an explanation for this result or the there is need to question the methodology used. Also, Bloom, Canning and Sevilla (2001) estimated the effect of health on economic growth using a panel

data for 1960-1990 via a non-linear two stage least squares (2SLS) estimates and this method can be used to correct the issue of endogeniety.

From the above works, all the studies that used life expectancy as the health indicator found a positive relationship between health (as indicated by life expectancy) and economic growth which was shown by the positive coefficients except in the work of Caselli et al. (1996) which had a negative coefficient of -0.001.

2.3.3 Conclusion

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

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

CHAPTER THREE

THEORETICAL FRAMEWORK AND RESEARCH METHODOLOGY

3.1 Introduction

This chapter discusses the Solow neoclassical growth model or framework, the model specification, estimation techniques in which the panel data analysis is to be used, apriori expectation and sources of data.

3.2 Theoretical Framework

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

3.2.1 The Solow Neoclassical Growth Model Framework

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

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

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

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

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

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

Also, given a Cobb-Douglas production function of the form $Y = AK^{\alpha}L^{1-\alpha}$..... (1b) and expressing it in per capita terms i.e. dividing Y by L we have,

$Y/L = A (K/L)^{\alpha} (L/L^{\alpha}) \bullet (L/L) = AK^{\alpha}L$

Therefore, $y = Ak^{\alpha}$..... (2) Where $y = Y/L$

Equation 2 states that output per worker is a function that depends on the amount of capital per worker that is, the more the capital possessed by a worker, the more output the worker can produce. The model also says that total capital stock increases when savings are greater than depreciation but capital per worker increases when savings is greater or higher than the required equipments needed to increase the capital stock of new workers as that of existing workers that is, savings needed to replace or repair the capital stock.

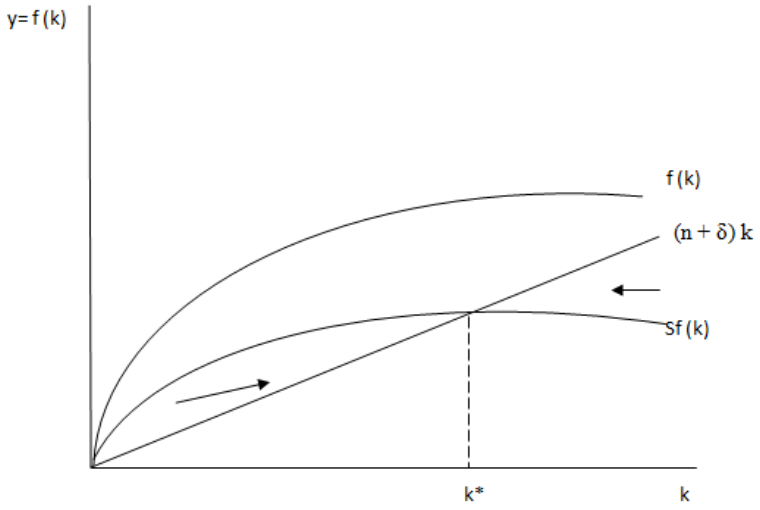
The Solow equation showing the change in the capital stock is as shown below:

$\Delta k = sf(k) - (\delta + n)k$.....(3)

Where Δk is the change in the capital stock, $sf(k)$ is the savings rate, δ is the depreciation which is a constant fraction of the stock of capital, k, and n is the labour force growth. The above equation gives the growth or increase in the ratio of capital to labour (k) which is known as capital deepening. From

the equation, the growth of k depends on savings, sf(k), after allowing for the amount of capital that depreciates, (δk), and after capital widening which is the increase in capital without changing the proportions of the factors of production used.

The Solow growth model can also be diagrammatically represented below in two axes which consists of the capital stock (horizontal axis) and total output (vertical axis).



Adapted from Todaro and Smith (2011)

Figure 3.1 Equilibrium in Solow Growth Model

The above graph shows the equilibrium in the Solow growth model. The concave or the inward curved shape of f(k) which shows that it is increasing at a decreasing rate indicates that output is subject to diminishing returns to capital.

Assuming that A remains constant there would be a state where output and capital per worker are not going to change and this can be referred to as the steady state which is found by setting equation (3) i.e. $\Delta k = 0$ which gives $\Delta k = sf(k) - (\delta + n)k = 0$,

Therefore, $sf(k^*) = (\delta + n)k^*$.....(4)

Where k* means the level of capital per worker when the economy is in a stable equilibrium. Also examining the graph above, k* occurs at the point where sf(k) equals (n + δ)k i.e. savings rate equals the rate of depreciation.

Therefore, there are forces bringing the economy to this steady state k*. Looking at the left hand side of k* i.e. k<k*, the savings curve lies above the depreciation line, (n + δ)k, and this results to a growth in capital stock, k, towards the stable state at point k* where there is no further growth of k. On the other hand, to the right of k* that is, k*>k, the (n + δ)k lies above sf(k) and this will bring about a decline or shrinking of the capital stock toward the stable equilibrium k*. Also, the above diagram applies given that the Inada conditions hold and it states that the marginal product of k goes to infinity as k goes to zero and goes to zero as k goes to infinity and vice-versa.

According to Solow, this stable equilibrium level of capital stock and similar level of output of the economy is known as the 'steady state equilibrium'.

The above neoclassical assumptions can be summarised mathematically below using equation (1b) as shown or cited in Kalyvitis (2013):

1. The Cobb-Douglass production function has positive and diminishing marginal returns of factor inputs i.e. capital and labour.

For capital, first order condition (foc) and second order condition (soc) can be shown as:

$MP_k = \alpha AK^{\alpha-1}L^{1-\alpha} = \alpha A\,(L/K)^{1-\alpha} > 0, \quad MP_{kk} = \alpha(\alpha-1)\,AK^{\alpha-1-1}L^{1-\alpha} = -\alpha(1-\alpha)\,AK^{\alpha-2}L^{1-\alpha} < 0$

For labour, first order condition (foc) and second order condition (soc) can be shown as:

$MP_l = (1-\alpha)AK^{\alpha}L^{1-\alpha-1} = (1-\alpha)A(K/L)^{\alpha} > 0, \quad MP_{ll} = -\alpha(1-\alpha)AK^{\alpha}L^{-\alpha-1} = -\alpha(1-\alpha)AK^{\alpha}L^{-1-\alpha} < 0$

2. The Cobb-Douglass production function exhibits a constant return to scale which is shown by multiplying the function by a scalar (λ). This is shown as:

$A(\lambda K)^{\alpha}(\lambda L)^{1-\alpha} = \lambda^{\alpha}\lambda^{1-\alpha}AK^{\alpha}L^{1-\alpha} = \lambda AK^{\alpha}L^{1-\alpha} = \lambda Y$

The production function is homogenous of degree $\lambda=1$

3. The Cobb-Douglass production function satisfies the inada conditions which states that the marginal product of capital goes to infinity as k goes to zero and goes to infinity as k goes to infinity. On the other hand, the marginal product of labour goes to infinity as l goes to zero and goes to zero as l goes to infinity. This can be shown as:

   For capital,

$$\lim_{k\to 0} MPk = \lim_{k\to 0} \alpha A[\frac{L}{K}]^{1-\alpha} = \infty$$

$$\lim_{k\to \infty} MPk = \lim_{k\to \infty} \alpha A[\frac{L}{K}]^{1-\alpha} = 0$$

   For labour,

$$\lim_{l\to 0} MPl = \lim_{l\to 0}(1-\alpha)A[\frac{K}{L}]^{\alpha} = \infty$$

$$\lim_{l\to \infty} MPl = \lim_{l\to \infty}(1-\alpha)A[\frac{K}{L}]^{\alpha} = 0$$

In summary, since health is a form of capital (human capital), it can be deduced that an increase in the level of health is expected to lead to an increase in output and the total health stock should increase when savings are allocated to cover the increased depreciation of the increasing stock of capital (health).

3.3 Research Methodology

The econometrics approach will be used and the panel data analysis will be applied. This is because the dataset of the study deals with the observation of entities across time. The panel is the combination of both the cross-sectional and time series that is it has space as well as time dimension.

This econometrics method is chosen due to the nature of this study as it covers 38 countries in Sub-Saharan Africa from 1990-2011.

Some of the merits or virtues of this method according to Balgati as cited in Gujarati and Porter (2009) include:

1. Panel data through its combination of both time series and cross-sectional data gives more informative, data efficiency, variability, degrees of freedom and less co linearity among variables.
2. Panel data helps or allows the control of variables that cannot be measured or observed such as cultural factors or variables that change over time but not across entities such as national polices. Therefore it takes account of individual heterogeneity.
3. Panel data could also enable us to study more complicated behavioural models such as economies of scale and technological change than by only using cross section or time series data.

In summary, a panel data analysis improves the quality of our empirical analysis which may not be feasible using either cross-section or time series data.

Some of the disadvantages or drawbacks include:

1. The issue of data collection could arise.
2. Since it consists of both cross-sectional and time series data, the issue of heteroskedasticity and autocorrelation will be needed to be addressed.

Also, according to Torres-Reyna (2013) panel data analysis could be specified using either the fixed effects model or the random effect model as shown below.

The equation for the fixed effects model is given as:

$Y_{it} = \beta_1 X_{it} + \alpha_i + u_{it}$..... (1)

Where

α_i(i=1….n) is the unknown intercept for each entity (n entity-specific intercepts).

Y_{it} is the dependent variable where i= entity and t = time.

X_{it} represents one independent variable,

β_1 is the coefficient for that $_{independent}$ variable,

u_{it} is the error term

While the equation for the random effects model is given as:

$Y_{it} = \beta X_{it} + \alpha + u_{it} + \varepsilon_i$..... (2)

Where

ε_i= Within-entity error

u_{it}=Between-entity error

α= is the intercept value with no (i) because it is assumed to be a random variable.

Therefore, this study will be using the panel data analysis in studying the role of health on economic growth in Sub-Saharan Africa.

3.3.1 Model Specification

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

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

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

Where

PCI = Gross Domestic Product per capita as a proxy for economic growth

A = level of total factor productivity

GCF = Gross Fixed Capital Formation as a proxy for the stock of accumulated capital

LAB = Labour force, total

SSE = School enrolment, secondary (% gross)

LFE = Life expectancy as a proxy for health taking into account the mortality aspect

HIV = prevalence of HIV as a proxy for health taking into account the morbidity aspect

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

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

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

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

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

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

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

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

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

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

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

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

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

Justification of Variables

PCI: Gross Domestic Product per capita is used as a proxy for economic growth because of the theoretical framework for this study where output(Y) is expressed in per capita terms i.e. Y/L and also based on previous literature as seen in the works of Bloom et al (2004), Barro (1996), Gallup and Sachs (2000) and others.

A: level of total factor productivity is specified here because of the neoclassical growth model which is the backbone of this study and also because it is one of the factors affecting growth though A is exogenously determined within the model.

GCF: Gross Fixed Capital Formation as a proxy for the stock of accumulated capital is used in this research work in order to capture the physical aspect of capital which is one of the determinants of growth through investment and this can also be seen in the previous literature.

LAB: Labour force, total is included in this study because not only is it one of the determinants of growth or output, it is also a necessary factor in the production process as an efficient labour force leads to an increase in output ceteris paribus.

SSE: School enrolment, secondary (% gross) as a proxy for education is used in this study because the rate of enrolment in to secondary education is an important determinant of the level of educational attainment in a country and also at the secondary level of education, one should possess the required skill be able to adapt to existing technology required for production. This can also be seen in previous works such as, Barro (1996), Barro and Lee (1994) and Barro and Sala-I-martin (1995). Also, the unavailability of data across countries is one of the reasons for the use of this variable.

LFE: Life expectancy as a proxy for health taking into account the mortality aspect which is an important aspect of health in the sense that it takes into account the expected length of life given the prevailing mortality rate. This can also be seen in the works of Barro (1996), Barro and Lee (1994), Barro and Sala-I-martin (1995) and Bloom et al (2004).

HIV: prevalence of HIV as a proxy for health taking into account the morbidity aspect which is one of the ignored aspects of health as seen in previous works. This is used in this study to account for the morbidity aspect of health which looks at the quality of one's life and it is an improvement to previous literature.

Apriori Expectation

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

a which consists of other exogenous factors affecting economic growth and this is expected to be positive because even when other factors affecting economic growth within the model are absent there are still some exogenous factors that are responsible for an increase in economic growth.

α which is the log coefficient of the gross fixed capital formation is expected to be positive as an increase in the gross fixed capital formation increases the stock of accumulated capital which is translated into investments for future productivity and these investments will generate income that will increase the level of economic growth ceteris paribus.

β which is the log coefficient of the total labour force is expected to be positive as an increase in the total labour force leads to an increase in the amount of labour which is an important determinant in the production of output and therefore this is expected to increase economic growth.

ϕ_1 and ϕ_2 which are the log coefficients of secondary school enrolment and life expectancy respectively are expected to be positive since these are components and contributors of the human capital which is one of the determinants that positively affects economic growth.

Φ_3 which is the log coefficient of the prevalence of HIV is expected to be negative since the higher the prevalence of HIV, the higher the rate of morbidity and this decreases the efficiency rate of the labour force thereby leading to a reduction in economic growth.

3.3.2 Technique of Estimation

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

Two methods of estimation are involved under the panel data analyses which are the fixed effects and the random effects. The former (fixed effects) assumes that there is need to control the unique characteristics of the entities and its impact or bias on the predictor variables. Therefore it reduces the

effect that the time invariant characteristics may have on the predictor variables so that the net effect of the predictors can be seen. On the other hand, random effects assume that the variations across entities are random and do not correlate with the predictor variables in the model. This means that the time invariant variables are included in the model unlike in the fixed model where it is absorbed by the intercept (Alege and Ogundipe, 2013).

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

Other diagnostic tests include:-

1. The test for multicollinearity which checks whether there is correlation among the explanatory variables and this can be done using either the pair wise correlation (pwcorr) or variance inflation factor (vif) (Ogumdipe and Alege, 2013).
2. The test for random effects using the Breusch-pagan LM test and this is used to check if there is a difference between the random effect and the pooled OLS.
3. The test for heteroskedasticity as to whether our residuals are normally distributed with a mean of zero and a constant variance.

3.3.3 Data Employed, Measurement and Sources

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

Table 3.1 Data Employed, Measurement and Sources

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

CHAPTER FOUR

DATA ANALYSIS AND INTERPRETATION

4.1 Introduction

This chapter focuses on the presentation, analysis and interpretation of data. The descriptive analysis is conducted to show the data features of each variable and econometric analysis will investigate the impact of health on economic growth in Sub-Saharan Africa from 1990-2011. The summary of findings, economic interpretation and policy implications are also examined.

4.2 Descriptive Analysis of the Data

This shows the features of the data and is used to summarise and interpret the data for various variables.

4.2.1 **Statistical Analysis**

The table presented below shows the statistical analysis of all the variables gross domestic product per capita (PCI), gross fixed capital formation (GCF), total labour force (LAB), secondary school enrolment (SSE), life expectancy (LFE) and the prevalence of HIV (HIV) of this study which include the Mean which is the sum of all the values in the data group divided by the total number of the values, Variance which is based on the difference between each value in the data set and the mean of the group and these differences are squared before being summed, Standard deviation which is the positive square root of the variance, Coefficient of variation(CV) which shows the degree of variation in a variable, it is dimensionless and the higher the CV, the higher the degree of variation in the variable, the Minimum value which is the lowest number in a set of data, Maximum value which is the highest number in a set of data, Range which is the difference between the highest number and the lowest number of the data, Skewness which shows the degree of asymmetry of the distribution and this could be negatively or positively skewed, and Kurtosis which measures the degree to which the frequency distribution is focused about its mean or the peakedness of the distribution and it could

be mesokurtic (when the kurtosis coefficient is = 0), platykurtic (when the kurtosis coefficient is < 0) and leptokurtic (when the kurtosis coefficient is > 0). This is as shown below:

Table 4.1 Summary Statistics of Variables

VAR.	PCI	GCF	LAB	SSE	LFE	HIV
Mean	1.24E+03	2.04E+09	6.01E+06	3.10E+01	5.19E+01	5.80E+00
Standard deviation	1.98E+03	6.35E+09	8.18E+06	2.05E+01	6.57E+00	6.56E+00
Coefficient of variation	1.60E+02	3.11E+02	1.36E+02	6.60E+01	1.27E+01	1.13E+02
Variance	3.92E+06	4.04E+19	6.69E+13	4.20E+02	4.32E+01	4.30E+01
Minimum	1.13E+02	-2.06E+07	1.18E+05	4.81E+00	2.68E+01	1.00E-01
Maximum	1.49E+04	7.62E+10	5.10E+07	9.57E+01	7.39E+01	2.73E+01
Range	1.48E+04	7.62E+10	5.09E+07	9.09E+01	4.71E+01	2.72E+01
Observations	8.34E+02	8.19E+02	8.36E+02	8.36E+02	8.36E+02	5.10E+02
Sum of weights	8.34E+02	8.19E+02	8.36E+02	8.36E+02	8.36E+02	5.10E+02
Skewness	3.50E+00	7.79E+00	2.88E+00	1.07E+00	2.16E-01	1.64E+00
Kurtosis	1.83E+01	7.34E+01	1.22E+01	3.78E+00	4.11E+00	4.95E+00

Source: Author's Compilation with Stata SE 10

From the table above, looking at the Maximum and Minimum values for all variables, PCI grew as much as 14901.35 and this was found in Equatorial Guinea in 2008 while it decreased to as low as 113.0082 and this was found in Ethiopia in 1992. GCF also grew as much as 7.62e+10 and this was found in South Africa in 2011 while it decreased to as low as -2.06e+07 in Sierra Leone in 1997. LAB increased to as much as 5.10e+07 in Nigeria in 2011 and decreased to as low as 117999.7 in Cape Verde in 1990. SSE increased to as much as 95.69964 in South Africa in 2007 and decreased to as low as 4.81315 in Burundi in 1990. LFE reached a peak of 73.91678 and this was found in Cape Verde in 2011 and contracted to 26.81871 in Rwanda in 1993. HIV reached a peak of 27.3 in

Zimbabwe in 1998 and reduced to as low as 0.1 in Sierra Leone in 1990-1993, Senegal in 1990 and Comoros from 1990—2011.

Looking at the Skewness, all variables (PCI, GCF, LAB, SSE, LFE and HIV) were all positively skewed. Examining the Kurtosis, all variables (PCI, GCF, LAB, SSE, LFE and HIV) had their entire kurtosis coefficient >0 which shows that they are Leptokurtic.

Finally, the observations and sum of weight for PCI, GCF, LAB, SSE, LFE and HIV are 834, 819, 836, 836, 836 and 510 respectively.

4.3 Empirical Analysis and Discussion of Results

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

4.3.1 Test for Multicollinearity

Multicollinearity is a situation in which there is linear dependence or relationship among the explanatory variables (lGCF, lLAB, lSSE, lLFE and lHIV).

To do this, the variance inflation factor (Vif) is used which is a way of checking for the presence of multicollinearity. Also, before the above is done, we have to run the ordinary pooled OLS though this is not my interest as it does not take into effect the differences in countries as panel study takes into account the differences within and between countries.

The rule of thumb here is that once the Vif is less than 5 (< 5) or when 1/Vif which is the tolerance is greater than 0.5 (> 0.5) then multicollinearity does not exist. The result is as shown below:

Table 4.2 VIF (Variance Inflation Factor)

Variable	VIF	1/VIF
lSSE	1.92	0.521326
lLFE	1.85	0.541377
lHIV	1.45	0.688245
lLAB	1.25	0.8007
lGCF	1.25	0.801455
Mean VIF	1.54	

Source: Author's Compilation with Stata SE 10

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

4.3.2 Test for Heteroskedasticity

Heteroskedasticity is a violation of the assumption of the classical linear regression model and the opposite of homoskedasticity which means that the residuals are normally distributed with a mean of zero (0) and constant or equal variance.

The problem of heteroskedasticity has a more tendency to be found in cross-sectional data than time series and since this is a panel study that involves both the latter and the former, this cannot be overruled.

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

Table 4.3 Modified Wald Test for GroupWise Heteroskedasticity in Fixed Effect Regression Model

chi2 (38)	13116.79
Prob>chi2	0.0000

Source: Author's Compilation with Stata SE 10

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

4.3.3 Hausman Test

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

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

Table 4.4 Hausman Test

chi2(5)	2.13
Prob>chi2	0.8313

Source: Author's Compilation with Stata SE 10

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

4.3.4 Interpreting the Random Effects Model

Table 4.5 Random Effects Model

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

rho	0.95863885	

Source: Author's Compilation with Stata SE 10

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

Table 4.6 Robust Random Effects Model

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

Source: Author's Compilation from Stata SE 10

R-sq: within = 0.4506;between = 0.4402;overall = 0.4565, Wald chi2(5) = 238.56; Prob>chi2=0.0000, Random effects u_i ~ Gaussian;corr(u_i, X) = 0 (assumed).

From the above table, the coefficient values, the z values and P>|z|, [95% Conf.Interval],the rho, R-squared, Wald chi2(5) and Prob> chi2 and corr(u_i, X) of all logged explanatory variables (lGCF, lLAB, lSSE, lLFE and lHIV) will be interpreted.

Examining the coefficients of each of the explanatory variables (lGCF, lLAB, lSSE, lLFE and lHIV) as to whether it is elastic (when the coefficient value in absolute terms is > 1) or inelastic (when the

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

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

Looking at the [95% Conf.Interval] we could see that lGCF, lLAB, lSSE and lLFE were all significant since there is no zero between the two intervals while lHIV is not significant as 0 lies between -0.0026253 to 0.0731496.

Looking at the rho which is the interclass correlation, we can see that 95.9% of variance is due to difference across panels.

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

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

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

Table 4.7 Bias in the Standard error and z value

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

Source: Author's Compilation with Stata SE 10

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

The test used in this study in testing for random effects is the Breush-Pagan Lagrange Multiplier (LM) test and this test is needed if the Hausman test suggests random effect as the preferred model and it is used to check if there is a significant difference between random effects regression and the simple or ordinary pooled OLS (Ogundipe, Alege and Ogundipe, 2014). This test is run immediately after the random test.

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

Table 4.8 Breusch and Pagan Lagrangian multiplier Test for Random Effects

chi2(1)	2355.71
Prob> chi2	0.0000

Source: Author's Compilation with Stata SE 10

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

4.4 Summary of Findings and Economic interpretation of results

The results of the robust random effects taking cognizance of both the degree of responsiveness which is the elasticity and the significance of each explanatory variable gross fixed capital formation

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

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

Total labour force was inelastic (0.2450477) and had a significant influence on the level of gross domestic product per capita and this makes sense as since gross domestic product per capita is made up of the gross domestic product divided by population in which the total labour force is one of the major parts of it, the total labour force is expected to show a significant influence on gross domestic product per capita and also this fails to meet apriori expectation and this can be attributed to the low contributively nature of the labour force as a result of low productivity and high pressure on the available resources and this tends to reduce economic growth. On the other hand, the inelastic nature of this relationship could be attributed to the low level of labour productivity, high pressure on available resources, high level of morbidity in the total labour force found in this region which

reduces the level of efficiency and thereby making a change in total labour force to bring about a less than proportionate change in gross domestic product per capita other things being equal.

Secondary school enrolment was inelastic (0.1867532) and had a significant influence on gross domestic product per capita and this significant influence is expected as this aligns with the apriori expectations based on the theory as human capital in which education is one of its components increases the quality of labour force and this enhances economic growth as it increases the ability of the labour force to produce and also through an increase in the knowledge required for proper maintenance of health and this tends to improve the level of efficiency of the work force as a healthier work force has a higher level of productivity than a less healthy one.

Life expectancy in Sub-Saharan Africa though it had a significant influence on the gross domestic product per capita was inelastic (0.296871) and this means that a change in life expectancy will about a less than proportionate change in gross domestic product per capita. Life expectancy does not meet apriori expectations and this can be attributed to the low contribution of the labour force which may be due to high rate of morbidity which reduces the level of efficiency or the or due to the high level of non-market activities such as subsistence farming which makes an increase in the length of life or life expectancy not to necessarily lead to an increase in the gross domestic product per capita as well as economic growth and also its significant influence can be explained looking at the apriori expectation based on economic theory as the higher the level of life expectancy, the larger the level of human capital formation, the lower the level of mortality, the lower the level of population growth which reduces the pressure on the available resources since people will not have the fear of the need for a replacement in the family labour force and these all translates to increase in economic growth.

The prevalence of HIV in Sub-Saharan Africa did not have a significant influence on the level of gross domestic product per capita and was inelastic (0.0352622) which implies that a change in the level of prevalence of HIV will bring about a less than proportionate change in gross domestic

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

4.5 Policy Implications of Findings and Conclusions

The major findings of this work and their policy implications can be seen in terms of the mortality aspect of health as represented by life expectancy and the morbidity aspect of health as proxied by the prevalence of HIV.

Sub-Saharan Africa showed an inelastic relationship between life expectancy and economic growth as proxied by PCI and the possible reasons for this can be seen above in summary of findings. Looking at the implications this will have on policy, it is evident that there is need for the government in the Sub-Saharan Africa region to direct more of their resources into areas or policies that increases the level of welfare, alleviates poverty and increases the participatory rate of the economy and also for preventive measures and institutions should be set in place to make sure or see that these resources allocated are efficiently utilised.

On the other hand, the morbidity aspect of health which is represented by the prevalence of HIV also showed an inelastic though not a significant effect on economic growth in Sub-Saharan Africa. Looking at the policy implications of this there is need for more coverage or equity in the administration of these health interventions by the government, donors and various institutions as this will enhance the access to the drugs, preventive measures and also there is need to increase the level of awareness and education of those in the rural areas of how they can prevent and manage this burden and this also aligns with the MDG 5 thereby increasing the level of development.

In conclusion, based on these empirical results and findings I can reject my H_0 and accept my H_1 in Hypothesis I that there is a significant relationship between life expectancy and economic growth in Sub-Saharan Africa and will fail to reject my H_0 in Hypothesis II that there is no significant relationship between the prevalence of HIV and economic growth in Sub-Saharan Africa and reject my H_1.

CHAPTER FIVE

SUMMARY, RECOMMENDATIONS AND CONCLUSION

5.1 Summary of Work

This study examines the role of health on economic growth in Sub-Saharan Africa from the period of 1990-2011. The explanatory variables used in this study are gross fixed capital formation, total labour force, secondary school enrolment ratio, life expectancy and the prevalence of HIV. The proxies for health are life expectancy which is used to capture the mortality aspect of health and the prevalence of HIV which is used to capture the morbidity aspect of health. The panel data analysis in which the random effect was used to estimate the model employed in the study.

In order to adequately comprehend and understand this topic, the research work was proficiently divided in to five chapters. In the first chapter, a general overview and background of the study was examined including the statement of the research problem, the research questions, the research objectives, hypothesis among others. Also, a thorough review of existing literature on the role of health on economic growth in Sub-Saharan Africa and this consisted of the conceptual, theoretical and empirical issues. In chapter three, the theoretical foundation of this work which is the Solow neoclassical growth model was examined which states that output per worker depends on the amount of capital per worker that is, the more the capital possessed by a worker, the more output the worker can produce. This supports this study and implies that since health is a form of capital which is the human capital, the more health possessed by a worker, the more output the worker can produce. The fourth chapter consist of the data analysis and presentation in which both the descriptive and econometric analysis was conducted. The summary of findings, economic interpretation of results and policy implications were examined. Lastly, the fifth chapter provides a conclusion to the study, recommendations, limitations of the study and suggestions for further research.

Findings

The findings in this study showed that the gross fixed capital formation in Sub-Saharan Africa is inelastic as the coefficient value in absolute terms (0.1779429) is < 1 therefore a change in gross fixed capital formation across time and between countries will lead to a less than proportionate change in gross domestic product per capita ceteris paribus. For the total labour force in Sub-Saharan Africa we could say that it is inelastic as the absolute of the coefficient (0.2450477) is < 1 therefore, a change in total labour force across time and between countries will lead to a less than proportionate change in gross domestic product per capita others things being equal. For, the secondary school enrolment in Sub-Saharan Africa, it is inelastic as the absolute value of the coefficient (0.1867532) is < 1 and we can say that a change in the secondary school enrolment across time and between countries will lead to a less than proportionate change in gross domestic product per capita ceteris paribus. Life expectancy in Sub-Saharan Africa is inelastic since the absolute value of the coefficient (0.296871) is < 1 therefore, a change in Life expectancy across time and between countries will lead to a less than proportionate change in gross domestic product per capita ceteris paribus. The prevalence of HIV in Sub-Saharan Africa is inelastic since the absolute value of the coefficient (0.0352622) is < 1 therefore, a change in the prevalence of HIV across time and between countries will lead to a less than proportionate change in gross domestic product per capita other things being equal.

It was also found that gross fixed capital formation, total labour force, secondary school enrolment and Life expectancy all had significant influence on the gross domestic product per capita while the prevalence of HIV did not have a significant influence on gross domestic product per capita. Also, other tests showed that multicolinearity was not present among the explanatory variables (gross fixed capital formation, total labour force, secondary school enrolment, Life expectancy and prevalence of HIV) and there was presence of heteroskedasticity which was controlled or corrected.

5.2 Recommendations

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

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

5.3 Conclusion

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

The findings indicate that the relationship between life expectancy and economic growth is inelastic and significant as this could be attributed to the high rate of non-market activity which is not

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

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

5.3.1 Limitations of the study

The findings of this study were not void of certain limitations. Due to the nature of data used which is the secondary data, the problem of errors occurring in the data estimation process cannot be overruled; therefore the findings of this study are as accurate as the data used.

This study was also, unable to take into consideration all the countries found in Sub-Saharan Africa due to the unavailability of data in those countries.

5.3.2 Suggestions for further studies

The following suggestions are made for further studies:

1. Other measures of morbidity such as malaria and tuberculosis prevalence should be taken into consideration in analysing the role of health on economic growth in Sub-Saharan Africa.
2. The role of institutions on health in Sub-Saharan Africa can also be examined.
3. A panel causality and co-integration relationship between health and economic growth in Sub-Saharan Africa should be examined.

REFERENCES

Alege, P., & Ogundipe, A. (2013). *The Role of Services Trade in Economic Development*. University Library of Munich, Germany.

Africa Development Indicators Factoids. (2011). *Ten Facts about Sub-Saharan Africa Compared with the World.*

Andrés Aguayo-Rico, I. A.-T.-H. (2005). Empirical Evidence of the Impact of Health on Economic Growth. *Issues in Political Economy, Vol. 14, August 2005*.

Barbara Mcpake, L. K. (2002). *Health Economics An International Perspective.* London : Routledge, Taylor and Francis Group.

Barro, R. (1996). Health and economic growth.

Barro, R. J. (2013). Health and Economic Growth. *Annals Of Economics And Finance 14-2*, 329-366.

Barro, R., & Sala-I-Martin, X. (1995). *Economic growth.* New York: McGraw-Hill.

Berg, H. V. (2013). A Critique of the Solow Model: What a Difference Disaggregation Makes! 1-38.

Bhargava, A., Jamison, D., Lau, L., & Murray, C. (2001b). Modeling the effects of health on economic growth. *Journal of Health Economics*, 20(3),423–440.

Bloom, D. E., & Williamson, J. G. . (1998). Demographic transitions and economic miracles in emerging Asia. *World Bank Economic Review*, 12(3), 419–455.

Bloom, D., & Malaney, P. (1998). Macroeconomic consequences of the Russian mortality crisis. *World Development*, 26, 2073–208.

Caselli, F., Esquivel, G., & Lefort, F. (1996). Reopening the convergence debate: a new look at cross country growth empirics. *Journal of Economic Growth*, 1,363–389.

David E. Bloom and David Canning. (2005). Health and Economic Growth: Reconciling the Micro and Macro Evidence. *Harvard School of Public Health*, 1-25.

David E. Bloom and David Canning. (2008). Population Health and Economic Growth. *Commission on Growth and Development*, 1-36.

Damodar N.Gujarati and Dawn C. Porter. (2009). *Basic Econometrics.* Singapore: McGGraw-Hill.

Daron Acemoglu and Simon Johnson. (2009). Disease and Deveopment: The Effect of Life Expectancy on Economic Growth. *Commission on Growth and Development*, 77-129.

David E. Bloom, D. C. (2004). The Effect of Health on Economic Growth: A Production Function Approach. *World Development Vol. 32, No. 1*, 1–13.

David N. Weil. (2006). Accounting for the effect of health on economic growth. 1-59.

Dolan, P. (2003). *Grossman's theory of the demand for health care.* olso.

Encarta Dictionaries. (2009).

Gallup, J., & Sachs, J. (2000). The economic burden of malaria. *Working Paper No. 52, Center for International Development, Harvard University, Cambridge MA.*

Gillespie, A. (n.d.). Economics through diagrams. *Oxford revision guides*.

Grossman, M. . (1972). "On the Concept of Health Capital and the Demand for Health. *" Journal of Political Economy* , 80: 223–55.

Guillem López-Casasnovas, B. R. (2007). The role of health on economic growth.An Introduction. *"Health and Economic Growth: Findings and Policy Implications"*, 1-25.

Haacker, M. (2004). "HIV/AIDS: The Impact on the Social Fabric and theEconomy.". *In The Macroeconomics of HIV/AIDS, ed. M. Haacker.Washington, D.C.: International Monetary Fund.*

Hendrik Van den Berg. (2013). A Critique of the Solow Model: What a Difference Disaggregation Makes! 1-38.

John Strauss and Duncan Thomas. (1998). Health, Nutrition and Economic Development. *Journal of Economic Literature, Vol. 36, No. 2*, pp. 766-817.

Mankiw, N. G., D. Romer, and D. Weil. (1992). A Contribution to the Empirics of Economic Growth. *Quarterly Journal of Economics* , 107(2): 407–37.

Michael P. Todaro and Stephen C. Smith. (2011). *Economic Development, Eleventh edition.* Harlow: Pearson.

Oscar Torres-Reyna. (2013). *Panel Data Analysis Fixed & Random Effects (using Stata 10.x) (ver. 4.1).* Princeton University.

Ogundipe, A. A., & Alege, P. O. (2013). Interest Rate Pass-Through to Macroeconomic Variables: The Nigerian Experience. *International Journal of Economics & Finance*, *5*(10).

Ogundipe, A., Alege, P., and Ogundipe, M. (2013). *Income Heterogeneity and Environmental Kuznets Curve in Africa*. University Library of Munich, Germany.

Quamrul H. Ashraf, Ashley Lester, David N. Weil. (2009). When Does Improving Health Raise GDP? In K. R. Daron Acemoglu, *NBER Macroeconomics Annual 2008, Volume 23* (pp. 157-204). University of Chicago Press.

Research Analyst, DSAED. (2010). The Role of Health in Economic Development. *Knowledge Note*, 1-7.

Robert .J. Barro. (2013). Health and Economic Growth. *Annals Of Economics And Finance 14-2*, 329-366.

Sarantis Kalyvitis . (2013). The Neoclassical Solow-Swan growth model. 1-19.

Spring. (2005). Notes on Health and Development. *Econ 570*.

The Afro Central About African Health Care.htm. (n.d.). Retrieved September 3, 2013, from Afro Central Web site: http://www.afrocentral.net

THE World Bank. (2011). *Afrrica Development Indicators.* Washington, D.C: THE World Bank.

Weil, D. (2001). “Accounting for the Effect of Health on Economic Growth.” . *Brown University,Providence, RI. Processed.*

William Jack and Maureen Lewis. (2009). Health Investments and Economic Growth: Macroeconomic Evidence and Microeconomic Foundations. *Commission on Growth and Development*, 1-39.

Working Group 1 of the Commission on Macroeconomics and Health. (2002). *Health, Economic growth and Poverty reduction.* Geneva: World Health Organization.

World Development Indicators. (2013). *World Veiw.*

World Health Organisation. (2011). *Health Situation Analysis in the African Region Atlas of Health Statistics.* Brazzaville: Replika Press Pvt. Ltd.

World Health Organisation. (2013).

Young, A. . (2005). “The Gift of the Dying: The Tragedy of AIDS and the Welfare of Future African Generations.” . *Quarterly Journal of Economics* , 120: 243–66.

APPENDICES

APPENDIX A: PANEL DATA FOR ALL VARIABLES

Country	Id	Year	GDP per capita (constant 2005 US$)	Gross fixed capital formation (current US$)	Labor force, total	Life expectancy at birth, total (years)	Prevalence of HIV, total (% of population ages 15-49)	School enrollment, secondary (% gross)
Angola	1	1990	1579.14	1141911777	3848731.4	41.14141463	0.6	11.33788
Angola	1	1991	1513.49	1578782334	3968550	41.20887805	0.7	12.01068
Angola	1	1992	1364.23	209080605.6	4113309.2	41.31453659	0.8	13.53202
Angola	1	1993	993.899	1397570036	4297400.6	41.47819512	0.9	
Angola	1	1994	996.162	1239027943	4430584.8	41.71621951	1.1	
Angola	1	1995	1066.92		4559990.8	42.05092683	1.2	
Angola	1	1996	1153.35	2620861267	4670800	42.50160976	1.3	
Angola	1	1997	1211.44	1954913755	4791423.9	43.06163415	1.4	
Angola	1	1998	1259.79	2298358076	4914129.4	43.71431707	1.5	12.96705
Angola	1	1999	1264.69	1778168521	5045966.6	44.43909756	1.6	12.95819
Angola	1	2000	1264.02	1164482322	5199204.7	45.20492683	1.6	14.85065
Angola	1	2001	1262.01	1201984759	5368905.2	45.97331707	1.7	16.78409
Angola	1	2002	1396.23	1442087192	5522221.2	46.71192683	1.8	18.1241
Angola	1	2003	1392.43	1773779062	5717366.8	47.39336585	1.9	
Angola	1	2004	1494.3	1808587944	5902911	48.00370732	1.9	
Angola	1	2005	1706.54	2481851683	6065208.3	48.53843902	2	
Angola	1	2006	1990.84	6422691149	6236723.2	49.00714634	2	
Angola	1	2007	2359.28	8167768162	6401236.9	49.43529268	2	
Angola	1	2008	2597.05	13658662766	6597146	49.84741463	2	25.53805
Angola	1	2009	2573.69	11503473173	6848824.1	50.25102439	2.1	27.12827
Angola	1	2010	2576.65	10447588316	7111734.8	50.65365854	2.1	31.30734
Angola	1	2011	2593.84	11880122597	7365110.5	51.05931707	2.1	31.51639
Benin	2	1990	457.94	247377931.3	1947552.2	48.64853659	3.2	
Benin	2	1991	460.599	257359524.8	2021659.4	49.12312195	3	
Benin	2	1992	456.966	227457175.1	2109684.5	49.60339024	2.7	
Benin	2	1993	465.945	315765946.8	2199509.8	50.07346341	2.6	
Benin	2	1994	458.571	259572012.1	2288732.9	50.52241463	2.4	
Benin	2	1995	470.136	381092129.6	2373788.3	50.94126829	2.3	
Benin	2	1996	475.325	385812708.8	2449633.6	51.3245122	2.2	
Benin	2	1997	487.969	390736748.1	2517650.1	51.67407317	2.1	

Benin	2	1998	492.947	424209444.7	2584948	51.99582927	2	
Benin	2	1999	504.332	446235613.2	2657093.8	52.2917561	1.9	22.17601
Benin	2	2000	512.955	425293014.6	2738003.7	52.56534146	1.8	23.08362
Benin	2	2001	527.874	455247935	2824960.3	52.81909756	1.7	25.01569
Benin	2	2002	533.383	531174854.2	2920162.2	53.0615122	1.6	27.08993
Benin	2	2003	535.954	695218058.4	3034320.9	53.3014878	1.5	28.47844
Benin	2	2004	534.739	786417161.4	3152724.4	53.54895122	1.4	30.37656
Benin	2	2005	532.611	843556819.9	3273165.4	53.81373171	1.3	37.07148
Benin	2	2006	535.494	920038890.6	3395314.5	54.10668293	1.3	
Benin	2	2007	543.293	1097575086	3519792.6	54.43073171	1.3	
Benin	2	2008	553.657	1345494418	3646437	54.78731707	1.2	
Benin	2	2009	551.967	1380016365	3775236	55.17341463	1.2	
Benin	2	2010	550.045	1344674981	3906262.4	55.58558537	1.2	
Benin	2	2011	553.743	1287101265	4033683.5	56.01443902	1.2	51.39515
Botswana	3	1990	3287.74	1226493902	561440.77	64.01717073	6.2	39.8245
Botswana	3	1991	3432.27	1232985472	585030.57	63.648	8.4	48.17457
Botswana	3	1992	3434.6	1225301876	608886.92	62.966	10.9	47.58234
Botswana	3	1993	3406.86	1121013588	633546.19	61.97670732	13.8	51.5659
Botswana	3	1994	3440.05	1107967614	659582.63	60.71163415	16.7	50.32983
Botswana	3	1995	3504.02	1220613325	684969.11	59.19780488	19.3	56.88765
Botswana	3	1996	3612.92	1189496788	710470.73	57.47765854	21.7	
Botswana	3	1997	3893.02	1293702934	735963.34	55.65153659	23.7	
Botswana	3	1998	4216.12	1352784027	762109.12	53.84170732	25.2	72.30872
Botswana	3	1999	4345.52	1463199782	786463.97	52.15895122	26.1	73.1519
Botswana	3	2000	4521.46	1455318600	810780.54	50.7654878	26.8	74.61948
Botswana	3	2001	4608.26	1422828538	832770	49.81156098	27	74.20156
Botswana	3	2002	4952.27	1494184297	854632.19	49.33753659	26.9	74.98104
Botswana	3	2003	5195.18	2104421645	874141.93	49.32734146	26.6	75.52047
Botswana	3	2004	5440.03	2493924587	893706.32	49.7374878	26.2	76.33649
Botswana	3	2005	5467.27	2516553409	912277.34	50.44656098	25.8	76.87836
Botswana	3	2006	5687	2430635957	929850.18	51.28431707	25.4	78.54617
Botswana	3	2007	6130.01	2958461214	945215.81	52.06895122	25	79.98046
Botswana	3	2008	6295.88	3064177413	961081.58	52.66368293	24.6	82.13911
Botswana	3	2009	5746.38	3324687939	976526.5	53.01153659	24.1	
Botswana	3	2010	6157.63	4041423472	991800.72	53.1095122	23.7	
Botswana	3	2011	6592.77	4946597459	1005714.9	53.0184878	23.4	
Burkina Faso	4	1990	269.324	550199658.5	3894634.5	48.45304878	3.7	6.33801
Burkina Faso	4	1991	285.992	627067229.4	3994033.2	48.52741463	3.6	6.6419

Burkina Faso	4	1992	279.041	436712043.1	4103993.4	48.61173171	3.5	6.86711
Burkina Faso	4	1993	280.982	437323035.3	4219631.5	48.71002439	3.4	7.28755
Burkina Faso	4	1994	277.018	487387800.4	4340514.3	48.83082927	3.2	7.62174
Burkina Faso	4	1995	284.921	534911042	4466345.8	48.9797561	3	
Burkina Faso	4	1996	307.684	583322396.9	4591709.9	49.15943902	2.9	
Burkina Faso	4	1997	318.151	592972705.6	4727601.7	49.36997561	2.7	
Burkina Faso	4	1998	331.974	627508895	4868600.6	49.61034146	2.5	
Burkina Faso	4	1999	346.627	570600148.3	5014598.1	49.8854878	2.4	9.12025
Burkina Faso	4	2000	343.114	488118774.6	5171761.6	50.20129268	2.2	9.72435
Burkina Faso	4	2001	355.358	416668424.7	5327967.8	50.56556098	2.1	9.93489
Burkina Faso	4	2002	362.992	542887236.9	5489464.9	50.97763415	1.9	9.98406
Burkina Faso	4	2003	380.103	764624501.1	5656714.6	51.43236585	1.8	11.27716
Burkina Faso	4	2004	385.695	940579761.6	5830300.6	51.92221951	1.7	12.37604
Burkina Faso	4	2005	406.999	1075486753	6017911.1	52.43519512	1.6	13.35987
Burkina Faso	4	2006	421.958	1117714773	6205669.3	52.95790244	1.5	14.06205
Burkina Faso	4	2007	424.497	1435252817	6400708.6	53.47695122	1.4	15.13664
Burkina Faso	4	2008	436.11	1723910094	6603326.1	53.9824878	1.3	17.74582
Burkina Faso	4	2009	436.093	1879262523	6813811.8	54.46604878	1.2	19.08661
Burkina Faso	4	2010	457.229	1828902056	7032427.3	54.92419512	1.2	20.71763
Burkina Faso	4	2011	462.924	1740406015	7259383.2	55.35790244	1.1	22.60019
Burundi	5	1990	218.341	172567224.3	2643495.8	46.22714634	2.1	4.81315
Burundi	5	1991	223.513	173915917.9	2679543.9	45.62153659	2.6	5.46704
Burundi	5	1992	220.67	110387272.4	2710260.2	45.11095122	3.3	5.89429
Burundi	5	1993	202.729	104192751.2	2733191.5	44.7537561	4	6.64318
Burundi	5	1994	191.496	64303043.98	2749236.5	44.57846341	4.7	
Burundi	5	1995	173.562	64457594.95	2763017	44.5885122	5.1	
Burundi	5	1996	157.532	72696284.06	2770337.9	44.75841463	5.2	

Burundi	5	1997	153.2	51542500.17	2776404.4	45.02670732	5	
Burundi	5	1998	158.533	53351551.05	2786170.3	45.33843902	4.7	
Burundi	5	1999	154.591	47554830.01	2829744.4	45.67056098	4.3	
Burundi	5	2000	150.304	35337442.85	2894739.6	46.00504878	3.9	
Burundi	5	2001	149.691	37635836.99	2987011.1	46.33639024	3.5	10.54775
Burundi	5	2002	151.941	35870675.94	3103182.4	46.67307317	3.1	10.9604
Burundi	5	2003	145.4	63128557.79	3240545.2	47.02156098	2.8	11.1392
Burundi	5	2004	147.427	92886011.04	3382065.7	47.38036585	2.5	12.67301
Burundi	5	2005	143.784	223450877.4	3532572.3	47.75146341	2.3	13.79438
Burundi	5	2006	146.398	254636131	3678689.6	48.13887805	2.1	15.07209
Burundi	5	2007	148.141	271215660	3829697.3	48.54663415	1.9	16.0407
Burundi	5	2008	150.279	322326857.3	3987779.8	48.9757561	1.7	
Burundi	5	2009	150.223	347956307.2	4140674.3	49.42126829	1.6	21.3622
Burundi	5	2010	150.742	405372882.9	4286190.9	49.87721951	1.4	24.78757
Burundi	5	2011	151.997	471130412.7	4428030.5	50.33709756	1.3	27.95962
Cameroon	6	1990	999.742	1933099913	4363811.5	53.25309756	1	24.85631
Cameroon	6	1991	933.816	2069788924	4517176	53.12790244	1.4	26.27075
Cameroon	6	1992	878.953	1630286379	4669505	52.92931707	1.8	27.14082
Cameroon	6	1993	826.766	1841900245	4827861.5	52.66687805	2.2	
Cameroon	6	1994	783.622	1146411126	4993006.4	52.35056098	2.7	26.1367
Cameroon	6	1995	787.246	1172626218	5157983.6	51.99190244	3.2	25.27411
Cameroon	6	1996	804.243	1321284617	5330182.4	51.59990244	3.7	
Cameroon	6	1997	822.706	1410856631	5493541.8	51.19153659	4.1	23.66023
Cameroon	6	1998	841.371	1434800006	5662489.9	50.7867561	4.5	24.55001
Cameroon	6	1999	855.368	1537770902	5844665.1	50.4065122	4.8	26.09064
Cameroon	6	2000	868.123	1514692829	6022819.6	50.07126829	5	27.65084
Cameroon	6	2001	883.854	1989019514	6213989.4	49.79297561	5.1	32.72662
Cameroon	6	2002	895.646	2197940439	6409965.4	49.57809756	5.2	
Cameroon	6	2003	907.88	2432039217	6610992.8	49.43556098	5.2	30.39999
Cameroon	6	2004	917.428	3113037720	6817493.9	49.37485366	5.2	27.20895
Cameroon	6	2005	914.553	2551284457	7039896.9	49.41241463	5.1	27.8144
Cameroon	6	2006	919.969	2540171923	7258535.1	49.56117073	5.1	23.15625
Cameroon	6	2007	926.906	3088343173	7483253.2	49.81517073	5	31.73853
Cameroon	6	2008	926.484	4025636035	7724996.8	50.16090244	4.9	38.01777
Cameroon	6	2009	920.867	3646155428	7973216.1	50.58292683	4.8	42.19886
Cameroon	6	2010	927.254	3614978464	8227925.6	51.0627561	4.7	46.75333
Cameroon	6	2011	941.001	5004832391	8489175.7	51.57646341	4.6	51.30071
Cape Verde	7	1990	1103.82	125341375	117999.72	65.08021951	0.8	20.52018
Cape Verde	7	1991	1095.41	124078236.9	121362.52	65.5195122	0.8	

Cape Verde	7	1992	1100.51	132634773.9	125345.73	65.94531707	0.9	
Cape Verde	7	1993	1149.1	144658460.5	129740.63	66.36012195	0.9	
Cape Verde	7	1994	1195.91	178590187	134651.99	66.77043902	0.9	28.32145
Cape Verde	7	1995	1253.41	190211650.8	139423.41	67.18231707	0.9	
Cape Verde	7	1996	1306.84	189955649.4	144180.06	67.60319512	1	
Cape Verde	7	1997	1377.13	191100038.7	148757.53	68.03704878	1	
Cape Verde	7	1998	1463.65	164983909.3	153713.18	68.48780488	1	
Cape Verde	7	1999	1606.18	205050557.5	158732.25	68.95639024	1	
Cape Verde	7	2000	1690.74	164202377.9	164387.08	69.44826829	1	68.29741
Cape Verde	7	2001	1761.13	178412149	170497.92	69.96985366	1	66.07504
Cape Verde	7	2002	1820.53	223189229	176957.02	70.51365854	1	69.48582
Cape Verde	7	2003	1873.96	253162785.2	183513.6	71.06763415	1	70.40175
Cape Verde	7	2004	1926.77	359897894.3	190114.48	71.61778049	1	69.88266
Cape Verde	7	2005	2030.66	348009375	195932.46	72.14065854	1	73.37531
Cape Verde	7	2006	2221.34	428275219.3	201445.17	72.61034146	1	85.51533
Cape Verde	7	2007	2404.62	618267460.3	206440.94	73.01085366	1	84.75987
Cape Verde	7	2008	2548.71	722056175.5	211119.31	73.33619512	1	86.58666
Cape Verde	7	2009	2637.55	625393231.4	215795.34	73.58680488	1	85.42651
Cape Verde	7	2010	2764.21	627184101.9	220699.66	73.77404878	1	87.52732
Cape Verde	7	2011	2886.2	694233565.1	226235.58	73.91678049	1	89.74241
Central African Republic	8	1990	429.755	170187266.4	1290224.5	48.82887805	8.6	11.47254
Central African Republic	8	1991	417.804	167720103.7	1319939.2	48.41497561	8.9	11.53327
Central African Republic	8	1992	381.84	171350226.5	1357011.9	47.91739024	9.2	9.61693
Central African Republic	8	1993	374.004	123610966	1395229.1	47.35060976	9.3	
Central African Republic	8	1994	383.077	99800029.49	1432662	46.73858537	9.4	
Central African Republic	8	1995	401.248	147451131.1	1467805.6	46.10629268	9.5	
Central African Republic	8	1996	376.621	46134078.55	1506191	45.48017073	9.4	
Central African Republic	8	1997	387.962	98172017.78	1542522.4	44.89163415	9.3	

Central African Republic	8	1998	397.673	142893035.7	1576211.2	44.37256098	9.1	
Central African Republic	8	1999	403.75	152671971	1608715.5	43.95334146	8.8	
Central African Republic	8	2000	386.213	91319756.48	1641916.8	43.66336585	8.5	
Central African Republic	8	2001	381.636	80915940.2	1673486.2	43.52353659	8.1	11.86996
Central African Republic	8	2002	372.982	93728806.37	1703764.5	43.52882927	7.7	11.93463
Central African Republic	8	2003	340.855	72498762.36	1738433.8	43.67219512	7.3	
Central African Republic	8	2004	338.609	86519618.2	1770424.9	43.94612195	6.9	
Central African Republic	8	2005	340.844	131928346.7	1805365.4	44.34756098	6.5	
Central African Republic	8	2006	347.548	149476914.1	1843671.7	44.8675122	6.1	
Central African Republic	8	2007	353.844	181422963.5	1885083.4	45.48253659	5.7	
Central African Republic	8	2008	354.176	252705832.7	1931781.4	46.1632439	5.4	
Central African Republic	8	2009	353.346	261077061.4	1980861.4	46.88370732	5.1	13.87562
Central African Republic	8	2010	357.985	283497098.5	2031893.8	47.61846341	4.9	
Central African Republic	8	2011	361.903	271380063.5	2082233.6	48.34560976	4.6	18.02017
Chad	9	1990	326.39	82968191.14	2266086.8	50.67992683	2.3	6.58942
Chad	9	1991	343.233	86764487.95	2324388.6	50.60709756	2.6	
Chad	9	1992	359.213	99279510.59	2384106.1	50.47578049	2.9	
Chad	9	1993	293.364	100879252.5	2469666.1	50.29895122	3.1	
Chad	9	1994	312.909	138687587.8	2538583.9	50.08809756	3.2	7.15767
Chad	9	1995	306.576	207593562.6	2615094.7	49.84973171	3.4	8.04546

Chad	9	1996	303.118	240535826.6	2691973.9	49.58585366	3.5	8.41238
Chad	9	1997	309.655	252257671.9	2772742.8	49.3045122	3.6	8.73007
Chad	9	1998	319.992	246809751.6	2862451.1	49.01717073	3.7	9.55964
Chad	9	1999	306.744	260469098.9	2958778.5	48.73882927	3.7	10.09491
Chad	9	2000	293.121	290052646.6	3062579.6	48.48897561	3.7	10.84254
Chad	9	2001	315.154	625266421.5	3170210.1	48.28258537	3.7	12.64824
Chad	9	2002	328.976	1187069024	3289691.1	48.12958537	3.6	13.62602
Chad	9	2003	363.169	1330046789	3414654.7	48.03597561	3.6	15.11827
Chad	9	2004	467.536	1003970678	3542118.8	48.0112439	3.5	15.63372
Chad	9	2005	529.433	883451053	3669995.9	48.05885366	3.4	16.24977
Chad	9	2006	512.953	806438553.3	3797581.8	48.18129268	3.3	16.82845
Chad	9	2007	497.756	1191111132	3925713.7	48.36858537	3.3	19.58217
Chad	9	2008	480.652	1998225766	4055767	48.6057561	3.2	22.39543
Chad	9	2009	460.656	2235465156	4189835.2	48.88531707	3.2	24.83122
Chad	9	2010	505.021	2716386873	4329523.2	49.19482927	3.2	24.63191
Chad	9	2011	497.842		4475326.3	49.52326829	3.1	25.38692
Comoros	10	1990	732.741	29780085.66	121169.47	55.59941463	0.1	
Comoros	10	1991	676.523	29138136.64	125024.14	55.8292439	0.1	
Comoros	10	1992	716.754	48963019.58	129056.67	56.04812195	0.1	22.30589
Comoros	10	1993	720.775	41269927.15	133290.03	56.26453659	0.1	
Comoros	10	1994	666.457	36260909.59	137744.15	56.48443902	0.1	22.84526
Comoros	10	1995	673.873	36008400.12	142168.26	56.70980488	0.1	
Comoros	10	1996	648.937	31428870.01	147095.46	56.94214634	0.1	
Comoros	10	1997	658.437	28358840.88	151960.86	57.17646341	0.1	
Comoros	10	1998	650.28	31749846.22	157230.82	57.41129268	0.1	
Comoros	10	1999	646.191	26541088.3	162502.44	57.64509756	0.1	29.79911
Comoros	10	2000	638.875	20378009.51	167995.91	57.87643902	0.1	28.94729
Comoros	10	2001	643.501	22127131.02	173394.85	58.09980488	0.1	
Comoros	10	2002	653.265	27655494.65	179048.12	58.31721951	0.1	35.28872
Comoros	10	2003	652.46	33436936.62	185005.04	58.53165854	0.1	40.36705
Comoros	10	2004	634.329	33916847.89	190991.95	58.74807317	0.1	45.70568
Comoros	10	2005	644.273	36029818.1	196694.96	58.97841463	0.1	46.34076
Comoros	10	2006	635.567	38812767.69	202814.97	59.23707317	0.1	
Comoros	10	2007	622.325	51939591.03	208654.86	59.53	0.1	
Comoros	10	2008	612.37	75710551.3	214642.62	59.86117073	0.1	
Comoros	10	2009	607.725	66372075.36	220864.57	60.22907317	0.1	
Comoros	10	2010	604.771		227004.82	60.62626829	0.1	
Comoros	10	2011	603.111		233468.63	61.04178049	0.1	
Congo, Rep.	11	1990	1816.82	482251123.9	889896.54	56.24656098	5.1	48.73972

Congo, Rep.	11	1991	1811.89	535612547.2	918632.73	55.88078049	5.2	47.45192
Congo, Rep.	11	1992	1811.25	603721005.1	949650.02	55.50860976	5.2	48.14968
Congo, Rep.	11	1993	1747.17	555418285.9	981777.01	55.15992683	5.1	
Congo, Rep.	11	1994	1607.93	936681559.2	1015230.2	54.85621951	5	50.55435
Congo, Rep.	11	1995	1627.26	725796639.2	1048550.9	54.60939024	4.8	
Congo, Rep.	11	1996	1650.4	805933029.7	1085112.9	54.42146341	4.6	48.37652
Congo, Rep.	11	1997	1594.07	501684710.3	1123236.4	54.28341463	4.4	
Congo, Rep.	11	1998	1607.29	474440474.7	1162010.2	54.1882439	4.3	
Congo, Rep.	11	1999	1523.05	625792664	1201963.9	54.14090244	4.1	
Congo, Rep.	11	2000	1595.59	673337044	1238801.8	54.14585366	3.9	35.64445
Congo, Rep.	11	2001	1615.22	734017374	1275508.3	54.21304878	3.8	
Congo, Rep.	11	2002	1649.06	680795596.7	1310820.3	54.3414878	3.7	38.63521
Congo, Rep.	11	2003	1623.08	890748325.7	1346401.7	54.52965854	3.6	39.95889
Congo, Rep.	11	2004	1637.9	1018303992	1382622.4	54.77260976	3.5	45.26965
Congo, Rep.	11	2005	1718.1	1200542033	1423038.9	55.06485366	3.4	
Congo, Rep.	11	2006	1773.29	1643775006	1468470.9	55.40143902	3.3	
Congo, Rep.	11	2007	1693.14	1799798243	1518250.4	55.77041463	3.3	
Congo, Rep.	11	2008	1733.25	2137056377	1570733.5	56.15934146	3.3	
Congo, Rep.	11	2009	1807.38	2130145438	1623474.6	56.5587561	3.3	
Congo, Rep.	11	2010	1909.83	2434111547	1674738.7	56.96019512	3.3	
Congo, Rep.	11	2011	1922.03	3613923059	1721620.5	57.35619512	3.3	
Cote d'Ivoire	12	1990	1075.84	917878532.3	4511426.2	52.64414634	5.8	
Cote d'Ivoire	12	1991	1040.69	899658950.9	4683040.8	52.37963415	6.3	
Cote d'Ivoire	12	1992	1004.41	948272654.1	4861428.3	52.07082927	6.7	
Cote d'Ivoire	12	1993	970.667	1032277604	5043529.9	51.73219512	7	
Cote d'Ivoire	12	1994	948.509	960150407.6	5225183	51.38521951	7.2	
Cote d'Ivoire	12	1995	986.183	1505493564	5402853.8	51.05136585	7.3	
Cote d'Ivoire	12	1996	1032.28	1797581101	5576904.7	50.74712195	7.3	
Cote d'Ivoire	12	1997	1061.59	1680574734	5738087	50.48992683	7.2	
Cote d'Ivoire	12	1998	1083.63	1366043861	5898025.3	50.29421951	7.1	
Cote d'Ivoire	12	1999	1075.34	1809487690	6041581.3	50.17890244	6.9	22.9796
Cote d'Ivoire	12	2000	1014.43	1165769183	6183391.5	50.16087805	6.6	23.56393
Cote d'Ivoire	12	2001	996.372	1043328546	6303282.4	50.25056098	6.2	24.7694
Cote d'Ivoire	12	2002	967.108	1249518995	6404488	50.44387805	5.8	27.14373
Cote d'Ivoire	12	2003	938.845	1334655164	6485749.8	50.73282927	5.4	
Cote d'Ivoire	12	2004	942.613	1524177841	6578470.1	51.11139024	5	
Cote d'Ivoire	12	2005	940.752	1593081993	6682221.6	51.57556098	4.6	
Cote d'Ivoire	12	2006	932.792	1620990691	6799488.3	52.11836585	4.3	
Cote d'Ivoire	12	2007	933.634	1719292949	6919030.8	52.72587805	3.9	

Cote d'Ivoire	12	2008	939.117	2374469676	7063159.1	53.37770732	3.6	
Cote d'Ivoire	12	2009	956.457		7211934.9	54.05590244	3.4	
Cote d'Ivoire	12	2010	959.992		7376057.2	54.74156098	3.2	
Cote d'Ivoire	12	2011	895.098		7568558.6	55.4212439	3	
Equatorial Guinea	13	1990	1089.42	22970978.54	200574.25	46.76543902	0.9	
Equatorial Guinea	13	1991	1042.01	66210774.77	204845.76	47.13485366	1	
Equatorial Guinea	13	1992	1115.34	37321745.41	209283.39	47.47229268	1.1	
Equatorial Guinea	13	1993	1146.09	33429874.87	213809.63	47.77229268	1.2	42.55035
Equatorial Guinea	13	1994	1164.94	93180925.71	218759.49	48.03139024	1.4	38.43005
Equatorial Guinea	13	1995	1287.93	125154482.3	223978.42	48.24260976	1.5	
Equatorial Guinea	13	1996	1610.2	294250494.9	229545.27	48.4	1.6	
Equatorial Guinea	13	1997	2669.33	326918212.1	235806.23	48.51153659	1.8	
Equatorial Guinea	13	1998	3152.17	417481496.2	242544.76	48.58719512	1.9	
Equatorial Guinea	13	1999	4319.89		250368.94	48.64095122	2.1	33.12687
Equatorial Guinea	13	2000	4707.74	840791286.9	259019.72	48.69026829	2.3	31.39785
Equatorial Guinea	13	2001	7455.36	1363982638	268248.84	48.75556098	2.5	27.71963
Equatorial Guinea	13	2002	8634.91	649225057.5	278298.13	48.85178049	2.6	27.49205
Equatorial Guinea	13	2003	9543.07	1825837847	288904.26	48.98892683	2.8	
Equatorial Guinea	13	2004	12777.6	2148029335	300067.61	49.17192683	3	
Equatorial Guinea	13	2005	13612.8	3221102885	310859.36	49.40029268	3.3	
Equatorial Guinea	13	2006	11084.6	3045370660	321511.15	49.6655122	3.5	
Equatorial Guinea	13	2007	13130.3	4233617491	332452.19	49.95263415	3.7	
Equatorial Guinea	13	2008	14901.4	5137981913	343399.3	50.24721951	3.9	
Equatorial Guinea	13	2009	14606.6	7014696048	354494.5	50.5447561	4.2	
Equatorial Guinea	13	2010	13960.2	7736477936	366258.06	50.84080488	4.4	
Equatorial	13	2011	14245.1	6727586070	377875.01	51.13687805	4.7	

Guinea								
Eritrea	14	1990			1439862.4	48.23353659	0.2	
Eritrea	14	1991			1439769.9	49.02158537	0.2	
Eritrea	14	1992	176.675	37265725.57	1424579.5	49.84265854	0.3	
Eritrea	14	1993	199.685	79515639.22	1398211.1	50.6922439	0.4	11.49409
Eritrea	14	1994	240.529	133652597.4	1378385	51.55287805	0.5	12.49695
Eritrea	14	1995	244.363	130265625	1385875.8	52.40460976	0.8	13.71046
Eritrea	14	1996	261.947	191341419.3	1412757.3	53.227	0.9	15.10039
Eritrea	14	1997	275.76	214740465.6	1460435.7	54.00653659	1	17.0113
Eritrea	14	1998	272.386	240706980	1529855.9	54.7357561	1.1	
Eritrea	14	1999	263.305	313556886	1613006.9	55.40758537	1.1	21.83158
Eritrea	14	2000	245.711	155378667.3	1713592	56.02497561	1.1	25.01239
Eritrea	14	2001	256.653	265289811.1	1818040.7	56.59429268	1.1	25.46258
Eritrea	14	2002	253.254	215506680	1933946.9	57.13246341	1	26.43693
Eritrea	14	2003	236.004	230998203.5	2058439.3	57.65392683	1	27.06227
Eritrea	14	2004	229.526	224726746.4	2179648.1	58.16268293	0.9	27.5045
Eritrea	14	2005	226.29	223413671	2294745.8	58.66426829	0.9	30.03957
Eritrea	14	2006	216.042	165700470.4	2398482.1	59.15773171	0.8	30.9773
Eritrea	14	2007	211.772	167034491.8	2494596	59.63921951	0.8	29.20691
Eritrea	14	2008	184.938	175470859.3	2588888.2	60.10526829	0.7	30.22218
Eritrea	14	2009	186.033	172000486.4	2676668.5	60.55692683	0.7	31.38936
Eritrea	14	2010	184.046	196867869.1	2767309	60.99419512	0.7	31.93706
Eritrea	14	2011	193.558	260733663.9	2861501.3	61.41707317	0.6	32.59071
Ethiopia	15	1990	142.91	1562922469	20950466	47.04539024	1.3	
Ethiopia	15	1991	128.172	1478892394	21722833	47.50290244	1.6	13.97338
Ethiopia	15	1992	113.008	1115624010	22526430	47.94895122	2	12.30524
Ethiopia	15	1993	123.47	1448605287	23238092	48.398	2.4	11.02646
Ethiopia	15	1994	123.157	1126130531	23982407	48.85304878	2.8	10.73244
Ethiopia	15	1995	126.524	1365832915	24754488	49.31363415	3.1	10.87238
Ethiopia	15	1996	137.913	1408553800	25429249	49.77526829	3.3	11.39364
Ethiopia	15	1997	138.082	1755975204	26196024	50.23895122	3.5	
Ethiopia	15	1998	129.523	1706912460	27003238	50.70868293	3.7	
Ethiopia	15	1999	132.378	1715250032	27760668	51.19292683	3.7	13.3356
Ethiopia	15	2000	136.45	1658783138	28823607	51.71012195	3.7	14.48941
Ethiopia	15	2001	143.574	1752427840	29929185	52.28221951	3.6	17.4656
Ethiopia	15	2002	141.599	1864124881	31043241	52.91868293	3.4	19.52273
Ethiopia	15	2003	134.611	1869396931	32209949	53.618	3.2	20.13528
Ethiopia	15	2004	148.595	2560450948	33400056	54.37065854	2.9	22.32353
Ethiopia	15	2005	161.573	2829810315	34659769	55.15665854	2.6	24.97055

Ethiopia	15	2006	174.222	3673958493	35738105	55.95156098	2.4	28.91048
Ethiopia	15	2007	188.991	4587552034	36874852	56.72392683	2.1	32.00292
Ethiopia	15	2008	203.855	5337011345	38076958	57.45078049	1.9	33.3462
Ethiopia	15	2009	216.003	7234287344	39305456	58.11817073	1.7	33.93908
Ethiopia	15	2010	231.314	7330543167	40656202	58.71509756	1.6	35.72439
Ethiopia	15	2011	241.818	8093260774	42136780	59.24309756	1.4	37.57581
Gabon	16	1990	7124.09	1276698330	350578.62	61.28912195	1.2	
Gabon	16	1991	7358.73	1411167158	358366.05	61.39653659	1.4	
Gabon	16	1992	6943.67	1233887860	366971.81	61.41297561	1.7	
Gabon	16	1993	7029.55	1002245292	375329.1	61.36095122	2.1	
Gabon	16	1994	7102.08	883097744.7	384108.14	61.2554878	2.5	39.58973
Gabon	16	1995	7264.16	1124515177	392756.93	61.09760976	2.9	42.06948
Gabon	16	1996	7335.89	1335933387	401898.75	60.87943902	3.3	49.63399
Gabon	16	1997	7561.03	1606046253	411483.67	60.60495122	3.8	
Gabon	16	1998	7628.72	1722174700	421405.01	60.29268293	4.2	
Gabon	16	1999	6776.52	1220238825	432222	59.97204878	4.6	47.91228
Gabon	16	2000	6488.29	1109966762	442425.18	59.69095122	5	
Gabon	16	2001	6469.44	1211644806	454152.54	59.49778049	5.2	52.37083
Gabon	16	2002	6301.46	1208803028	465246.8	59.42390244	5.4	53.07932
Gabon	16	2003	6307.74	1450453386	477290.47	59.4837561	5.5	
Gabon	16	2004	6244.09	1750972592	488821.61	59.68180488	5.5	
Gabon	16	2005	6281.95	1846704163	500674.79	60.00558537	5.5	
Gabon	16	2006	6205.71	2469983943	515452.45	60.42717073	5.5	
Gabon	16	2007	6394.29	2997024084	529794.69	60.89914634	5.4	
Gabon	16	2008	6303.82		545328.35	61.38112195	5.3	
Gabon	16	2009	5974.7		561040.24	61.84912195	5.2	
Gabon	16	2010	6223.16		577776.83	62.28668293	5.1	
Gabon	16	2011	6500.83		594603.87	62.69129268	5	
Gambia, The	17	1990	424.624	70846624.44	382861.63	53.12504878	0.1	16.29774
Gambia, The	17	1991	422.754	140393712.6	395944.41	53.209	0.2	16.89077
Gambia, The	17	1992	423.57	177058847.9	407532.97	53.28346341	0.2	17.14623
Gambia, The	17	1993	423.962	39849215.32	417781.22	53.38043902	0.2	19.31267
Gambia, The	17	1994	413.008	34976930.3	428236.6	53.52046341	0.3	19.15024
Gambia, The	17	1995	405.248	54263101.85	440232.8	53.71353659	0.3	21.21666
Gambia, The	17	1996	402.85	57503848	452852.09	53.95963415	0.4	20.60141
Gambia, The	17	1997	410.944	41589388.28	467035.28	54.24026829	0.5	
Gambia, The	17	1998	413.482	41042908.27	482045.28	54.53741463	0.5	
Gambia, The	17	1999	427.455	38740514.94	496921.05	54.84507317	0.6	
Gambia, The	17	2000	437.857	35720428.43	512716.55	55.1567561	0.7	

Gambia, The	17	2001	449.418	76802603.28	528815.02	55.4654878	0.8	
Gambia, The	17	2002	421.509	42085859.27	546764.56	55.7687561	0.9	
Gambia, The	17	2003	436.477	48893256.11	564563.35	56.06556098	1.1	
Gambia, The	17	2004	452.685	140162146.5	582214.44	56.35485366	1.2	
Gambia, The	17	2005	434.495	137187533	600494.74	56.64007317	1.3	
Gambia, The	17	2006	425.811	159032812.8	620223.97	56.92665854	1.3	
Gambia, The	17	2007	427.688	152510197.4	639848.53	57.22004878	1.4	
Gambia, The	17	2008	438.293	144980133	660231.01	57.5242439	1.4	54.06815
Gambia, The	17	2009	452.136	176636208	682362.39	57.83821951	1.4	55.17869
Gambia, The	17	2010	466.653	203889237.3	704581.61	58.16002439	1.4	54.08471
Gambia, The	17	2011	432.625	172541507.6	727795.65	58.48470732	1.5	
Ghana	18	1990	376.59	847230097	5851766.8	56.84302439	1	35.7732
Ghana	18	1991	385.56	1044841409	6040561.5	57.28629268	1.2	
Ghana	18	1992	389.421	817151953.8	6245200.7	57.63004878	1.4	
Ghana	18	1993	397.128	1419736611	6481983.1	57.85595122	1.6	
Ghana	18	1994	399.386	1229487970	6721727.6	57.96907317	1.7	
Ghana	18	1995	405.35	1365980399	6961985.8	57.99292683	1.9	35.33149
Ghana	18	1996	413.925	1407303125	7201638.2	57.9684878	2	
Ghana	18	1997	421.492	1642607978	7442386.8	57.95512195	2.1	
Ghana	18	1998	431.471	1673257167	7698491.4	58.0012439	2.1	
Ghana	18	1999	440.276	1579699957	7954836.5	58.13480488	2.2	40.1816
Ghana	18	2000	445.877	1150944998	8225675.7	58.3822439	2.2	40.52343
Ghana	18	2001	452.455	1441548464	8364367.2	58.75553659	2.2	38.61194
Ghana	18	2002	461.037	1157700179	8508656.8	59.23219512	2.2	40.6379
Ghana	18	2003	472.698	1750711688	8645769.4	59.78573171	2.1	42.06077
Ghana	18	2004	486.38	2520325409	8785744.4	60.39660976	2.1	44.91349
Ghana	18	2005	501.864	3112475799	8927105.1	61.03831707	2	47.20623
Ghana	18	2006	520.268	3391695944	9070284	61.68136585	1.9	49.07605
Ghana	18	2007	539.666	4392006955	9363562.1	62.3002439	1.8	53.66504
Ghana	18	2008	570.364	4775739170	9661609.5	62.8735122	1.7	56.26766
Ghana	18	2009	578.574	6186771314	9958280.7	63.38817073	1.6	59.05578
Ghana	18	2010	610.194	7405208534	10249335	63.83726829	1.5	
Ghana	18	2011	686.018	7275005908	10547958	64.22431707	1.5	58.1423
Guinea	19	1990	285.841	611549530.4	2411691.2	43.67068293	0.7	11.31254
Guinea	19	1991	277.996	636348322.1	2539489.4	44.10995122	0.8	11.7876
Guinea	19	1992	270.783	661286918	2684598.8	44.5217561	0.9	
Guinea	19	1993	268.424	664757090.5	2837811.3	44.90858537	1	12.96757
Guinea	19	1994	265.043	662416854.4	2986059.2	45.27895122	1.1	13.2465
Guinea	19	1995	265.825	734750779.5	3108894.1	45.65185366	1.2	

Guinea	19	1996	268.849	739340884.2	3206208.7	46.04882927	1.3	13.57146
Guinea	19	1997	275.903	742884591.9	3286640.4	46.48834146	1.4	
Guinea	19	1998	280.523	641560997.1	3346922.2	46.97890244	1.4	
Guinea	19	1999	286.351	654539420.5	3401026.2	47.522	1.5	13.78233
Guinea	19	2000	288.645	586901136.9	3466073.5	48.11014634	1.5	
Guinea	19	2001	294.185	439148308.6	3528605.6	48.72982927	1.5	18.55457
Guinea	19	2002	304.235	421775541	3597487.4	49.35702439	1.6	21.38813
Guinea	19	2003	302.718	682878796.8	3660590.2	49.97373171	1.6	23.239
Guinea	19	2004	304.021	723960867.9	3741769.5	50.56895122	1.6	25.69047
Guinea	19	2005	306.701	544962172.8	3833296.3	51.13565854	1.5	30.69876
Guinea	19	2006	307.216	469283742.1	3937031.6	51.67336585	1.5	34.59457
Guinea	19	2007	304.9	583781203.4	4058493.1	52.18856098	1.5	37.37836
Guinea	19	2008	311.648	661745034.7	4178336.4	52.6872439	1.5	36.7243
Guinea	19	2009	302.602	476080158.7	4322084.5	53.16992683	1.4	38.06059
Guinea	19	2010	300.441	500415006.5	4463776	53.63858537	1.4	
Guinea	19	2011	304.2	896877919.1	4602316.4	54.0922439	1.4	41.71295
Kenya	20	1990	555.326	1770037661	8997557.1	59.33995122	2.5	
Kenya	20	1991	544.938	1551236252	9293384.8	58.97958537	3.7	
Kenya	20	1992	523.311	1361184681	9603679	58.46312195	5.3	
Kenya	20	1993	508.855	974215535.3	9920693.6	57.79958537	6.9	
Kenya	20	1994	506.654	1349075188	10234278	57.01746341	8.4	
Kenya	20	1995	513.864	1934608642	10537339	56.14921951	9.3	
Kenya	20	1996	520.588	1928429609	10826849	55.23631707	9.8	
Kenya	20	1997	509.372	2018240815	11104712	54.33712195	9.8	
Kenya	20	1998	512.694	2209264379	11358494	53.51197561	9.6	
Kenya	20	1999	511.153	2010672644	11626321	52.81321951	9.3	38.44118
Kenya	20	2000	500.963	2122912374	11896289	52.29963415	8.9	39.19954
Kenya	20	2001	506.285	2357159736	12170203	52.01807317	8.5	40.20156
Kenya	20	2002	495.569	2266259622	12445771	51.96595122	8.1	40.80617
Kenya	20	2003	496.493	2360606516	12718108	52.1272439	7.6	42.91808
Kenya	20	2004	507.91	2616974314	13000454	52.48392683	7.2	46.94086
Kenya	20	2005	523.614	3503820003	13290681	53.00956098	6.8	47.66127
Kenya	20	2006	542.042	4293875375	13715630	53.66219512	6.6	49.84976
Kenya	20	2007	564.667	5274843412	14161178	54.38602439	6.4	52.41398
Kenya	20	2008	558.193	5921143568	14636097	55.12421951	6.3	59.12225
Kenya	20	2009	558.32	6012914030	15106364	55.83936585	6.2	60.17172
Kenya	20	2010	574.853	6544028463	15577753	56.49707317	6.2	
Kenya	20	2011	584.038	6857073756	16099382	57.08087805	6.2	
Lesotho	21	1990	510.689	308369984.4	666305.58	59.32685366	0.8	24.50379

Lesotho	21	1991	520.732	440120261.8	683813.92	59.642	1.5	24.19274
Lesotho	21	1992	547.594	507136007.1	701314.52	59.59826829	2.9	25.63868
Lesotho	21	1993	554.773	459061137.2	719482.61	59.13578049	5.2	26.58347
Lesotho	21	1994	573.704	503872503.2	737744.81	58.24612195	8.6	28.81399
Lesotho	21	1995	575.586	602522771.2	754049.94	56.93787805	12.9	30.15785
Lesotho	21	1996	596.959	610489075.2	768038.39	55.25160976	17	29.85064
Lesotho	21	1997	613.594	532795944	781133.81	53.32817073	20.1	30.8894
Lesotho	21	1998	617.465	392216670.6	791749.94	51.32182927	22.1	30.26374
Lesotho	21	1999	613.88	433915530.6	802805.31	49.35782927	23.1	30.28608
Lesotho	21	2000	639.659	316682653.5	801873.24	47.58636585	23.4	30.13797
Lesotho	21	2001	661.27	259836723	799663.82	46.13558537	23.4	31.76523
Lesotho	21	2002	659.859	219088679.5	797168.95	45.05478049	23.3	32.63028
Lesotho	21	2003	685.986	321623606	794590.25	44.3637561	23.1	33.13905
Lesotho	21	2004	696.839	326390296.6	793263.09	44.07590244	22.9	35.02282
Lesotho	21	2005	710.548	288956291.6	791050.28	44.17117073	22.8	36.5389
Lesotho	21	2006	735.59	307676465.3	791451.34	44.59012195	22.7	36.19546
Lesotho	21	2007	764.354	350786176.8	792171.67	45.21502439	22.7	38.9853
Lesotho	21	2008	801.452	454658990.5	794493.36	45.93156098	22.8	40.85562
Lesotho	21	2009	822.888	462667787.6	808367.13	46.66936585	23	43.86453
Lesotho	21	2010	879.224	599473291.4	824318.08	47.36507317	23.2	46.39142
Lesotho	21	2011	902.828	669840447.9	839962.09	47.98373171	23.3	49.06304
Madagascar	22	1990	328.417	456591983.3	5454247.2	50.74239024	0.1	18.72611
Madagascar	22	1991	298.58	282707537	5637935.6	51.42041463	0.1	
Madagascar	22	1992	293.114	339002047	5823293.5	52.19739024	0.2	
Madagascar	22	1993	290.266	385879983.4	6014025.5	53.03992683	0.2	
Madagascar	22	1994	281.252	324590496.2	6206501.7	53.93102439	0.2	
Madagascar	22	1995	277.29	345769055.5	6405868.8	54.85473171	0.2	
Madagascar	22	1996	274.473	464901628.3	6604060.9	55.80307317	0.2	
Madagascar	22	1997	275.741	454354836.4	6802829	56.77004878	0.2	
Madagascar	22	1998	277.651	552632947.6	7014335.9	57.74612195	0.2	
Madagascar	22	1999	281.59	554669186.3	7228343.9	58.71629268	0.3	
Madagascar	22	2000	285.963	583394633.4	7448377.9	59.67456098	0.3	
Madagascar	22	2001	294.004	837957940.1	7684145.8	60.62092683	0.3	
Madagascar	22	2002	249.068	627177210.2	7943973.9	61.55136585	0.3	
Madagascar	22	2003	265.365	979467739.2	8199241.9	62.45731707	0.3	
Madagascar	22	2004	271.168	1020226789	8465396.1	63.32078049	0.3	
Madagascar	22	2005	275.477	1118469908	8740852.2	64.11217073	0.3	21.76684
Madagascar	22	2006	281.08	1395038067	9025218.7	64.80143902	0.3	24.53993
Madagascar	22	2007	290.221	2377953316	9319310	65.37556098	0.3	27.15566

Madagascar	22	2008	302.238	3795117030	9624122.1	65.83553659	0.3	29.74828
Madagascar	22	2009	281.72	2797275348	9941077.5	66.19136585	0.3	31.09844
Madagascar	22	2010	275.364		10271029	66.46707317	0.3	
Madagascar	22	2011	272.746		10614307	66.69568293	0.3	
Malawi	23	1990	189.116	378373853.5	3978774.5	47.09426829	7.8	16.21696
Malawi	23	1991	201.147	374556885.8	4086702.3	47.15014634	8.9	16.36894
Malawi	23	1992	184.45	308774638.4	4148905.2	47.12241463	9.8	18.63923
Malawi	23	1993	201.476	268716692.6	4176923.3	47.01758537	10.6	17.69368
Malawi	23	1994	179.906	316411616.9	4207087.8	46.85217073	11.3	15.89937
Malawi	23	1995	207.635	207061204.1	4258357.9	46.64268293	11.8	23.78186
Malawi	23	1996	218.674	222394641.7	4335948	46.41214634	12.3	25.28899
Malawi	23	1997	221.493	248092293.4	4429537.1	46.19646341	12.8	
Malawi	23	1998	223.756	194246175.1	4536229.8	46.03502439	13.3	33.51257
Malawi	23	1999	224.02	223881476.9	4697932.8	45.96368293	13.6	38.16432
Malawi	23	2000	221.345	214836644.8	4858671.9	46.02973171	13.8	32.15167
Malawi	23	2001	204.874	236861962.3	5024485	46.2764878	13.8	32.90811
Malawi	23	2002	203.053		5192131.4	46.70731707	13.8	31.57353
Malawi	23	2003	208.76	342827173.4	5369863.8	47.30863415	13.7	
Malawi	23	2004	213.136	425864656.7	5560568.8	48.06290244	13.4	28.45179
Malawi	23	2005	213.157	555986688.3	5759443.6	48.93804878	13	27.94402
Malawi	23	2006	211.294	708419167.8	5959731.5	49.88914634	12.5	29.53935
Malawi	23	2007	224.496	873351608	6100500.4	50.86231707	11.9	29.0257
Malawi	23	2008	235.915	1024176987	6364259.2	51.80473171	11.4	31.21711
Malawi	23	2009	249.551	1199962401	6555051.5	52.68095122	10.9	31.7762
Malawi	23	2010	258.058	1304406276	6760710.2	53.46263415	10.4	32.99057
Malawi	23	2011	261.545	759267614.1	6981977.8	54.13636585	10	34.17208
Mali	24	1990	329.663	556076335.7	2184082.5	44.16221951	1.1	6.54482
Mali	24	1991	328.134	551563928.5	2225996.2	44.47426829	1.2	6.96241
Mali	24	1992	347.266	623396714.6	2274831	44.77531707	1.4	7.96095
Mali	24	1993	331.372	584000207.5	2336476.2	45.07687805	1.5	8.05671
Mali	24	1994	325.84	481717839.4	2406766.6	45.38395122	1.6	9.19098
Mali	24	1995	337.239	564753846.2	2468300.6	45.6975122	1.6	10.28439
Mali	24	1996	339.286	599770375	2539348.4	46.01304878	1.7	10.78215
Mali	24	1997	353.034	509887964.7	2606522.4	46.32653659	1.7	11.71252
Mali	24	1998	364.694	542737122.2	2675666	46.63397561	1.7	12.71492
Mali	24	1999	378.919	544931086.8	2753823.2	46.93839024	1.7	14.34212
Mali	24	2000	380.248	595081140	2831573.5	47.24326829	1.7	16.54147
Mali	24	2001	414.063	815482539.8	2914213.9	47.55265854	1.6	
Mali	24	2002	418.584	622225231.5	3006995.7	47.87309756	1.5	

Mali	24	2003	436.221	1057069564	3104118	48.20758537	1.5	20.90969
Mali	24	2004	432.151	1023078821	3205130.3	48.55763415	1.4	22.69262
Mali	24	2005	444.285	1201391987	3322461.3	48.92619512	1.4	24.47858
Mali	24	2006	467.356	1341712125	3437879.7	49.3112439	1.3	26.33947
Mali	24	2007	472.119	1597807375	3557624.3	49.7107561	1.3	28.92667
Mali	24	2008	480.057	1598440374	3687416.8	50.12019512	1.2	32.32035
Mali	24	2009	485.885	1838956397	3811667.1	50.53604878	1.2	35.21251
Mali	24	2010	498.475	1990663724	3936166.5	50.95482927	1.1	37.71738
Mali	24	2011	496.783	2361474933	4060272.8	51.37207317	1.1	39.48033
Mozambique	25	1990	186.882	554367511.6	6033968.3	43.17626829	0.4	6.97938
Mozambique	25	1991	191.445	444764346.4	6219107.4	43.49668293	0.7	6.92786
Mozambique	25	1992	175.888	389248795	6494993.6	43.90046341	1.4	6.63096
Mozambique	25	1993	184.146	414314171.4	6836293	44.36963415	2.3	6.66938
Mozambique	25	1994	189.477	483242025.1	7177010.2	44.8847561	3.5	6.77672
Mozambique	25	1995	188.164	606080914.7	7497060.7	45.41095122	4.7	7.29984
Mozambique	25	1996	196.173	655583840.6	7759307	45.91082927	5.7	
Mozambique	25	1997	210.489	784331843.8	7991334.3	46.3554878	6.6	
Mozambique	25	1998	227.324	792954138.7	8260404.8	46.72753659	7.4	
Mozambique	25	1999	239.6	906841388.3	8516548.5	47.02097561	8.2	5.18658
Mozambique	25	2000	235.885	1333997931	8770874.5	47.23785366	9	6.07794
Mozambique	25	2001	256.785	813859462.5	9012993.6	47.39565854	9.7	6.83216
Mozambique	25	2002	271.7	1258647713	9247729.6	47.52678049	10.3	8.44146
Mozambique	25	2003	280.043	1039459673	9486286	47.66212195	10.7	
Mozambique	25	2004	296.177	1062672248	9695215.1	47.81960976	11	10.82119
Mozambique	25	2005	313.108	1229812976	9919081	48.01714634	11.1	13.24601
Mozambique	25	2006	324.003	1252661574	10136436	48.26514634	11.2	15.56512
Mozambique	25	2007	338.44	1296590375	10372110	48.56058537	11.3	18.29254
Mozambique	25	2008	352.165	1630152949	10602312	48.89839024	11.3	20.51937
Mozambique	25	2009	364.882	1446157241	10851664	49.27802439	11.3	23.29666
Mozambique	25	2010	380.849	2026063421	11095305	49.69692683	11.3	25.45128
Mozambique	25	2011	398.523	3101440719	11359025	50.15060976	11.3	26.38109
Namibia	26	1990	2672.81	498585248.3	444440.88	60.77741463	1.8	38.09905
Namibia	26	1991	2791.27	400895949.9	465632.48	60.85521951	2.3	43.35263
Namibia	26	1992	2898.01	592213047.1	485273.97	60.86131707	3.1	48.54616
Namibia	26	1993	2756.42	601944783.5	505895.91	60.7862439	4	51.94561
Namibia	26	1994	2872.71	635068451.7	525199.65	60.62802439	5.3	55.91661
Namibia	26	1995	2903.39	776656736.7	537102.17	60.36073171	6.8	55.53805
Namibia	26	1996	2906.39	822217471.3	550969.09	59.95790244	8.6	55.09021
Namibia	26	1997	2938.23	713547602.6	566338.54	59.4344878	10.4	56.18112

Namibia	26	1998	2948.21	781616839.8	591812.17	58.83185366	12	55.60911
Namibia	26	1999	2969.79	779116513	615859.27	58.20585366	13.5	57.4096
Namibia	26	2000	3007.32	648142833.5	637381.5	57.65773171	14.6	60.10899
Namibia	26	2001	2990.31	742347050.6	663955.18	57.30121951	15.5	64.17703
Namibia	26	2002	3090.22	670350993.5	687116.38	57.20165854	15.9	63.58881
Namibia	26	2003	3183.93	941339870.4	707929.2	57.38895122	15.8	63.31561
Namibia	26	2004	3535.26	1226374166	728127.15	57.85358537	15.6	63.17133
Namibia	26	2005	3582.24	1351400580	750306.14	58.54412195	15.1	63.12855
Namibia	26	2006	3787.22	1725749856	773653.86	59.37426829	14.6	63.05897
Namibia	26	2007	3937.49	2085910382	799184.2	60.22326829	14.2	64.04979
Namibia	26	2008	4012.41	2159244373	825734.66	60.98934146	13.9	
Namibia	26	2009	3908.14	1960070648	846542.09	61.61858537	13.7	
Namibia	26	2010	4073.83	2510236692	869079.7	62.07009756	13.6	
Namibia	26	2011	4200.23	2656885958	894912.01	62.33241463	13.4	
Niger	27	1990	302.852	281711053.5	2300896.9	41.43285366	0.4	6.2041
Niger	27	1991	300.734	182200427.9	2394299.9	41.91331707	0.4	6.73622
Niger	27	1992	272.088	171097107.7	2502705.8	42.4687561	0.5	6.48853
Niger	27	1993	266.912	108720203.7	2613287.6	43.08819512	0.5	6.47799
Niger	27	1994	268.225	139047813.5	2734328.3	43.76212195	0.6	
Niger	27	1995	265.748	131608148.7	2856254.4	44.4775122	0.6	
Niger	27	1996	265.214	186037634.6	2993781	45.22534146	0.7	6.61704
Niger	27	1997	262.834	195283499.6	3137765.1	45.99060976	0.7	6.85551
Niger	27	1998	279.824	228774634.6	3282014.3	46.76034146	0.8	6.82567
Niger	27	1999	268.242	201397071.4	3435867.4	47.52202439	0.8	7.08235
Niger	27	2000	254.991	201416824.1	3587713	48.26668293	0.8	6.96538
Niger	27	2001	263.362	231684554.6	3736790.4	48.99082927	0.8	6.83248
Niger	27	2002	261.6	303495739.1	3883242.4	49.69602439	0.9	6.83847
Niger	27	2003	265.647	398824629.8	4034125.4	50.38226829	0.9	7.41697
Niger	27	2004	256.395	488636045.3	4184835	51.04356098	0.9	8.94438
Niger	27	2005	258.282	729177686.3	4336350.5	51.67290244	0.9	9.82571
Niger	27	2006	263.356	822733098.4	4481710.3	52.26526829	0.9	11.20849
Niger	27	2007	261.74	973672737.1	4634210.3	52.81814634	0.9	10.79985
Niger	27	2008	276.313	1667048322	4802190.8	53.3344878	0.8	11.18715
Niger	27	2009	263.7	1749470529	4972004.2	53.81582927	0.8	11.78863
Niger	27	2010	233.68	2049642656	5151611.6	54.26563415	0.8	13.51693
Niger	27	2011	230.089	2214651982	5341706.8	54.69092683	0.8	14.4429
Nigeria	28	1990	663.326	40121.31	29938467	45.63734146	0.5	24.28445
Nigeria	28	1991	677.387	45190.23	30776505	45.53453659	0.7	
Nigeria	28	1992	679.781	70809.16	31587772	45.41536585	1.1	

Nigeria	28	1993	677.54	96915.51	32480727	45.29026829	1.4	
Nigeria	28	1994	661.491	105575.49	33340919	45.17973171	1.8	
Nigeria	28	1995	661.319	141920.24	34222368	45.11570732	2.3	
Nigeria	28	1996	672.747	204047.61	35125184	45.13321951	2.7	
Nigeria	28	1997	673.857	242899.79	36047665	45.25370732	3	
Nigeria	28	1998	669.558	242256.26	36984374	45.48614634	3.3	
Nigeria	28	1999	660.179	231661.69	37860873	45.82953659	3.5	23.25023
Nigeria	28	2000	678.586	331056.73	38736772	46.27231707	3.7	24.28275
Nigeria	28	2001	682.253	372135.65	39610699	46.79146341	3.7	26.65445
Nigeria	28	2002	675.559	499681.53	40412296	47.3504878	3.8	29.16394
Nigeria	28	2003	726.447	865876.46	41215948	47.91636585	3.7	
Nigeria	28	2004	783.074	863072.62	41951865	48.47260976	3.7	34.4422
Nigeria	28	2005	804.152	804400.82	43092686	49.00470732	3.6	34.43702
Nigeria	28	2006	831.789	1546525.648	44347507	49.51065854	3.6	34.01248
Nigeria	28	2007	862.142	1936958.208	45558533	49.9994878	3.6	31.52283
Nigeria	28	2008	889.433	2053005.946	46893149	50.47973171	3.6	35.08644
Nigeria	28	2009	925.786	3050575.917	48187380	50.94941463	3.6	38.99424
Nigeria	28	2010	972.546	4012918.651	49617165	51.41002439	3.7	44.04996
Nigeria	28	2011	1015.56	3908280.323	51009170	51.86312195	3.7	
Rwanda	29	1990	236.008	373601775.8	3228427.9	32.82697561	5.8	16.48939
Rwanda	29	1991	238.026	268039805	3164899.5	29.44004878	5.8	16.72485
Rwanda	29	1992	268.505	317220023.2	3040576.8	27.33458537	5.8	16.56174
Rwanda	29	1993	266.208	330171823.3	2901817.9	26.81870732	5.7	
Rwanda	29	1994	140.254	75231818.47	2809169.8	27.93634146	5.6	
Rwanda	29	1995	191.821	173451854.4	2809219.5	30.47317073	5.4	
Rwanda	29	1996	206.578	198647416	2918702.9	33.97580488	5.2	
Rwanda	29	1997	215.523	255696103.6	3125444.2	37.76419512	5	
Rwanda	29	1998	211.74	294575251.3	3386125	41.27392683	4.8	
Rwanda	29	1999	207.971	238998980.4	3642320.9	44.23480488	4.6	10.02174
Rwanda	29	2000	210.713	232064995.3	3854148.3	46.51021951	4.4	11.11652
Rwanda	29	2001	219.454	230026783.6	4016319.8	48.13670732	4.1	11.10942
Rwanda	29	2002	242.797	226141902.2	4146197.5	49.37758537	3.8	11.72521
Rwanda	29	2003	242.579	255740212.4	4253531.8	50.44909756	3.6	12.92745
Rwanda	29	2004	255.835	313967134.7	4349909.4	51.39641463	3.4	14.51709
Rwanda	29	2005	273.747	407297917.6	4458494.3	52.24763415	3.3	15.86902
Rwanda	29	2006	290.038	497838919.6	4573794	53.00639024	3.1	17.80026
Rwanda	29	2007	303.775	674378404.8	4693300.6	53.65973171	3.1	20.25419
Rwanda	29	2008	327.942	1068895262	4820358.5	54.20619512	3	22.16224
Rwanda	29	2009	338.27	1133177891	4971525.4	54.66580488	3	26.61204

Rwanda	29	2010	352.412	1179437803	5142631	55.05712195	3	32.1703
Rwanda	29	2011	370.921	1362476594	5338276.9	55.39458537	2.9	35.8105
Senegal	30	1990	680.41	1028619695	3008461	53.24834146	0.1	15.39422
Senegal	30	1991	676.595	1016139380	3118097.5	53.50180488	0.2	
Senegal	30	1992	664.313	1134503778	3228604.2	53.7242439	0.2	15.86739
Senegal	30	1993	653.045	1031529086	3346078	53.93268293	0.2	
Senegal	30	1994	634.352	826545360.5	3463386.9	54.14212195	0.2	
Senegal	30	1995	650.287	923473930.5	3573826.2	54.36307317	0.2	
Senegal	30	1996	646.397	1025698350	3685516.1	54.60453659	0.3	15.26312
Senegal	30	1997	650.315	910847985.9	3789902.3	54.86353659	0.3	15.08944
Senegal	30	1998	672.262	1163042554	3894475.3	55.13856098	0.3	15.03242
Senegal	30	1999	697.778	1150834021	3997968.7	55.43112195	0.4	15.87991
Senegal	30	2000	702.348	1047981497	4119042.4	55.7392439	0.4	16.46885
Senegal	30	2001	715.835	1108426388	4243028.4	56.05843902	0.5	16.7216
Senegal	30	2002	701.734	1323844163	4385843.3	56.38265854	0.5	18.0933
Senegal	30	2003	728.599	1451212592	4523409.8	56.70741463	0.5	
Senegal	30	2004	750.904	1820836502	4664590.8	57.02917073	0.6	21.38448
Senegal	30	2005	771.817	2578144980	4814092.4	57.34934146	0.6	23.48565
Senegal	30	2006	770.006	2642219709	4965714.6	57.66787805	0.6	25.21879
Senegal	30	2007	785.559	3497802237	5120336.9	57.98721951	0.6	
Senegal	30	2008	792.438	4042676656	5278931.8	58.30936585	0.7	31.40293
Senegal	30	2009	786.639	3562562408	5442910	58.63231707	0.7	
Senegal	30	2010	796.149	3728036279	5613359.4	58.95407317	0.7	37.43125
Senegal	30	2011	793.8	4377862349	5790670.1	59.27219512	0.7	42.07769
Sierra Leone	31	1990	366.045	84492257.07	1478835.4	38.72146341	0.1	17.16944
Sierra Leone	31	1991	373.676	85087171.35	1482286.7	38.12239024	0.1	16.86168
Sierra Leone	31	1992	304.246	56914297.16	1479549.2	37.6632439	0.1	
Sierra Leone	31	1993	311.541	59568458.15	1468342.2	37.34563415	0.1	
Sierra Leone	31	1994	308.558	79006306.46	1457329.7	37.18760976	0.2	
Sierra Leone	31	1995	285.641	48526218.22	1453764.2	37.20870732	0.3	
Sierra Leone	31	1996	291.199	103930704.9	1453606.8	37.41887805	0.3	
Sierra Leone	31	1997	273.485	-20612328.07	1458755.1	37.79902439	0.4	
Sierra Leone	31	1998	276.009	35726528.52	1472549.7	38.3254878	0.5	
Sierra Leone	31	1999	265.943	1960425.673	1501116.5	38.97468293	0.7	
Sierra Leone	31	2000	276.145	6974332.011	1544488.4	39.73158537	0.8	
Sierra Leone	31	2001	247.121	118491554	1604861.1	40.57768293	0.9	27.61257
Sierra Leone	31	2002	298.328	146286326.8	1682933.4	41.48943902	1.1	
Sierra Leone	31	2003	311.105	155588398.1	1766728.9	42.43078049	1.2	
Sierra Leone	31	2004	316.599	149561322.3	1891325.6	43.36860976	1.3	

Sierra Leone	31	2005	317.947	186499814.9	1972576.6	44.2602439	1.4	
Sierra Leone	31	2006	325.686	195651509.7	2039822	45.07302439	1.5	
Sierra Leone	31	2007	343.101	204050613.3	2097813.5	45.79587805	1.6	
Sierra Leone	31	2008	353.785	228293024.9	2149501	46.42526829	1.6	
Sierra Leone	31	2009	358.222	242061347.2	2199831	46.95768293	1.6	
Sierra Leone	31	2010	370.438	620155786.8	2249179	47.40219512	1.6	
Sierra Leone	31	2011	385.173	1183762950	2304596.6	47.77636585	1.6	
South Africa	32	1990	4855.52	21444962263	10403438	61.54960976	0.5	66.07226
South Africa	32	1991	4708.03	20625680666	10796375	61.53153659	0.8	69.5147
South Africa	32	1992	4512.27	20425915571	11216416	61.35692683	1.3	
South Africa	32	1993	4472.49	19157267906	11685028	61.02485366	2.1	
South Africa	32	1994	4519.51	20571430523	12153096	60.53882927	3.3	79.67117
South Africa	32	1995	4560.64	23997782462	12641673	59.88741463	4.9	
South Africa	32	1996	4652.37	23406332805	13130608	59.06270732	6.9	
South Africa	32	1997	4667.48	24570733734	13645612	58.09112195	9.2	
South Africa	32	1998	4582.61	22957033266	14213476	57.01760976	11.4	89.68784
South Africa	32	1999	4578.79	20583406697	14806684	55.89253659	13.3	88.32965
South Africa	32	2000	4652.34	20122544235	15394283	54.77631707	14.8	85.25531
South Africa	32	2001	4682.78	17832707102	15924725	53.72731707	15.9	86.31167
South Africa	32	2002	4788.06	16331954979	16351860	52.79241463	16.6	87.45332
South Africa	32	2003	4866.92	26041709468	16760367	52.01343902	17	88.6465
South Africa	32	2004	5028.8	35014050591	17087224	51.4252439	17.2	91.18535
South Africa	32	2005	5234.31	41475134822	17434143	51.05968293	17.3	92.38011
South Africa	32	2006	5465.96	47859506300	17807595	50.92965854	17.3	95.00687
South Africa	32	2007	5706.28	57663016749	18173233	51.00365854	17.2	95.69964
South Africa	32	2008	5848.04	63032190148	18877614	51.24021951	17.2	93.11715
South Africa	32	2009	5697.23	61223147163	18543222	51.61131707	17.2	93.81168
South Africa	32	2010	5794.24	70207405639	18271901	52.0814878	17.3	
South Africa	32	2011	5923.99	76202028818	18624602	52.61478049	17.3	
Swaziland	33	1990	2017.01	162175480.7	250789.85	59.34404878	3	49.35292
Swaziland	33	1991	1995.8	172779997.9	259059.53	59.29258537	4	46.70947
Swaziland	33	1992	2013.22	244599065.5	265614.39	58.97678049	5.3	47.11439
Swaziland	33	1993	2034.79	236187587.2	272097.22	58.38473171	6.8	47.19893
Swaziland	33	1994	2043.92	236763657.4	278119.55	57.5235122	8.6	47.31824
Swaziland	33	1995	2099.84	261918317.3	285854.33	56.39373171	10.6	
Swaziland	33	1996	2133.84	261760549.4	294642.62	55.008	12.8	45.72653
Swaziland	33	1997	2151.41	283878229.6	304105.03	53.44180488	15	44.41262
Swaziland	33	1998	2160.37	301250795	313997.99	51.79453659	17.1	41.83965
Swaziland	33	1999	2182.83	258139632.9	323262.22	50.16207317	19.1	41.90808

Swaziland	33	2000	2188.75	276188387.9	331760.71	48.67021951	20.8	41.97456
Swaziland	33	2001	2191.34	309890110.5	338025.58	47.4397561	22.2	41.2828
Swaziland	33	2002	2214.99	236302045.6	343603.44	46.52797561	23.3	44.63021
Swaziland	33	2003	2252.65	381982262.2	348645.13	45.96173171	24.2	46.50785
Swaziland	33	2004	2303.66	369646078.4	354226.91	45.74697561	24.8	50.23591
Swaziland	33	2005	2339.29	388625947.7	361106.92	45.86019512	25.1	53.89044
Swaziland	33	2006	2387.13	377742217.8	369521.74	46.2394878	25.3	
Swaziland	33	2007	2434.36	375338964	379847.65	46.7695122	25.4	53.94912
Swaziland	33	2008	2450.83	333618870.8	390283.98	47.34192683	25.6	58.00356
Swaziland	33	2009	2440.1	325372435.7	402211.08	47.88882927	25.8	59.964
Swaziland	33	2010	2445.08	376863318	413019.25	48.34280488	25.9	
Swaziland	33	2011	2413.95	379982067.5	424050.63	48.65892683	26	
Tanzania	34	1990	300.83	1097044395	12263937	50.59714634	5	5.05618
Tanzania	34	1991	297.142	1288699257	12703310	50.3292439	6	5.33712
Tanzania	34	1992	289.035	1240701952	13169753	50.06470732	6.9	5.31965
Tanzania	34	1993	282.972	1059887835	13635249	49.83597561	7.6	5.30097
Tanzania	34	1994	278.426	1102403774	14112342	49.66602439	8.1	5.25849
Tanzania	34	1995	279.938	1029809323	14573929	49.5737561	8.3	5.3405
Tanzania	34	1996	284.729	1070037875	15015868	49.56763415	8.4	5.15948
Tanzania	34	1997	287.267	1131146135	15425430	49.64453659	8.3	5.56876
Tanzania	34	1998	290.65	1827211687	15844212	49.80085366	8.1	
Tanzania	34	1999	297.349	1653577702	16266692	50.04097561	7.8	
Tanzania	34	2000	304.359	1665851840	16682946	50.37329268	7.5	
Tanzania	34	2001	314.547	1765266323	17132494	50.80473171	7.2	
Tanzania	34	2002	328.525	1811346145	17655725	51.32826829	6.9	
Tanzania	34	2003	342.05	2192901888	18178056	51.93539024	6.6	
Tanzania	34	2004	359.037	2841662711	18699496	52.61160976	6.4	
Tanzania	34	2005	374.999	3487079294	19241506	53.34692683	6.1	
Tanzania	34	2006	389.082	3900862773	19805960	54.12936585	6	
Tanzania	34	2007	404.978	4914729858	20349436	54.9425122	5.8	
Tanzania	34	2008	422.44	6080623055	20916638	55.76943902	5.8	
Tanzania	34	2009	434.704	6075055960	21533273	56.58973171	5.8	
Tanzania	34	2010	451.547	7221949669	22153254	57.3874878	5.8	31.71978
Tanzania	34	2011	466.368	8608820163	22801577	58.15121951	5.8	
Togo	35	1990	425.608	411386273.6	1535334.8	52.99197561	1.7	22.17811
Togo	35	1991	411.745	289101638.4	1586222	53.24680488	1.9	21.11185
Togo	35	1992	385.668	270675901.9	1636615.9	53.47826829	2.1	20.94491
Togo	35	1993	319.663	134661485.2	1687881.8	53.68787805	2.4	
Togo	35	1994	358.849	117924237	1741941.7	53.87717073	2.6	21.03135

Togo	35	1995	377.699	177923136.7	1797902.2	54.05009756	2.9	23.37169
Togo	35	1996	400.995	251391628.4	1860886.2	54.21117073	3.1	25.1294
Togo	35	1997	447.232	194455695	1925863.6	54.36585366	3.4	25.64311
Togo	35	1998	425.937	259561020.9	1997254.2	54.51707317	3.6	
Togo	35	1999	425.435	210736044.4	2069218.2	54.66729268	3.8	31.20353
Togo	35	2000	411.362	187197249.1	2143576.6	54.8094878	4	33.68787
Togo	35	2001	394.337	194237344.6	2217512	54.93409756	4.1	36.4627
Togo	35	2002	380.677	218616169.4	2296676.3	55.03863415	4.2	40.62018
Togo	35	2003	389.26	270908009.2	2378018.6	55.12656098	4.2	42.80766
Togo	35	2004	387.28	303115492.2	2458056.8	55.20836585	4.2	44.32758
Togo	35	2005	381.782	334742823.8	2539383.7	55.304	4.1	46.80196
Togo	35	2006	387.079	357165849.9	2625144.5	55.43743902	4	48.78454
Togo	35	2007	385.836	363459931.1	2702277.9	55.62619512	3.9	45.54439
Togo	35	2008	384.365	442145390.2	2783884.5	55.88031707	3.8	
Togo	35	2009	387.693	505133026.7	2866957	56.20280488	3.6	
Togo	35	2010	392.855	600664563.2	2951738.8	56.58870732	3.5	
Togo	35	2011	401.122	685818760.1	3034523.4	57.02658537	3.4	56.48817
Uganda	36	1990	197.64	546834359.7	7492038.5	47.35673171	13.4	11.23594
Uganda	36	1991	201.478	503948344.7	7727160	46.70236585	13	10.40364
Uganda	36	1992	201.353	454802846.9	7972034.3	46.07914634	12.5	10.07572
Uganda	36	1993	210.911	489991115.6	8218180.4	45.5394878	11.8	9.92893
Uganda	36	1994	217.145	583971836.7	8466935.7	45.12236585	11.1	10.09463
Uganda	36	1995	234.466	942074675.2	8709159.3	44.86529268	10.3	10.3362
Uganda	36	1996	247.77	1025935456	8965878.8	44.7917561	9.6	
Uganda	36	1997	252.425	1059151314	9216657.6	44.89019512	8.9	9.73386
Uganda	36	1998	256.718	1048569024	9487742.5	45.14487805	8.2	
Uganda	36	1999	268.811	1155633963	9761398.6	45.54814634	7.7	
Uganda	36	2000	268.487	1191206866	10052804	46.09168293	7.2	16.30739
Uganda	36	2001	273.26	1112473624	10376640	46.76673171	6.9	16.46782
Uganda	36	2002	287.326	1233444163	10721064	47.54312195	6.6	19.20214
Uganda	36	2003	295.723	1310639530	10977055	48.3852439	6.4	19.35352
Uganda	36	2004	305.291	1583660057	11216466	49.2575122	6.4	19.1235
Uganda	36	2005	313.799	2001226002	11435095	50.12392683	6.4	19.34585
Uganda	36	2006	336.098	2087727059	11810406	50.95307317	6.4	20.96489
Uganda	36	2007	352.309	2605900269	12218421	51.72968293	6.6	24.42368
Uganda	36	2008	370.336	3284942596	12628990	52.43997561	6.7	26.96024
Uganda	36	2009	384.07	3776869645	13074531	53.07058537	6.9	28.37167
Uganda	36	2010	393.149	3999342912	13539987	53.61463415	7	
Uganda	36	2011	405.333	4103357711	14007698	54.0742439	7.2	

Zambia	37	1990	676.832	443061131.5	3390731.4	47.48063415	13.8	21.36253
Zambia	37	1991	660.282	383774768	3481849.4	46.56009756	14.4	
Zambia	37	1992	633.774	336373299.4	3575666.4	45.66939024	14.7	
Zambia	37	1993	661.298	375549059.8	3660624.9	44.84841463	14.9	
Zambia	37	1994	590.078	378928350.7	3762108.8	44.12656098	14.8	20.72078
Zambia	37	1995	559.43	432458876.6	3863665.3	43.51526829	14.8	
Zambia	37	1996	582.99	367834594.6	3961383.8	43.0084878	14.6	
Zambia	37	1997	586.276	511045814	4068999	42.58960976	14.5	
Zambia	37	1998	559.916	479625209.1	4184095.7	42.25507317	14.5	
Zambia	37	1999	557.147	458162148.7	4292335	42.02121951	14.4	
Zambia	37	2000	561.793	518337089.4	4396235.1	41.92987805	14.4	
Zambia	37	2001	574.438	641855263.6	4489495.3	42.03082927	14.4	
Zambia	37	2002	578.789	764007001.9	4585250.7	42.34253659	14.4	
Zambia	37	2003	593.437	1049627681	4675732.9	42.85856098	14.3	
Zambia	37	2004	609.824	1285180412	4771484.2	43.55495122	14.2	
Zambia	37	2005	625.854	1607487876	4882483.6	44.38436585	13.9	
Zambia	37	2006	647.362	2223995199	4997685.2	45.2885122	13.6	
Zambia	37	2007	668.642	2379392774	5122957.1	46.19763415	13.3	
Zambia	37	2008	689.335	2858200716	5266203.8	47.05243902	13.1	
Zambia	37	2009	709.999	2506041232	5415571.5	47.81453659	12.9	
Zambia	37	2010	741.442	3410739194	5578215.2	48.4554878	12.7	
Zambia	37	2011	767.911	4499379561	5754990.1	48.96882927	12.5	
Zimbabwe	38	1990	678.552	1599509534	4128498.2	60.52892683	13.6	47.04309
Zimbabwe	38	1991	697.99	1778879790	4279140.6	59.58170732	15.9	48.75649
Zimbabwe	38	1992	620.708	1509815472	4415299	58.31534146	18.3	43.46016
Zimbabwe	38	1993	614.392	1548516599	4539847.7	56.77080488	20.8	39.06028
Zimbabwe	38	1994	658.339	1472638090	4657563.3	55.00802439	23.2	38.97891
Zimbabwe	38	1995	647.442	1747755524	4784179.6	53.09839024	25	40.53848
Zimbabwe	38	1996	702.052	1543029650	4909072.2	51.12426829	26.2	41.50235
Zimbabwe	38	1997	708.92	1539557890	5035802.6	49.18890244	27	43.2305
Zimbabwe	38	1998	718.418	1318900372	5080176.3	47.39956098	27.3	
Zimbabwe	38	1999	703.612	175133018.4	5091355	45.8474878	27	42.77601
Zimbabwe	38	2000	675.6	789279655.6	5424440.2	44.61797561	26.2	42.71686
Zimbabwe	38	2001	680.801	821270016.9	5726273.3	43.76843902	25	43.59747
Zimbabwe	38	2002	617.593	645151225.1	5997839.3	43.28478049	23.6	41.58596
Zimbabwe	38	2003	511.331	791195891.7	6233026.1	43.1434878	22.2	38.001
Zimbabwe	38	2004	480.878	296538813.2	6435960.2	43.33697561	20.7	
Zimbabwe	38	2005	452.789	115129682.3	6441073.4	43.86158537	19.3	
Zimbabwe	38	2006	436.644	121109434.2	6438959.7	44.70178049	18.1	

Zimbabwe	38	2007	420.169	268746140.3	6433960.9	45.79707317	17.1	
Zimbabwe	38	2008	344.742	145095996.8	6446153.8	47.07060976	16.3	
Zimbabwe	38	2009	362.4	656841088	6501296.7	48.4504878	15.7	
Zimbabwe	38	2010	391.55	1040737934	6616609.9	49.86087805	15.2	
Zimbabwe	38	2011	419.236	1202143793	6816226	51.23643902	14.9	

SOURCE: WDI 2013

APPENDIX B: SUMMARY STATISTIC OF VARIABLES

GDP per capita (constant 2005 US$)

	Percentiles	Smallest		
1%	136.4497	113.0082		
5%	184.9376			
	123.1573			
10%	221.3448	123.4702	Obs	834
25%	298.5799	126.524	Sum of Wgt.	834
50%	487.1745		Mean	1237.3
		Largest	Std. Dev.	1979.153
75%	993.8985	13960.19		
90%	3434.603	14245.07	Variance	3917045
95%	5706.278	14606.63	Skewness	3.498716
99%	9543.067	14901.35	Kurtosis	18.29466

Gross fixed capital formation (current US$)

	Percentiles	Smallest		
1%	231661.7	-2.06e+07		
5%	3.57e+07	40121.31		
10%	8.09e+07	45190.23	Obs	819
25%	2.42e+08	70809.16	Sum of Wgt.	819
50%	6.57e+08		Mean	2.04e+09
		Largest	Std. Dev.	6.35e+09
75%	1.54e+09	6.12e+10		
90%	3.11e+09	6.30e+10	Variance	4.04e+19

95%	6.19e+09	7.02e+10	Skewness	7.79087
99%	2.60e+10	7.62e+10	Kurtosis	73.38001

Labor force, total

	Percentiles	Smallest		
1%	134652	117999.7		
5%	214642.6	121169.5		
10%	366971.8	121362.5	Obs	836
25%	1257155	125024.1	Sum of Wgt.	836
50%	3644379		Mean	6009301
		Largest	Std. Dev.	8181318
75%	6613802	4.69e+07		
90%	1.36e+07	4.82e+07	Variance	6.69e+13
95%	2.28e+07	4.96e+07	Skewness	2.88327
99%	4.20e+07	5.10e+07	Kurtosis	12.20875

School enrollment, secondary (% gross)

	Percentiles	Smallest		
1%	5.30097	4.81315		
5%	6.77672	5.05618		
10%	9.37531	5.15948	Obs	510
25%	15.10039	5.18658	Sum of Wgt.	510
50%	27.0761		Mean	31.13821
		Largest	Std. Dev.	20.37079
75%	42.06077	93.11715		
90%	58.07293	93.81168	Variance	414.9689
95%	74.98104	95.00687	Skewness	1.064818

99%	91.18535	95.69964	Kurtosis	3.796707

Life expectancy at birth, total (years)

	Percentiles	Smallest		
1%	37.20871	26.81871		
5%	43.06163	27.33459		
10%	44.70178	27.93634	Obs	836
25%	47.47646	29.44005	Sum of Wgt.	836
50%	51.23833		Mean	51.92904
		Largest	Std. Dev.	6.570229
75%	56.05328	73.3362		
90%	60.22327	73.58681	Variance	43.16791
95%	62.28668	73.77405	Skewness	.2158064
99%	71.06763	73.91678	Kurtosis	4.109493

Prevalence of HIV, total (% of population ages 15-49)

	Percentiles	Smallest		
1%	.1	.1		
5%	.2	.1		
10%	.5	.1	Obs	836
25%	1.3	.1	Sum of Wgt.	836
50%	3.3		Mean	5.795933
		Largest	Std. Dev.	6.558254
75%	7.35	27		
90%	15.1	27	Variance	43.01069
95%	23	27	Skewness	1.644051

99%	26.2	27.3	Kurtosis	4.950198

APPENDIX C: ORDINARY POOLED OLS

Source	SS	df	MS	Number of obs =	507
Model	297.334803	5	59.4669606	F(5, 501) =	143.16
Residual	208.112488	501	.415394187	Prob > F =	0.0000
Total	505.447291	506	.998907689	R-squared =	0.5883
				Adj R-squared =	0.5842
				Root MSE =	.64451

lPCI	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lGCF	.1087317	.0192543	5.65	0.000	.0709026	.1465608
lLAB	-.269475	.0242515	-11.11	0.000	-.3171221	-.2218279
lSSE	.7808337	.0562023	13.89	0.000	.6704124	.8912551
lLFE	-.4962079	.3253094	-1.53	0.128	-1.135347	.1429309
lHIV	.0816605	.0267609	3.05	0.002	.0290831	.1342379
_cons	7.561033	1.256943	6.02	0.000	5.091503	10.03056

APPENDIX D: TEST FOR MULTICOLLINEARITY USING THE (VARIANCE INFLATION FACTOR) VIF

Using the (variance inflation factor)vif

Variable	VIF	1/VIF
lSSE	1.92	0.521326
lLFE	1.85	0.541377
lHIV	1.45	0.688245
lLAB	1.25	0.800700
lGCF	1.25	0.801455
Mean VIF	1.54	

Using the pair wise correlation (pwcorr)

	lGCF	lLAB	lSSE	lLFE	lHIV
lGCF	1.0000				
lLAB	0.1880*	1.0000			
lSSE	0.2289*	-0.2703*	1.0000		
lLFE	0.2441*	-0.2397*	0.5296*	1.0000	
lHIV	0.2762*	0.1756*	0.2916*	-0.2051*	1.0000

APPENDIX E: FIXED EFFECTS MODEL

```
Fixed-effects (within) regression               Number of obs      =       507
Group variable: id                              Number of groups   =        38

R-sq:  within  = 0.4556                         Obs per group: min =         2
       between = 0.2984                                        avg =      13.3
       overall = 0.3207                                        max =        22

                                                F(5,464)           =     77.66
corr(u_i, Xb)  = 0.2835                         Prob > F           =    0.0000

------------------------------------------------------------------------------
        lPCI |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        lGCF |   .1735699   .0143087    12.13   0.000     .1454521    .2016878
        lLAB |  -.1031063   .0710796    -1.45   0.148    -.2427841    .0365714
        lSSE |   .1322349   .0320835     4.12   0.000      .069188    .1952818
        lLFE |  -.3496512   .1037611    -3.37   0.001     -.553551   -.1457514
        lHIV |   .0188569   .0151171     1.25   0.213    -.0108496    .0485634
       _cons |   5.341002    .895112     5.97   0.000     3.582026    7.099977
-------------+----------------------------------------------------------------
     sigma_u |  .86824957
     sigma_e |  .13682979
         rho |  .97576639   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(37, 464) =   287.88             Prob > F = 0.0000
```

APPENDIX F: RANDOM EFFECTS MODEL

```
Random-effects GLS regression                   Number of obs      =       507
Group variable: id                              Number of groups   =        38

R-sq:  within  = 0.4506                         Obs per group: min =         2
       between = 0.4402                                        avg =      13.3
       overall = 0.4565                                        max =        22

Random effects u_i ~ Gaussian                   Wald chi2(5)       =    401.86
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

------------------------------------------------------------------------------
        lPCI |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        lGCF |   .1779429   .0140298    12.68   0.000     .1504449    .2054408
        lLAB |  -.2450477   .0529756    -4.63   0.000     -.348878   -.1412175
        lSSE |   .1867532   .0283348     6.59   0.000      .131218    .2422885
        lLFE |   -.296871   .1043153    -2.85   0.004    -.5013252   -.0924168
        lHIV |   .0352622   .0145447     2.42   0.015     .0067552    .0637692
       _cons |   7.048303   .7217039     9.77   0.000      5.63379    8.462817
-------------+----------------------------------------------------------------
     sigma_u |  .65873671
     sigma_e |  .13682979
         rho |  .95863885   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

APPENDIX G: TEST FOR HETEROSKEDASTICITY

```
Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model

H0: sigma(i)^2 = sigma^2 for all i

chi2 (38)  =   13116.79
Prob>chi2 =      0.0000
```

APPENDIX H: ROBUST FIXED EFFECTS MODEL

```
Fixed-effects (within) regression               Number of obs      =       507
Group variable: id                              Number of groups   =        38

R-sq:  within  = 0.4556                         Obs per group: min =         2
       between = 0.2984                                        avg =      13.3
       overall = 0.3207                                        max =        22

                                                F(5,464)           =     44.68
corr(u_i, Xb)  = 0.2835                         Prob > F           =    0.0000

                                    (Std. Err. adjusted for clustering on id)
------------------------------------------------------------------------------
             |               Robust
        lPCI |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        lGCF |   .1735699   .0285539     6.08   0.000     .1174589    .2296809
        lLAB |  -.1031063   .0748133    -1.38   0.169    -.2501213    .0439086
        lSSE |   .1322349   .0506869     2.61   0.009     .0326306    .2318392
        lLFE |  -.3496512   .1197073    -2.92   0.004    -.5848867   -.1144156
        lHIV |   .0188569   .0181918     1.04   0.300    -.0168917    .0546055
       _cons |   5.341002   1.116783     4.78   0.000     3.146423    7.535581
-------------+----------------------------------------------------------------
     sigma_u |  .86824957
     sigma_e |  .13682979
         rho |  .97576639   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

APPENDIX I: ROBUST RANDOM EFFECTS MODEL

```
Random-effects GLS regression                   Number of obs      =       507
Group variable: id                              Number of groups   =        38

R-sq:  within  = 0.4506                         Obs per group: min =         2
       between = 0.4402                                        avg =      13.3
       overall = 0.4565                                        max =        22

Random effects u_i ~ Gaussian                   Wald chi2(5)       =    238.56
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

                                    (Std. Err. adjusted for clustering on id)
------------------------------------------------------------------------------
             |               Robust
        lPCI |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        lGCF |   .1779429   .0292014     6.09   0.000     .1207093    .2351765
        lLAB |  -.2450477   .0703282    -3.48   0.000    -.3828884   -.1072071
        lSSE |   .1867532   .0442157     4.22   0.000      .100092    .2734144
        lLFE |   -.296871   .1310557    -2.27   0.023    -.5537355   -.0400065
        lHIV |   .0352622   .0193307     1.82   0.068    -.0026253    .0731496
       _cons |   7.048303   1.057185     6.67   0.000     4.976259    9.120348
-------------+----------------------------------------------------------------
     sigma_u |  .65873671
     sigma_e |  .13682979
         rho |  .95863885   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

APPENDIX J: HAUSMAN TEST

	---- Coefficients ----			
	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
	fe	re	Difference	S.E.
lGCF	.1735699	.1779429	-.004373	.
lLAB	-.1031063	-.2450477	.1419414	.0255144
lSSE	.1322349	.1867532	-.0545183	.0247817
lLFE	-.3496512	-.296871	-.0527802	.
lHIV	.0188569	.0352622	-.0164053	.

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(5) = (b-B)'[(V_b-V_B)^(-1)](b-B)

= 2.13

Prob>chi2 = 0.8313

(V_b-V_B is not positive definite)

APPENDIX K: BREUSCH AND PAGAN LAGRANGIAN MULTIPLIER TEST FOR RANDOM EFFECTS

```
Breusch and Pagan Lagrangian multiplier test for random effects

        lPCI[id,t] = Xb + u[id] + e[id,t]


        Estimated results:

                         |       Var     sd = sqrt(Var)
                ---------+-----------------------------
                    lPCI |   .9989077       .9994537
                       e |   .0187224       .1368298
                       u |   .4339341       .6587367


        Test:   Var(u) = 0

                             chi2(1) =  2355.71
       Prob > chi2 =     0.000
```

APPENDIX L: LIST OF COUNTRIES IN SUB-SAHARAN AFRICA USED IN THIS RESEARCH WORK

1. Angola
2. Benin
3. Botswana
4. Burkina Faso
5. Burundi
6. Cameroon
7. Cape Verde
8. Central African republic
9. Chad
10. Comoros
11. Congo, Rep.
12. Cote d'Ivoire
13. Equatorial Guinea
14. Eritrea
15. Ethiopia
16. Gabon
17. Gambia, The
18. Ghana
19. Guinea
20. Kenya
21. Lesotho
22. Madagascar
23. Malawi

24. Mali
25. Mozambique
26. Namibia
27. Niger
28. Nigeria
29. Rwanda
30. Senegal
31. Sierra Leone
32. South Africa
33. Swaziland
34. Tanzania
35. Togo
36. Uganda
37. Zambia
38. Zimbabwe