Thesis By

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UNIVERSITY OF IBADAN

IMPACT OF HIV/AIDS EPIDEMIC ON HUMAN CAPITAL DEVELOPMENT AND ECONOMIC GROWTH IN WEST AFRICA

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BY

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ABSTRACT

Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome (HIV/AIDS) affects the most productive age group (PAG) in society. The disease hits hardest in sub-Saharan Africa. As at 2012, the prevalence among PAG in the region averaged 4.9%. West Africa bears the third highest burden of the pandemic globally. Prevalence among PAG in the sub-region stood at 0.7%, 2.0%, 1.7% and 1.5% in 1990, 2000, 2010 and 2012 respectively. This however, varied from 3.2% in Côte d'Ivoire to 3.1% in Nigeria and 3.9% in Guinea-Bissau. Studies that examined the macroeconomic implications of the disease have however been limited to its associated costs, demographic and output impacts. This study examined the impact of HIV/AIDS epidemic on human capital development and economic growth in West Africa over the period 1990 to 2011.

The augmented Solow model, rooted in the neoclassical growth theory, was employed. This was operationalised using dynamic panel data modeling approach, with Difference and System Generalized Method of Moments (GMM) estimation techniques. Incidence, prevalence, number of people living with HIV/AIDS (PLWHA) and AIDS related deaths were used to measure HIV/AIDS. Life expectancy and primary school enrolment were employed as human capital measures, while growth rate of real Gross Domestic Product (GDP) per capita was used to capture economic growth. Interactive variable methodology was employed to capture the impact of HIV/AIDS on economic growth through its effects on human capital. To ensure robustness of the parameter estimates, the Hansen, Arellano-Bond autoregressive and Wald tests were carried out. Data were collected from the African Statistical Yearbook, Joint United Nations programme on HIV/AIDS, World Development Indicators, and the World Health Organization. All the estimations were evaluated at the 5% level of significance.

The prevalence of HIV among PAG was 2.2%. It varied between 0.1% and 7.3%. Country-specific trend gave 1990 prevalence in Cote d'Ivoire, Guinea-Bissau, and Nigeria as 5.8%, 0.3% and 0.5% respectively. The 1995 values in these countries stood correspondingly at 7.3%, 0.6% and 2.3%. By 2011, it had declined to 3.4% in Cote d'Ivoire, leaving Guinea-Bissau and Nigeria with increased prevalence of 3.9% and 3.7% in that order. The HIV/AIDS depressed human capital and economic growth in West

Africa. A percentage increase in incidence, prevalence, and AIDS related deaths reduced life expectancy significantly by 1.9%, 0.5% and 1.3%, respectively. School enrolment was not significantly affected by the disease. The regressive impact of HIV/AIDS was more pronounced on life expectancy than on school enrolment. A percentage increase in incidence, prevalence, PLWHA, and AIDS related deaths correspondingly reduced growth significantly through their effects on life expectancy by 0.15%, 0.02%, 0.004%, and 0.03%. The impacts of PLWHA and AIDS-related deaths on enrolment lowered economic growth by 0.004% and 0.06% respectively. However, incidence and prevalence did not decrease growth significantly.

Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome affected human capital and economic growth through reduction in life expectancy. There is the need to effectively control the disease in West African countries.

Key Words: HIV/AIDS, Human capital development, Economic growth, Dynamic panel analysis, West Africa.

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DEDICATION

This Work Is Dedicated

To

My Maker

The Almighty God

The Elohim

The High And The Lofty One

That Inhabits Eternity

The One Who Has Graciously Kept Me In Him Till Date

All Honour

All Glory

And Adoration

Belong To Him

Hallelujah !!!

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CERTIFICATION

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ABBREVIATIONS

AfDB	African Development Bank
AIDSD	AIDS Deaths
AIS	AIDS Indicator Survey
ANC	Antenatal Clinic
AR	Autocorrelation
ART	Antiretroviral Therapy
AV	Actual Value
AVE	Actual Value of Expected Year of Schooling
AVL	Actual Value of Life Expectancy
AVS	Actual Value of Mean Year of Schooling
BAFROW/ GFRWHPE	The Gambia Foundation for Research on Women's Health, Productivity and the Environment
BIDPA	Botswana Institute for Development Policy Analysis
CBA	Cost-Based Approach; and
CEYS	Computed Expected Year of Schooling
CGE	Computable General Equilibrium
CIA	Central Intelligence Agency
CIDA	Canadian International Development Agency
CMYS	Computed Mean Year of Schooling
COI	Cost Of Illness
DAC	District AIDS Committees/Divisional AIDS Coordinators/Divisional AIDS Committees
DALYs	Disability-Adjusted Life Years
DEP	Dependency Population
DFID	Department for International Development
DHAPP	Department of Defense HIV/AIDS Prevention Program
DHS	Demographic and Health Survey
DI	Dimension Index;
DIFF-GMM	Difference Generalized Method of Moments
DoD	Department of Defense

DPD	Dynamic Panel Data
DRG	Debt Relief Gain
EFA	Education for All
EGM	Economic Growth Models
EI	Education Index
ENR	Enrolment or Primary School Enrolment
ENRHA	Enhancing Nigeria Response to HIV/AIDS
EPP	Estimation and Projection Package
EYS	Expected Year of Schooling Index
EYS_{max}	Maximum Expected Year of Schooling
EYS_{min}	Minimum Expected Year of Schooling
FC	Fixed/Physical Capital
FCFA	Franc of the African Financial Community
FD	First Difference
FE	Fixed Effects
FMOH	Federal Ministry of Health
FIM	Full-Income Method
FSW	Female Sex Workers
GAC	Ghana AIDS Commission
GAMS	General Algebraic Modeling System
GBD	Global Burden of Diseases
GDB	German Development Bank
GDP	Gross Domestic Product
GFATM	Global Fund to Fight AIDS, Tuberculosis and Malaria
GHP	Global Health Policy
GMM	Generalized Method of Moments
GNAC	Guinean National AIDS Committee
GNI	Gross National Income
GNP	Gross National Product
GWPS	Government Workplace Public Sector
HALE	Health Adjusted Life Expectancy

HARRP	HIV/AIDS Rapid Response Project
HC	Human Capital
HCI	Human Capital Index
HCNLS	*Haut Conseil National de Lutte contre le SIDA (HCNLS)*, which means Supreme National Council for AIDS
HDI	Human Development Index
HEAP	HIV/AIDS Emergency Action Plan
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome
HIVI	HIV Incidence
HIVP	HIV Population
HIVPR	HIV Prevalence
HLE	Healthy Life Expectancy
HPDP	HIV/AIDS Programme Development Project
HRD	Human Resource Development
HSE	Household Socio-Economic
HSSS	HIV/AIDS Sentinel Surveillance Survey
IBA	Income-Based Approach.
IBBSS	Integrated Biological and Behavioural Surveillance Survey
IDAMAP	International Development Association Multisectoral AIDS Programme
IDU	Injecting Drug Users
ILO	International Labour Organization
LACA	Local Government Action Committee on AIDS
LBFg	Labour Force Growth
KfW	*Krebital ftaltfür Wieberaufbas*
LEI	Life Expectancy Index
MAL	Reported and Confirmed Malaria Cases
MAP	Multisectoral AIDS Programme or Multicountry AIDS Program
MARPs	Most-at-Risk Populations
MaV	Maximum Value
MaVE	Maximum Value of Expected Year of Schooling
MaVL	Maximum Value of Life Expectancy

MaVS	Maximum Value of Mean Year of Schooling
MiV	Minimum Value
MiVE	Minimum Value of Expected Year of Schooling
MiVL	Minimum Value of Life Expectancy
MiVS	Minimum Value of Mean Year of Schooling
MOH	Ministry of Health
MRW	Mankiw, Romer and Weil
MSM	Men Who Have Sex with Men
MTCT	Mother-to-Child Transmission
MTP	Medium Term Plan
MUP	Media and the Uniform Personnel
MYS	Mean Year of Schooling Index
MYS_{max}	Maximum Mean Year of Schooling
MYS_{min}	Minimum Mean Year of Schooling
NAC	National AIDS Council/National AIDS Commission
NACA	National Action Committee on AIDS or National Agency for the Control of AIDS
NACP	National AIDS Control Programme
NAP	National Action Plan
NAS	National AIDS Secretariat
NASA	National AIDS Spending Assessment
NBTP	National Blood Transfusion Policy
NCP	National Children Policy
NEP	National Education Policy
NGOs	Non-Governmental Organizations
NHPAP	National Health Policy and Action Plan
NHRC	Naval Health Research Center
NPA	National Plan of Action
NPP	National Population Policy
NRHA	National Response to HIV/AIDS
NRHP	National Reproductive Health Policy

NSF	National Strategic Framework
NSP	National Social Policies
NSS	National Sentinel Surveillance
NYPAP	National Youth Policy and Action Plan
OBA	Output-Based Approach;
OECD	Organization for Economic Co-Operation and Development
OHS	October Household Survey
OIs	Opportunistic Infections
OLG	Overlapping Generation
OLS	Ordinary Least Squares
OPA	Ouagadougou Peace Agreement
OPE	Trade openness;
OPP	Private Out-of-Pocket
OVC	Orphans and Vulnerable Children
PAG	Productive Age Group (Ages 15-49 years)
PAW	Policy on Advancement of Women
PCA	Presidential Council on AIDS
PCGDP	Per Capita Gross Domestic Product
PCGDPg	Growth Rate of Per Capita GDP
PCHA	Parliamentary Committee on HIV/AIDS
PEPFAR	President's Emergency Plan for AIDS Relief
PFM	Production Function Method
PLWHA	People or persons Living with HIV/AIDS
PMA	Programme Management and Administration
PMTCT	Prevention of Mother-To-Child Transmission
PP	Prevention Programmes
PPP	Purchasing Power Parity
PRSP	Poverty Reduction Strategic Paper
PS	Private Sector
PTCT	Prevention of Mother to Child Transmission
R and D	Research and Development

RE	Random Effects
SACA	State Action Committee on AIDS
SAM	Social Accounting Matrix
SNCA	Supreme National Council for AIDS
SPSS	Social Protection and Social Services
SSA	Sub-Saharan African
STD	Sexually Transmitted Diseases
STIs	Sexually Transmitted Infections
STNLS	National Technical Secretariat of Fight Against AIDS in Guinea-Bissau
STP	Short-Term Plan
SYS-GMM	System Generalized Method of Moments
TB	Tuberculosis
TC	Treatment and Care
TCA	Technical Committee on AIDS
TODG	Technical and other Support Groups
TW	Transport Workers
UCH	University College Hospital
UN	United Nations
UNAIDS	Joint United Nations Programme on HIV/AIDS
UNDP	United Nations Development Programme
UNGASS	United Nations General Assembly Special Session
UNICEF	United Nations Children's Fund
UNPD	United Nations Population Division
USA	United States of America
USAID	United States Agency for International Development
VCT	Voluntary Counseling and Testing
WA	West Africa
WAT	Proportion of Population without Access to Improved Source of Water
WDI	World Development Indicators
WHO	World Health Organization
WPA	Willingness to Pay Approach

CHAPTER ONE

INTRODUCTION

1.0 Introduction

The health[1] of a country's population is very strategic for her wellbeing and economic performance. At the household level, an individual's state of heath determines his productivity and income heights. A healthy individual has the wherewithal to put in more hours and efforts into productive activities, which invariably could translate into higher income and improved standard of living. Actually, "healthier people are more productive, supply labour more efficiently, work harder and longer, and think more clearly" (Audibert, Motel and Drabo, 2012: p. 8). The same scenario holds at the national, regional and global levels. Healthier countries are regarded as wealthier nations; and a healthy population can enhance national productivity, thereby stimulating better economic performance.

Health is a critical factor in the determination of labour force participation, and good health is *sine qua non* for higher per capita income, which is very significant for savings, investments and level of productivity in the economy (Tandon, 2005). López-Casasnovas, Rivera and Currais (2007) contend that no country can maintain a state of continuous growth and high rate of investment without a labour force with the minimum levels of education and health. This is precipitated on the premise that good health raises human capital level, which invariably improves economic productivity of individuals and consequently increases a country`s economic growth rate. Indeed, any country whose population enjoys good health is likely to have higher average life

1Health is a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity (WHO, 1948).

expectancy, low morbidity and mortality rates[2]; higher savings, greater investment in physical and human capital as well as increased national income.

Since the work of Grossman (1972a and 1972 b) on health, being a durable capital stock that can influence productivity, a good number of country-specific and cross country empirical works on economic impact of health had been carried out. Most of such studies document positive and significant effect of health on economic outcomes. For instance Bloom, Canning and Sevilla (2004: p. 1) reported that "good health has a positive, sizable, and statistically significant effect on aggregate output." Other studies which confirm this outcome include: Bhargava, Jamison, Lau, and Murray (2001); Arora (2001); Mayer (2001); and Weil (2007).

The presence of chronic and infectious diseases in a country has the ability to undermine development and constitutes a great burden on the entire economy, particularly when such diseases have reached the state of a generalized epidemic.[3] Accordingly, "chronic diseases reduce life expectancy and ultimately economic productivity, thus depleting the quality and quantity of countries' labour force" (Abegunde and Stanciole, 2006: p. 3).

2 Morbidity and mortality measure the health status of the population. While morbidity describes the state of being ill or sick, mortality has to do with death. Increased morbidity and mortality in any society reduce level of productivity, thereby retarding economic growth and development, and raise poverty level. Bell *et al* (2004: p. 98) maintain that "morbidity reduces productivity on the job or results in outright absenteeism. If the worker dies, his or her skills and experience are destroyed."

3 There are three major categorizations of epidemic according to World Bank (1997), and WHO and UNAIDS (2000). These are: nascent/low; concentrated, and generalized. A nascent epidemic with respect to the HIV/AIDS disease is a situation in which prevalence is less than 5 percent in all population subgroups. In this case, "recorded infection is largely confined to individuals with higher risk behaviour: e.g. sex workers, drug injectors, men having sex with other men…and prevalence has not consistently exceeded five percent in any defined sub-population" (WHO and UNAIDS, 2000: p. 24). On the other hand, a concentrated epidemic occurs when the disease has spread in a defined subpopulation as against the general population. Although the epidemic is not "well-established in the general population", about "5 percent or more of individuals in groups with high-risk behaviour" are infected with "less than 5 percent of women attending urban antenatal clinics, infected" (World Bank, 1997) while "prevalence is below one percent in pregnant women in urban areas" (WHO and UNAIDS, 2000: p. 2). A generalized epidemic however is a case whereby prevalence of a particular disease is up to 1 percent and above in the general population. Therefore, in the case of HIV/AIDS, about "5 percent or more of women attending urban antenatal clinics are infected while infection rates among individuals in groups with high-risk behavior are also likely to exceed 5 percent in countries with a generalized HIV Epidemic" (World Bank, 1997: p. xxiii).

The two basic and direct effects of diseases on the population of any country are morbidity and mortality. Other effects are directly related to these two and they manifest as: "pain, suffering, fear, and dread; loss of working time and income; worry, anxiety, and breakup of families; disruptions in the life and welfare of the community; and costs of care, coping, and prevention" (Hyder, Rotllant and Morrow, 1998: p. 196).

Consequent on the above discussions and the importance of health as a vital key driver for labour, capital investment and economic growth, there is the need for a critical study and analysis of issues that may inhibit good health and healthy life in any economy.

The subject matter of Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome (HIV/AIDS)[4] globally and particularly in Africa continues to dominate debates as to its implication on economic outcomes. Its emergence in the early 1980s opened a new devastating chapter in the global epidemic history. The ugly health, economic and social milieu created by the dreaded pandemic calls for concern. It has been reported that where its prevalence[5] is high, economic growth rates have been reduced, life expectancy has been cut short, rate of mortality increased, poverty level deepened, and the number of orphans multiplied (see McPherson, 2003; Haacker, 2010; United Nations Population Division, UNPD, 2009a and 2009b; and Annim and Dasmani, 2011). United Nations programme on HIV/AIDS (UNAIDS, 2004: p. 41) reiterates that in countries mostly affected by the disease it is erasing decades of hard-won health, "economic and social progress, reducing life expectancy by decades, slowing economic growth, deepening poverty, and contributing to and exacerbating chronic food shortages."

According to Boutayeb (2009), HIV/AIDS does not only destroy and disable adults in the most productive part of their lives but it also has negative consequences for business activities, level of investment, industry and agricultural sustainability, as well as

4 HIV is the virus responsible for AIDS infection. This is the initial stage of the disease while AIDS is the final stage. At the final stage, the disease becomes full blown. This stage is associated with opportunistic infections as well as increased viral mass.

5 H1V prevalence is the number of people currently infected with HIV at a given point in time. It is the number of people with HIV at a point in time, often expressed as a percentage of the total population. Since there is no cure yet for HIV/AIDS, HIV prevalence reflects the cumulative numbers of infections from the past and the mortality rate of those infected (World Bank, 1997). Prevalence combines incidence or risk of HIV and its duration.

household income and economic growth of nations. The pandemic has the capacity to increase dependency ratio in terms of "the number of younger and older dependants as a proportion of the productive age group" with an extended effect of a significant increase in number of women-headed families (see UNAIDS, United Nations Children's Fund, UNICEF and United States Agency for International Development, USAID, 2004; and Tandon, 2005: p. 4). Annim and Dasmani (2011: p. 123) note that the years of intensive efforts to combat the menace of HIV/AIDS, notwithstanding, the disease continues to spread rapidly in the developing world and "threatening to halt or even reverse years of hard-won human and economic development progress in numerous countries", especially in sub-Saharan African (henceforth SSA), the hardest hit region.

HIV/AIDS is highly concentrated in SSA countries, of which West Africa belongs, compare to any other regions of the world. UNAIDS (2012a) reported that asides 4.9 percent prevalence of the disease in SSA, 69 percent of the number of people living with HIV/AIDS (PLWHA) globally, are in the region; which is 25 times higher than what obtains in Asia. Moreover, in spite of the appreciable number of human, water and natural resources endowment, inclusive of very fertile land, most countries of WA still groan under poor macroeconomic performance owing to a number of factors with HIV/AIDS inclusive. Therefore, as the disease reaches the third decade since its detection, it is essential to further carry out rigorous academic research into its effects on key economic variables such as growth, human capital, life expectancy, population and labour force, particularly at the cross-country level. This will assist better policy formulations that aimed not only at combating menace of the epidemic but also to initiate various measures and programmes to counter any negative economic shock the disease could pose in African countries bearing the greatest and heaviest brunt of the pandemic.

Thus, this study employs economic growth model, entrenched in the neoclassical growth theory as well as human capital model within the human capital output framework to examine how the HIV/AIDS pandemic affects human capital development activities and economic growth in the West African sub-region, using dynamic panel data econometric technique.

1.1 Problem Statement

HIV/AIDS was discovered and reported in the early 1980s in the United States (see Centers for Disease Control and Prevention, 2000 and 2001). Since this period, many countries in SSA region have continued to report cases of the disease. The Southern African sub-region accounts for the greatest burden of the virus globally, followed by East Africa, and then West Africa.

In the history of mankind, HIV/AIDS appears to have brought about unimaginable surge in mortality and morbidity rates generally and among people in their productive ages (with social and economic consequences) more than the bubonic plague disease otherwise known as the black death of 1348 to 1350. Available statistics suggest that approximately 34 million people were living with the virus globally in 2010, out of which about 22.9 million were found in SSA, with 1.9 million new infections, 5.0 percent prevalence and 1.2 million adult and child AIDS-related deaths (WHO, UNAIDS and UNICEF, 2011). The global morbidity caused by the pandemic rose from 34 million in 2010 to 35.3 million in 2012; however, new infections declined from 2.7 million in 2010 to 2.3 million in 2012 while AIDS-related deaths reduced from the 2010 figure of 1.8 million to 1.6 million by the end of 2012 (see WHO, UNAIDS and UNICEF, 2011; and UNAIDS, 2013b). The report on *Global Burden of Disease* (GBD) by WHO (2008) affirms that HIV/AIDS and malaria together cause more than 4 million deaths annually in SSA.

Estimates of both past and present trends of global HIV/AIDS morbidity and mortality revealed that since the detection of the virus in the early 1980s till 2013, some 75 million people have been infected globally while AIDS-deaths, which stood at 36 million as at 2013 is projected to reach 75 million by 2030 (Bongaarts, Pelletier and Gerland, 2009 and UNAIDS, 2013b).

HIV/AIDS has been reported as one of the leading causes of morbidity and mortality globally, with the children, women and the Productive Age Group (PAG) being mostly affected, especially in SSA (WHO, 2008; Mathers, Boerma and Fat, 2009; Lozano *et al.*, 2012). Bongaarts, Pelletier and Gerland (2009) in their studies on 58 countries reported that around 86 percent of AIDS-related deaths occurred among the age group 15-59 in 2007 alone.

In West Africa, HIV prevalence in the general population hovers around 2 percent and 5 percent (which is above the 1percent level threshold that constitutes a generalized epidemic (see World Bank, 1997; WHO and UNAIDS, 2000; and Beyrer *et al*, 2010). According to Lowndes *et al* (2008) and USAID (2011a), about five million adults and children are infected with the virus in the sub-region (making it the third highest globally, after Southern and East Africa in terms of HIV/AIDS burden). Population prevalence of the virus ranges from 4.7 percent in Cote d'Ivoire to 2.2 percent in Ghana, and 1.8 percent in Burkina Faso. The rates in Benin, The Gambia, Guinea Bissau, Liberia, Mali, Nigeria, Sierra Leone and Togo, is between 1.2 percent and 1.5 percent while the antenatal clinic (ANC) prevalence stood between 2.8 percent and 6.7 percent.

Furthermore, the pandemic is reported to have reversed gains in life expectancy, reduced productivity, and shrunk investment in human and physical capital stocks, especially in Africa (see McPherson, 2003; UNPD, 2009a and 2009b; and Haacker, 2010). Its rapacious spread has also facilitated a global resurgence of other diseases such as tuberculosis, malaria and pneumonia, with their concomitant expansion, debilitating and killing of millions per year due to their capacity to suppress the immune systems of their victims (Marchal, De Brouwere and Kegels, 2005; and Price-Smith and Tauber, 2008).

Apparently, the facts presented above revealed that HIV/AIDS constitutes a major public health and developmental challenges, chiefly in SSA, the most severely affected region. Moreover, the disease may be considered fundamentally a health issue; the evidences suggest that a more comprehensive view of its implication is required, especially in the subject matter of macroeconomy. This therefore raises certain critical questions relevant in a study of this nature. For instance, i) what is the magnitude and impact of HIV/AIDS on human capital? ii) what implication does the disease have for economic growth performance of West Africa ?; and iii) what is the magnitude of its effect on economic growth in the sub-region? These are some of the inquisitive and germane issues that readily come to the mind when considering economic impact of infectious diseases such as HIV/AIDS.

1.2 Study Objective

The main objective of the study is to determine and quantify the impact of HIV/AIDS epidemic on human capital development and economic growth in West Africa.

Specifically, the thesis

i) estimates the effect and magnitude of HIV/AIDS on human capital development in West Africa; and

ii) examines the extent to which the disease has affected economic growth in the sub-region.

1.3 Justification for the Study

The high prevalence of HIV/AIDS in African countries is capable of aggravating the magnitude of the problems confronting the continent. Of particular concern is the West African sub-region. In spite of rich natural resource endowment such as gold, crude oil, iron ore and bauxite, coupled with young and vibrant population age group, it is paradoxical to note that a good number of countries in West Africa continue to groan under the burdens of low per capita income, high rate of poverty, environmental vulnerability, low average life expectancy, bad governance, political instability, conflicts, high crime rate, famine, absence of institutional and technical capacity, insecurity (further compounded by the recent wave of terrorism) and HIV/AIDS pandemic (see African Development Bank, AfDB, 2011a and 2011b; African Statistical Yearbook, 2010, 2011, 2012 and 2013, United Nations Development Programme, UNDP, 2010, 2011 and 2013a; and World Bank, 2013).

Currently, HIV/AIDS is one of the leading causes of morbidity and mortality in West Africa. Its prevalence in the sub-region has already entered a generalized epidemic. Moreover, the high morbidity and mortality associated with the virus and increased related health expenditure could engender declining labour supply, investment and household savings while productivity may experience a downward trend given dependence of most affected nations on labour for production (see Kambou *et al*, 1992; Bonnel, 2000; Zerfu, 2002; Haacker, 2002; and Sydhagen and Cunningham, 2007).

Among the top killer infectious diseases, such as malaria, HIV/AIDS, tuberculosis, acute respiratory infections and diarrhoeal, which account for about 85 percent of overall infectious diseases and 13 million deaths per annum globally (see Boutayeb, 2009 and WHO, 2011b) and particularly in the SSA, the case of HIV/AIDS appears peculiar. Asides the high number of morbidity and mortality associated with the disease, its ability to weaken the immune systems of its victims is inconceivable, which increases the rate of absenteeism from work, thereby leading to reduction in productivity. Besides, since no cure has yet been discovered for the disease, the life span of infected persons is apparently shortened and their eventual productive contributions to the economy terminate at their demise, thereby resulting in a decline in the country's aggregate income.

Several studies have been conducted on other communicable diseases, particularly on malaria in West Africa (see Gallup and Sachs, 2001; Chima, Goodman and Mills, 2003; Okorosobo *et al*, 2011; and Datta and Reimer, 2013); however, not much have been done on HIV/AIDS in the sub-region. In fact, McDonald and Roberts (2006) observe that inadequate appreciation of the important role health plays in macroeconomic performance has limited available work on economic impact of HIV/AIDS in the literature. These facts make the focus of this thesis on HIV/AIDS in West Africa distinctive.

Furthermore, early studies carried out on HIV/AIDS related issues were primarily on the economic and social determinants of its transmission, demographic impact, associated costs, some economic implications and how to curtail the spread of the disease (see Myers and Henn, 1988; Over and Piot, 1991; Becker, 1990; Chin and Lwanga, 1991, and Bell, Devarajan and Gersbach, 2003). Recently, attention has shifted to macroeconomic implication of the epidemic. However, literature along this line is not conclusive. The reasons are not far to seek. Firstly, previous studies had to contend with the issue of data unavailability; and therefore resulted to using data points either preceding the inception of the disease or those that cover the early part of its spread. In addition, virtually all macroeconomic studies on the disease employ prevalence data as opposed to the HIV/AIDS variables used in the present study.

The forgone facts underscore the argument advanced by Ojiha and Pradhan (2006) that three developments emerged in the literature justifying more researches into the economic impact of HIV/AIDS. These are: i) HIV/AIDS epidemic is in the third decade since its inception and so, its effects on national economic performance are likely to be stronger and probably more noticeable; ii) data today, as compared to a decade ago, are available for a larger number of countries, and are more reliable; and iii) there is a realization that the AIDS cases data, rather than HIV prevalence data, should be used for macroeconomic impact of the disease.

Equally, whilst there is consensus on negative and significant relationship between the disease and macroeconomic variables globally, there are divergent views on the same relationship at the regional and national levels. Some studies report negative impact of the disease on economic growth (see Over, 1992; Kambou, Devarajan and Over 1992; Cuddington, 1993a and 1993b; Cuddington and Hancock, 1994 and 1995; Arndt and Lewis, 2000; Bell et al, 2003 and 2004; and McDonald and Roberts, 2006) and human capital (Bell et al, 2003 and 2004; McDonald and Roberts, 2006; and Fortson, 2011) while others found positive effect of the epidemic on economic growth (Masha, 2004; and Young, 2005). Those that took the middle position reported that the pandemic did not have any impact on economic growth (Bloom and Mahal, 1997; Clark and Vencatachellum, 2003; and Cuesta, 2010). Moreover, whereas country-specific studies on economic impact of HIV/AIDS are plethora, cross-country works are minute, with most of them concentrating on East and Southern Africa, while others focus on the remaining parts of the world.

The contribution of the present thesis to the existing literature manifests in several areas. Theoretically, the study employed the augmented Solow model, rooted in the neoclassical growth theory. Incorporated into this was HIV/AIDS disease variable, which captured the epidemiological environment that depresses economic growth through human capital. On methodological front, the study employed a dynamic panel data technique of analysis, using difference and system Generalized Method of

Moments (GMM) estimators due to their ability to address some issues peculiar to panel econometric analysis. These include autocorrelation (which is occasioned by the inclusion of a lagged dependent variable as one of the regressors), correlated specific effects (which is always associated with heterogeneity among the cross sectional units) and orthogonality, common to dynamic panel data. Moreover, the two estimators employ instruments, which aid to produce better and efficient results. While difference GMM estimator employs only lag values as instruments, system GMM estimator uses both level and lag values as instruments. In addition, the study applied four other estimators for the purpose of comparing results. They include: First Difference (FD) estimator, which is also a dynamic panel data technique of estimation, and three static panel esimtaors, which are Ordinary Least Squares (OLS) otherwise referred to as pooled estimator or common constant estimator; Fixed Effects (FE) estimator; and Random Effects (RE) estimator. The results of the three static panel estimators are however presented in *Appendix* B. Further to the use of four HIV/AIDS variables, which are incidence,[6] prevalence, number of persons living with HIV/AIDS per thousand population, and AIDS-deaths per thousand population, a new human capital measure was developed to complement the two other human capital measures (life expectancy and primary school enrolment rate) employed in the study.

On empirical ground, the thesis focuses on West Africa where studies of this type are scarce. Whereas, a few country-specific works such as Hilhorst *et al* (2006), Agboh-Noameshie *et al* (2007), Abdulsalam (2010), and Dauda (2012) have been conducted in the region, cross-country or sub-regional works covering this aspect of the effects of the disease are hard to come by. In fact, out of the four hundred and eighty-three (483) World Bank publications on HIV/AIDS from 1988 to 2011, only two, Lowndes *et al* (2008) and Hooks and Silue (2011) focus on West Africa with their focal point being mainly on responses, prevention, support, care services and availability of trained health care providers.

6 Incidence of HIV is the number of new cases of HIV (the number of people who become infected during a specified period of time, usually over a twelve-month interval) in a given time period, often expressed as a percentage for a given number of the susceptible population (World Bank, 1997). It is a measure of the frequency with which HIV occurs in a population over a period of time.

Furthermore, adult HIV/AIDS prevalence in the area hovers around 2 and 5 percentage points (Lowndes *et al*, 2008; USAID, 2011a and WHO, 2011a), which is above the 1 percent prevalence level threshold that constitutes a generalized epidemic in any country as proposed by World Bank (1997). Also, West Africa still occupies the third position globally with respect to the burden of HIV/AIDS, after East and Southern Africa (see UNAIDS and WHO, 2009; UNAIDS, 2010; and US Global Health Policy, 2010, WHO, 2011a).

The number of people living with HIV/AIDS in the sub-region was put at 4.1 million and 6 million in 2009 and 2010 respectively; AIDS deaths stood at 273,400 in 2008 and 315,900 in 2009 while orphan due to the pandemic in the region rose from 2.1 million in 2008 to 3.6 million in 2009 (see UNAIDS and WHO, 2009; UNAIDS, 2010; and US Global Health Policy, 2010). An in-depth analysis of the number of PWHA in the sub-region shows obviously that the figure is more than twice the population of The Gambia (1.7 million in 2011, World Bank, 2013 figure) and Guinea-Bissau (1.6 million in 2011, World Bank, 2013 figure), more than the population of Liberia (4.1 million in 2011, World Bank, 2013 figure), and Mauritania (3.7 million in 2011, World Bank, 2013 figure), and a little below that of Sierra Leone (5.9 million in 2011, World Bank, 2013 figure) and Togo (6.5 million in 2011, World Bank, 2013 figure). The import of all this is that the disease is capable of wiping out completely the equivalence of two nations in West Africa.

Moreover, decline in growth rate of life expectancy in SSA (of which West Africa belongs) to approximately zero between 1985 and 2005 (UNDP, 2009a and 2009b) attributable to HIV/AIDS (Haacker, 2010; and Anderson, 2010) is another justification for the consideration of the West African sub-region for this study. This argument of lower life expectancy due to HIV/AIDS scourge has also been supported by Masha, 2004; Batini, Callen and McKibbin (2006); Anderson (2010); and UNDP (2013a). Haacker (2010) specifically traced the increase in life expectancy gap between SSA and the global average from 13.4 years in 1980–1985 to 16.4 years in 2000–2005 to the scourge of HIV/AIDS. Additionally, West Africa already has other challenges such as high level of poverty, insecurity, poor governance and high level of corruption, very low Human Development Index (HDI), low income per capita, and high prevalence of other communicable diseases. So, could HIV/AIDS have added to these problems?

Finally, attempt at a study as this offers the platform to employ available data on HIV/AIDS in West Africa.

1.4 Scope of the Study

The focal point of this study is the impact of HIV/AIDS pandemic on human capital development and economic growth in West Africa, using four HIV/AIDS variables (incidence, prevalence, PLWHA, and AIDS deaths) over the period 1990 to 2011. It covered eleven (11) out of the sixteen (16) West African countries for which adequate data are available. The countries are: Benin Republic, Burkina Faso, Côte d'Ivoire, The Gambia, Ghana, Guinea, Guinea-Bissau, Mali, Nigeria, Sierra Leone and Togo. Excluded countries were either due to non-availability of data (Cape Verde and Liberia) or HIV/AIDS prevalence being below one percent (as in the case with Mauritania, Niger and Senegal).

1.5 Study Organization

The thesis covers six chapters, which include chapter one, an introduction, covering problems statement and other relevant issues. Chapter two presents background information, with specific emphasis on the stylized facts about economic growth, human capital and HIV/AIDS in West Africa. Chapter three detailed review of relevant literatures within the context of this study, chapter four examines theoretical framework and methodology employed in the thesis while chapter five concerns mainly with presentation, analysis and interpretation of results, which are guided principally by the objectives stated in chapter one of the study. Chapter six concludes the thesis.

CHAPTER TWO

BACKGROUND OF THE STUDY

This chapter provides basic stylized facts relevant to the understanding of the economic performance, human capital situation and dynamics of HIV/AIDS in West Africa. It presents a comprehensive description of the situation of the pandemic as well as specifics of its incidence, prevalence, number of persons living with it and AIDS-induced deaths within the sub-region. Finally, the chapter examines detailed situation of the disease in each of the eleven countries covered in the study, the policies put in place to address its menace as well as the effects of such policies in these countries.

2.1 Economy of West Africa

West Africa is a region in SSA. It comprises about one third of the total population of this region. According to World Bank (2013), the estimated population of West Africa as at the end of 2012 was 322 million, with an annual growth of approximately 2.58 percent. The sub-region based on the United Nations (UN)' definition comprises sixteen countries as earlier enumerated (see United Nations, 2013).

Agriculture is the mainstay of the sub-region's economy and the largest employer of labour in virtually all countries in the area. Its contribution and that of the services sector to the GDP account for the highest. According to Economic Community of West Africa, ECOWAS and United Nations Economic Commission for Africa, UNECA (2012), agriculture contributes about 35 percent to the GDP of ECOWAS region while its country-specific contribution hovers around 80 percent in some countries. The sector serves as the main source of income and means of subsistence for about 70 to 80 percent of the population of the entire sub-region as well as approximately 50 percent of exports of most countries in the area. Inspite of these vital roles of the sector, it is observed that per capita agricultural contribution has been decreasing, food prices increasing, rising food shortages appears common, chronic food insecurity in some countries of the sub-region, high rate of malnutrition continues to be experienced, while increasing rate of poverty among farmers is the order of the day (UNECA, 2009; and ECOWAS and UNECA, 2012)

Table 2.1 shows contributions of the main sectors-agriculture, industry and services- to gross domestic product and the percentage of the labour force employed by each of the sectors in eleven West African countries.

Agriculture and services sectors account for the major part of GDP figures in the entire region as evident in the statistics provided in the table. For instance, while 35.9 percent contribution was made by agricultural sector to the GDP in Benin, the services sector contributed 57.7 percent of the nation's GDP. Countries such as Guinea-Bissau and Mali have the greatest proportion of their GDP statistics from agriculture. Industrial share in GDP appears very low in West Africa. Aside Guinea and Nigeria, where industrial inputs in GDP stood at 48.5 and 43 percentages respectively, other countries recorded as low as 6.4 percent in Benin, 13.1 percent in Guinea-Bissau and 18.1 percent in Cote d'Ivoire, among others.

In terms of employment generation, approximately 74 percent of the sub-region's labour force is absorbed by the agricultural sector. This is further confirmed by Nin-Pratt *et al* (2011) who reported that agriculture appears to dominate economic activities in West Africa, with nearly 30 percent share in her Gross Domestic Product (GDP) and providing livelihood for approximately 60 percent of the population. In Burkina Faso, Guinea-Bissau, Mali and Guinea, the sector contributes about 90 percent, 82 percent, 80 percent and 76 percent respectively to employment while the industrial and services sectors jointly account for just 10 percent, 18 percent, 20 percent and 24 percent of employment in the respective countries.

Table 2.1. GDP Composition by Sector and Labour Force by Occupation in West Africa

Country Year	Sector/Occupation Agriculture		Industry		Services	
	GDP	Labour Fource	GDP	Labour Fource	GDP	Labour Fource
Benin	35.9	NA	6.4	NA	57.7	NA
Burkina Faso	34.4	90	23.4	10.0*	42.2	-
Cote d'Ivoire	28.8	68	21.8	NA	49.4	NA
Gambia	22.3	75	18.3	19	59.5	6
Ghana	24.6	56	27.4	15	47.8	29
Guinea	12.8	76	48.5	24.0*	38.7	-
Guinea-Bissau	56.3	82	13.1	18.0*	30.7	-
Mali	36.9	80	23.4	20.0*	39.7	-
Nigeria	30.9	70	43	10	26	20
Sierra Leone	43.2	NA	37.4	NA	19.3	NA
Togo	45.7	65	21.4	5	33	30

* Figure for both industry and services

Source: Author's Compilation from the CIA World FactBook (2013b)

With respect to natural resource endowment, the largest oil deposit in West Africa is found in Nigeria while Ghana and Niger in recent times also discovered crude oil in commercial quantities. Available facts from ECOWAS and UNECA (2012: pp. 32 and 33) indicate that four countries in West Africa -Nigeria, Côte d'Ivoire, Ghana and Niger-, produce petroleum in commercial quantities, with Nigeria being the largest of the four, accounting for about 86 percent "of total petroleum output for West Africa, and almost all the natural gas in the sub-region." The country's oil reserves in January 2006 alone stood at 35.9 billion barrels, which was an equivalence of 32 percent "of all African reserves and 3 percent of world proven reserves." Côte d'Ivoire is the third largest oil producer in the region, having 98 mbd while her proven reserves were 100 million barrels; however, about 86 percent of her "oil wells are offshore, in deep seas." Ghana is the fourth producer of oil in the sub-region of West Africa. Apart from these, other natural resources abound in countries of the area.[7]

In terms of economic growth, the rate in West Africa continues to fluctuate; although promising in some of the countries. The African Statistical Yearbook, ASY (2010) puts the combined real GDP growth of West Africa at 3.2 percent in 1998 and 2.5 percent in 1999; whereas population grew at 2.7 percent in 1999 (ECOWAS, 2000). This implies that population growth outweighed GDP growth in the sub-region this particular period. The average GDP growth rate for the region between 2000 and 2008 was 6.5 percent while the 2009 figure stood at 3.0 percent (ASY, 2010). It however rose to 6.9 percent in 2010 before it dropped slightly to 6.3 percent in 2011 (ASY, 2012). In spite of these growth figures, more is still expected from the sub-region in view of the abundant natural resource endowment as well as young population size, which could trigger better economic performance as witnessed in some Asian economies.

7 West African countries possess natural, mineral, water and human resources in proportions that cannot be reconciled with their low level of development. Gold is found in Ghana and Mali, diamond in Sierra Leone, Ghana and Guinea, uranium in Niger, bauxite in Guinea and Sierra Leone, petrol in Nigeria, and iron ore in Nigeria, Sierra Leone and Liberia. There is limestone in Benin, Nigeria and Sierra Lone, and colombine and tin in Nigeria and in Guinea. Several watercourses run through the sub-region, including major rivers: the Niger, Senegal and Gambia, and River Volta. The region also produces agricultural raw materials, the bulk of which is traded on the international market. Cotton is produced primarily in Mali, Burkina Faso and Benin, rubber in Liberia, cocoa and coffee in Ghana, and in Cote d'Ivoire. Progress made in education has endowed the countries with graduates and they boast an increasingly qualified workforce" (UNECA, 2009).

Table 2.2 below provides information on the level of GDP per capita and its growth rate in eleven countries of the sub-region. Per capita income in West African countries has been very low over the years compared with other regions of the world. A critical examination of the table revealed that all the countries with the exception of Nigeria had their income per capita below US$2000. This is a far cry from what obtains in some other African countries, like Algeria, Angola, Botswana and South Africa, whose per capita incomes in US dollars stood at 8655.28, 5919.60, 14745.75 and 10959.74 respectively in 2011 (World Bank, 2012). The worst cases occurred in Burkina Faso, Guinea, Guinea-Bissau, Mali, Sierra Leone and Togo, whose values in 2011 remained below US$1500. This same year, countries such as Qatar, Japan, Kuwait, United States and UK attained per capita GDP figures in US dollars of 88314.11, 59660.36, 54282.59, 48111.97 and 35598.38 (World Bank, 2012).

Global per capita GDP (PPP) country comparison, using data CIA World FactBook (2013b) data shows the following rankings for West African countries. Benin ranked 202; Burkina Faso, 207; Côte d'Ivoire, 201; The Gambia, 195; Ghana, 173; Guinea, 213; Guinea-Bissau, 215; Mali, 214; Nigeria, 181; Sierra Leone, 205 and Togo, 216.

Per capita income growth performance is not different likewise as evident in the table. Although a good number of the countries appears to have recorded positive figures, four of them, namely: Cote d'Ivoire, The Gambia, Mali, Sierra Leone and Togo, have some negative growths documented for certain years. The rates for Cote d'Ivoire in 1990, 2000 and 2011 stood at -0.8, -3.7 and -4.7 percentage points respectively; The Gambia had -0.6 percent and -4.9 percent growth declines in 2005 and 2011 in that order. Conversely, performances in Benin, Burkina Faso, Ghana, Guinea, Guinea-Bissau and Nigeria appear encouraging. In 1990, Benin had the highest per capita income growth rate of 9.2 percent, followed by Nigeria, which recorded a 9.1 percent. The 2000 figure showed Sierra Leone posting the highest growth of 5.8 percent while Cote d'Ivoire had the least, which stood at -3.7 percent. By 2011, Ghana, whose statistic stood at 6.6 percent in 2005 suddenly jumped to a double digits of 13.3 percent (the highest in the region) while all other countries maintained single digit, with The Gambia recording the least, put at -4.9 percent while Nigeria, Sierra Leone Guinea-Bissau and Togo had per capita income growth performances of 6.8; 5.9; 5.7; and 4.9 percent points respectively.

Table 2.2. GDP Per Capita and Per Capita GDP Growth Rate for West Africa (both Purchasing Power Parity (PPP)), 1990-2011

	GDP Per Capita (PPP International in US$)						Growth of GDP Per Capita (PPP International in US$)					
Country/Year	1990	1995	2000	2005	2010	2011	1990	1995	2000	2005	2010	2011
Benin	832.44	973.18	1165.5	1371.34	1572.76	1618.8	9.21	4.97	3.96	2.95	0.38	2.89
Burkina Faso	484.23	576.26	757.13	1013.54	1259.05	1301.8	0.43	5.1.0	1.15	8.65	5.36	3.34
Cote d'Ivoire	1379.83	1425.99	1606.3	1666.01	1875.87	1789.4	-0.77	6.26	-3.69	2.90	1.09	-4.72
Gambia, The	1099.93	1179.28	1391	1568.92	1899.82	1808.8	3.18	0.37	4.62	-0.6	4.29	-4.91
Ghana	655.13	792.15	946.4	1208.01	1637.77	1871.1	4.25	3.70	3.4	6.57	6.05	13.3
Guinea	644.94	669.61	802.16	970.88	1083.82	1124.2	3.47	2.54	3.19	4.52	0.39	3.66
Guinea-Bissau	872.33	1037.66	918.35	1016.69	1200.48	1270.5	7.64	4.60	3.78	6.09	0.33	5.67
Mali	480.32	551.5	673.21	884.55	1071.03	1091.1	-0.004	5.64	2.37	6.05	3.30	1.86
Nigeria	1023.42	1155.69	1303.4	1749.65	2367.04	2533.1	9.09	2.41	5.02	6.04	5.86	6.78
Sierra Leone	722.11	629.79	658.51	849.77	1066.35	1130.6	5.76	-5.60	5.77	3.52	3.66	5.86
Togo	696.96	707.13	812.68	858.22	999.43	1049.3	0.95	7.31	-1.67	2.20	2.55	4.87

Source: Author's Computation using data from World Bank (2012).

2.2 Facts on Human Capital

Most West African countries began investment in human capital (HC) immediately after their political independence, which spanned the period 1960s to 1980s, with specific focus on investments in education and health facilities (see Ojo, 1997; and Fredriksen and Kagia, 2013). Although aggressive investments were undertaken in these two important areas by various governments of each country that make up the sub-region; the impact on their economies have not been substantial. This is obvious in the poor macroeconomic performance, high rate of poverty and other problems confronting most countries in the area.

Table 2.3 below presents information on education and health variables in West Africa. The facts suggest little improvement in these indicators across countries of the sub-region. Adult literacy rate appears low in most of the countries, with the exception of Ghana and Nigeria, which attained approximately 67 percent and 61 percent respectively for the period 2005 to 2010.[8] The rates for same period in Mali, Burkina Faso, Guinea, Sierra Leone and Benin correspondingly stood at 26.2 percent, 28.7 percent, 39.5 percent, 40.9 percent and 41.7 percent. These facts suggest that literacy rate in the West African sub-region has been very low over the years.

Pearce (2009) has revealed that about 65 million young people and adults (approximately 40 percent of West Africa's population) could neither read nor write, with 40 million of this figure being women. The author further disclosed that around 14 million primary-school age children were out of school in West Africa while seven out of the ten countries with the least literacy rate globally (Benin, Burkina Faso, Guinea,

8 Adult literacy rate according to UNESCO (2009: p. 3) is the percentage of population within the age bracket 15 and above years "who can both read and write with understanding a short simple statement on his/her everyday life." The organization further noted that "'literacy' also encompasses 'numeracy', the ability to make simple arithmetic calculations." Its high rate is desirable in every economy. This is because it indicates "the existence of an effective primary education system and/or literacy programmes that have enabled a large proportion of the population to acquire the ability of using the written word (and making simple arithmetic calculations) in daily life and to continue learning." It is computed as $LIT_{15+}^{t} = L_{15+}^{t} / P_{15+}^{t} * 100$. Where: LIT_{15+}^{t} = Adult Literacy Rate (15+) in year t; L_{15+}^{t} = Adult Literate Population (15+) in year t; and P_{15+}^{t} = Adult Population (15+) in year t.

Mali, Niger, Senegal and Sierra Leone) are in the sub-region.[9] According to AfDB (2011b), very well above 45 percent of West African adult population is not literate. Data from UNDP (2013a) put literacy rates in Niger, Burkina Faso and Mali respectively as low as 28.7 percent, 28.7 percent, and 31.1 percent. These statistics are too low when compared with achievement in some African countries like Zimbabwe, South Africa, Kenya, Libya, etc whose literacy rates as at 2013 stood at 90.7 percent, 86.4 percent, 85.1 percent, 82.6 percent respectively (see The African Economist, 2013). As a matter of fact, the West African sub-region has the world's lowest literacy rate (see Pearce, 2009; United Nations Education, Scientific and Cultural Organization, UNESCO, 2012b; and UNDP, 2013a).

In the area of school enrolments[10], some levels of progress appear to have been recorded in the sub-region. However, different story emerges for the same variable with respect to secondary and tertiary education, whose enrolment figures have been abysmally low. For the period 2001-2010; primary enrolment rate in Benin, Guinea-Bissau, Togo and Ghana was above 100 while figures in the remaining countries were below 100. Côte d'Ivoire had the least value, which stood at 73.6 percent while the highest, 121.9 percent was recorded in Benin. It is instructive to note that an enrolment value beyond 90 percent implies that "the aggregate number of places for pupils is approaching the number required for universal access of the official age group"; however, the inclusion "of over-aged and under-aged pupils/students because of early or late entrants, and grade repetition" could make the figure to exceed 100 percent (UNESCO, 2009: p. 9) as the case with Benin, Ghana, Guinea-Bissau and Togo.

The case of secondary enrolment is however different in West Africa. It is observed that none of the countries attained the 90 percentage point required for universal access to

9 In a UNESCO (2012b) report on global adult and youth literacy, SSA has the lowest literacy rate globally, and among the eleven countries reported by the agency to have their adult literacy rate below 50 percent, eight of them (Benin, Burkina Faso, Gambia, Guinea, Mali, Niger, Senegal and Sierra Leone) are all in West Africa.

10 School enrolment, according to UNESCO (2009: p.9), is the "total enrolment in a specific level of education, regardless of age, expressed as a percentage of the eligible official school-age population corresponding to the same level of education in a given school year." It shows the degree of school participation at a specific level. A high enrolment value suggests a high level of participation while a low enrolment is an indication of a low level of school participation in the country under consideration. To determine whether there is a universal access to education of a particular age group for a given level of education, the enrolment figure should exceed 90 percent.

education of the official age. Only The Gambia and Ghana recorded figures slightly above 50 percent while the worst cases were observed in Burkina Faso, Sierra Leone, and Cote d'Ivoire, which all had 21.4 percent, 26.5 percent and 26.3 percent secondary enrolment figures in that order. Countries within the range of 30 and 37 percentatge points include: Benin, Guinea, Guinea-Bissau and Nigeria.

Enrolment figure for tertiary education remains the worst in West Africa. Asides Nigeria, which had an average of 10.1 percent for the period under consideration, other countries recorded a digit enrolment in this area. In fact, countries such as Sierra Leone, Guinea-Bissau, Burkina Faso, The Gambia, Togo, Benin and Mali attained just 2.0, 2.9, 3.4, 4.6, 5.3, 5.8 and 6.0 percentage points in tertiary education enrolment respectively. These figures portend danger for the growth and development of the sub-region, since researches at the tertiary education level have significant role to play in economic growth and development. Furthermore, pupil-teacher ratio appears to be relatively high in some of the countries. This is not ideal for effective teaching and learning process required for efficient literacy and human capital development through education.

Health statistics provided in the table-mortality and health adjusted life expectancy (HALE)-reflect poor state of health in the sub-region.[11] While HALE ranged between 35 years in Sierra Leone, and 51 years in The Gambia and Togo in 2009, under five mortality and adult mortality figures remained very high in all the eleven countries. The only countries with two digits of under five mortality values are Ghana and Togo. In fact, Guinea-Bissau recorded 193 per a thousand population, followed by Sierra Leone with 192 while Mali had 191 per a thousand population. Adult mortality in all the eleven countries considered in this thesis remains triple digits. The figure in Côte d'Ivoire, Guinea, Burkina Faso, Guinea-Bissau, Sierra Leone and Ghana stood at 528, 474, 443, 431, 414 and 402 per a thousand male population; and 456, 337, 262, 369, 363 and 253 per a thousand female population respectively.

11 Health Adjusted Life Expectancy (HALE) otherwise referred to as Healthy Life Expectancy (HLE) focuses exclusively on the life lived in good health. It takes into consideration the number of years a new born baby would live in full health given the prevailing levels of mortality, morbidity and general condition of health. In most cases, it is always less than average life expectancy at birth.

Table 2.3. Education and Health Statistics

Country	Education Statistics					Health Statistics			
	Average **Adult Literacy Rate (% Ages 15 and Older)**	**Gross Enrolment ratio (Average)**			**Average Pupil-Teacher Ratio**	**Health Adjusted Life Expectancy (Years)**	**Mortality**		
		Primary	**Secondary**	**Tertiary**			**Under Five (Per 1, 000 Live Births)**	**Adult (Per 1, 000 Population)**	
	2005-2010	**2001-2010**	**2001-2010**	**2001-2010**	**2005-2010**	**2009**	**2009**	**Female 2009**	**Male 2009**
Benin	41.7	121.9	36.3	5.8	44.9	50	118	246	385
Burkina Faso	28.7	79.2	21.4	3.4	47.8	43	166	262	443
Côte d'Ivoire	55.3	73.6	26.3	8.4	42.1	47	119	456	528
The Gambia	46.5	84.7	55.7	4.6	36.6	51	103	246	296
Ghana	66.6	105.2	57.2	8.6	33.1	50	69	253	402
Guinea	39.5	89.8	37	9.2	43.7	47	142	337	474
Guinea-Bissau	52.2	119.7	35.9	2.9	62.2	42	193	369	431
Mali	26.2	97.2	41.6	6	50.1	42	191	218	357
Nigeria	60.8	89.5	30.5	10.1	46.3	42	138	365	377
Sierra Leone	40.9	85.1	26.5	2	NA	35	192	363	414
Togo	56.9	115.2	41.3	5.3	41.3	51	98	278	338

Source: Author's Compilation from UNDP (2011). Human Development Report.

Life expectancy and human development index are also low in West Africa. In terms of regional comparison, SSA, to which West Africa belongs, has the least life expectancy and human development index globally. From **Table** 2.4 below while regions such as Arab States, East Asia and the Pacific, Europe and Central Asia; and Latin America and the Caribbean have already attained an average life expectancy well above 70 years, SSA still had her figure put at 54.9. Similarly, the region is the only one that falls within the group of low human development, with 0.48 human development index (HDI) in 2012.

Table 2.4. Human Development Index, Life Expectancy at Birth and GNP Per Capita (2005 PPP $) by Region, 2012

Region and HID Group	**HID**	**Life expectancy at birth (years)**	**Gross National Product Per capita (2005 PPP $)**
Region			
Arab States	0.652	71	8,317
East Asia and the Pacific	0.683	72.7	6,874
Europe and Central Asia	0.771	71.5	12,243
Latin America and the Caribbean	0.741	74.7	10,300
South Asia	0.558	66.2	3,343
Sub-Saharan Africa	0.475	54.9	2,010
HDI group			
Very High Human Development	0.905	80.1	33,391
High Human Development	0.758	73.4	11,501
Medium Human Development	0.64	69.9	5,428
Low Human Development	0.466	59.1	1,633
World	0.694	70.1	10,184

Note: Data are weighted by population and calculated based on HDI values for 187 countries.
Source: UNDP (2013a). Human Development Report

Country specific average life expectancy in the sub-region varies between the lowest of 39 years in Sierra Leone and the highest of 64 years in Ghana, between 1990 and 2011. The 1990 figure showed only Cote d'Ivoire, The Gambia, Ghana, and Togo reaching 50 years and above while other countries have theirs lied below 50 years. By 2000, four out of the eleven countries still had their average life expectancy below 50 years. While the least in this year was recorded by Sierra Leone, put at 40 years. The highest life expectancy in 2000 was however recorded in Ghana, which stood at 58 years. The 2011 figure put Ghana ahead of all the countries, with other countries having theirs below 60 years while Guinea-Bissau and Sierra Leone could not reach 50 years. These facts are provided in **Table** 2.5 below.

One of the factors alleged to have contributed largely to the low level of average life expectancy, most especially in SSA, is the HIV/AIDS pandemic. According to UNPD (2009a and 2009b), growth rate of life expectancy in SSA declined to approximately zero between 1985 and 2005. Haacker (2010) attributes this to the menace of HIV/AIDS. He further reiterated that there was a widen of average life expectancy gap between SSA and the global average by about 13.4 years for the period 1980 to 1985, and further of 16.4 years in 2000 to 2005 period due to the HIV/AIDS epidemic. In addition, estimates produced by the UNPD (2009b) suggest that life expectancy in SSA would have improved by 5.7 years between 1985 and 1990, and 2000 and 2005 without HIV/AIDS.

Table 2.5. Life Expectancies of Eleven West African Countries, 1990 – 2011

Country/Year	1990	1995	2000	2005	2010	2011
Benin	49	51	53	54	56	56
Burkina Faso	48	49	50	52	55	55
Cote d'Ivoire	53	51	50	52	55	55
Gambia, The	53	54	55	57	58	58
Ghana	57	58	58	61	64	64
Guinea	44	46	48	51	54	54
Guinea-Bissau	43	44	45	46	48	48
Mali	44	46	47	49	51	51
Nigeria	46	45	46	49	51	52
Sierra Leone	39	37	40	44	47	48
Togo	53	54	55	55	57	57

Source: World Bank (2013). World Development Indicators

2.3 Evolution of and Fact on HIV/AIDS

The first five cases of HIV/AIDS were reported in the USA in 1981 (see U.S. Department of Health and Human Services, 2001). Since then it has spread to all parts of the world leading to high prevalence, incidence, number of PLWHA and deaths, particularly in SSA. Cuesta (2010) stated that in 2000, the average adult HIV incidence in SSA was 8.8 percent, and in Caribbean it was 2.3 percent. The rates in North American, South and South-East Asian, and Latin American stood between 0.5 and 0.6 percentage points while the rest of the world shared 0.35 percent. On worldwide status of the disease, UNAIDS and WHO (2009: p. 7) revealed that about 33.4 million people were living with the virus in 2008, which was 20 percent higher than the number in 2000 with "the prevalence roughly threefold higher than in 1990." Conversely, a more recent report by WHO, UNAIDS and UNICEF (2011) showed number of PLWHA globally as 34 million in 2010, with 2.7 million new infections and 1.8 million AIDS-deaths. As at the end of 2012, PLWHA worldwide stood at 35.3 million while 2.3 million new infections and 1.6 million AIDS-related deaths were recorded (see UNAIDS, 2013a). Since the disease was discovered, approximately 75 million people have been infected worldwide, with SSA accounting for the highest (UNAIDS, 2013b).

UNAIDS (2004) alleged that Africa whose population is just over 10 percent of the global population accounts for more than 75 percent of the burden of HIV/AIDS. Evidences have shown that the continent of Africa accounts for the highest burden of communicable diseases worldwide (see Gallup and Sachs, 2001; African Union, AU, 2007 and USAID, 2011b). Facts provided by WHO (2009) reveal that the continent is responsible for 9 out of every 10 child deaths caused by malaria, 9 out of every 10 child deaths due to HIV/AIDS, and half of the world's child deaths arising from the scourge of diarrheal and pneumonia. WHO (2006) also noted that Africa which is home to about 11 percent of the world's population has an estimated 60 percent of the PLWHA. Conversely, SSA alone recorded 68 percent of all PLWHA in 2010 with 70 percent new infections the same year (UNAIDS, 2011). The agency however reiterates that new infections in the region have declined by more than 26 percent compared to 1997 rate.

The WHO (2008) GBD estimates which provides a comprehensive assessment of disease burden from over 100 diseases and injuries revealed that in SSA, mortality resulting from HIV/AIDS alone was 14 percent of the total disease burden, which translates to 1.7 million deaths out of a total of 11.7 million. In addition, the Disability-Adjusted Life Years (DALYs) lost as a result of HIV/AIDS was 12 percent of the overall DALYs. HIV/AIDS-induced infant mortality was 14 percent of AIDS-related deaths while the proportion of the overall death attributed to the AIDS was 41 percent. About 40 percent of deaths among men age bracket 30-44, and 56 percent of maternal mortality resulted from the epidemic in 2008.

Table 2.6 shows global statistics of HIV/AIDS regional basis. Of all the regions, SSA is the worst hit, having around 19.7 million adults and children infected with the virus in 2001, 22.4 million in 2008 and 22.5 million people in 2009. The 2012 statistics stood at 25 million persons. The progress recorded in the provision of antiretroviral therapy treatment to infected persons than previously is one of the factors responsible for the upsurge in number of PLWHA (see UNAIDS, 2012a, UNAIDS, 2013a; UNAIDS, UNICEF and WHO, 2013; and WHO, UNICEF and UNAIDS, 2013); this has reduced deaths among infected persons and lengthen their life span. The 2001 new infections for the region were put at 2.3 million. This however, declined slightly to 1.9 million in 2008, 1.8 million in 2009, and further to 1.6 million in 2012. Although these figures appear too high compare to what other regions recorded; nonetheless, their consistent declines are pointer to the fact that some of the policies put in place to address the menace of the pandemic are already yielding some encouraging results.

Adult HIV prevalence in SSA was 5.8 percent in 2001, 5.2 percent in 2008 and 5.0 percent in 2009. The 2012 rate was 4.7 percent. AIDS mortality as at 2001 was 1.4 million while the same figure was posted in 2008. The 2009 and 2012 statistics were estimated at 1.3 million and 1.2 million respectively. Other regions recorded lower statistics of the different categories of cases presented in the table. For instance in 2012, the closest region to SSA in terms of PLWHA and HIV prevalence is South and South-East Asia, which had 3.9 million PLWHA and 0.3 percent prevalence as against 25 million PLWHA and 4.7 percent prevalence respectively estimated for SSA region.

Table 2.6. Regional HIV/AIDS Statistics for 2001, 2008, 2009 and 2012

Region	Adults and Children Living with HIV in Million				Adults and Children Newly Infected with HIV in Million				Adult Prevalence (%)				Adult and Child Deaths Due to AIDS			
	2001	2008	2009	2012	2001	2008	2009	2012	2001	2008	2009	2012	2001	2008	2009	2012
SSA[a]	19.70	22.40	22.50	25.00	2.30	1.90	1.80	1.60	5.8	5.2	5.0	4.7	1.4m	1.4m	1.3m	1.2m
MENA[b]	0.20	0.31	0.46	0.26	0.03	0.04	0.08	0.03	0.2	0.2	0.2	0.1	11000	0.02m	0.024m	0.017m
SSEA[c]	4.00	3.80	4.10	3.90	0.31	0.28	0.27	0.27	0.3	0.3	0.3	0.3	0.26m	0.27m	0.26m	0.22m
EA[d]	0.56	0.85	0.77	0.88	0.10	0.08	0.082	0.08	<0.1	<0.1	0.1	<0.1	0.022m	0.059m	0.036m	0.041m
Oceania	0.04	0.06	0.06	0.05	0.01	0.004	0.01	0.002	0.2	0.3	0.3	0.2	<1000	2000	1400	1200
LA[e]	1.60	2.00	1.40	1.50	0.15	0.17	0.09	0.086	0.5	0.6	0.5	0.4	0.066m	0.077m	0.058m	0.052m
Caribbean	0.22	0.24	0.24	0.25	0.02	0.02	0.02	0.012	1.1	1.0	1.0	1.0	0.020m	0.012m	0.012m	0.011m
EECA[f]	0.90	1.50	1.40	1.30	0.28	0.11	0.13	0.13	0.5	0.7	0.8	0.7	0.026m	0.087m	0.076m	0.091m
WCE[g]	0.66	0.85	0.82	0.86	0.04	0.03	0.03	0.029	0.2	0.3	0.2	0.2	7900	0.013m	8500	7600
NA[h]	1.20	1.40	1.50	1.30	0.05	0.06	0.07	0.048	0.6	0.6	0.5	0.5	0.019m	0.025m	0.026m	0.02m
TOTAL	**29.00**	**33.40**	**33.30**	**35.30**	**3.20**	**2.70**	**2.60**	**2.30**	**0.8**	**0.8**	**0.8**	**0.8**	**1.90m**	**2.00m**	**11.80m**	**1.60m**

Note: a = sub-Saharan Africa, b = Middle East and North Africa, c = South and South-East Asia, d = East Asia, e = Latin America, f = Eastern Europe and Central Asia, g = Western and Central Europe, h = North America, m = million.

Source: Compiled by the author from UNAIDS and WHO (2009). AIDS epidemic update; UNAIDS (2010). Report on the Global AIDS Epidemic; and WHO and UNAIDS (2013a). Core epidemiology slides.

2.3.1 Dynamics of HIV/AIDS Epidemic in West Africa

In most West African countries, the first cases of HIV/AIDS were reported about the period 1985 to 1987 (see UNICEF, 2006, various issues of United Nations General Assembly Special Session, UNGASS reports for each country). It then became glaring that a major epidemic problem had begun in the sub-region. In SSA and globally too, West Africa has the third highest burden of HIV/AIDS (see USAID, 2011b, UNAIDS, 2013c and World Bank, 2013). Although the spread of the virus in the area has stabilized, nevertheless the number of PLWHA remains high while prevalence in the general population in most countries ranges between 2 and 5 percentage points, with prevalence in geographical regions being higher and varied (see USAID, 2011a).

Lowndes *et al* (2008) reports about five million infected persons in West Africa while USAID (2011a) put the figure at about 6 million. The population prevalence in Cote d'Ivoire, Ghana and Burkina Faso stood at 4.7, 2.2 and 1.8 percentage points respectively. The rates in Benin, The Gambia, Guinea Bissau, Liberia, Mali, Nigeria, Sierra Leone and Togo, ranged between 1.2 percent and 1.5 percent while the Antenatal Clinic (ANC) prevalence stood between 2.8 percent and 6.7 percent.

The total number of PLWHA in West Africa was given as 4.1 million and 4.7 million in 2008 and 2009 respectively out of which infected women were correspondingly 2.1 million and 2.4 million in 2008 and 2009 (UNAIDS, 2010). These figures are higher than those recorded in any other region of the world except Southern and East Africa. The number of AIDS-orphans increased from 2.1 million in 2008 to 3.6 million in 2009 in the sub-region. Prevalence among age group 15 to 49 years, the productive age group (PAG) was the highest in Nigeria followed by Côte d'Ivoire and then by Togo in 2009 while Mali has the least. A new and aggressive HIV strain was discovered in Guinea-Bissau, which has the potential to develop faster and rapidly into a full-blown AIDS within five years than the parent strains (Palm, *et al*, 2014).

Different modes of transmission of the virus exist in the sub-region but the principal means remains the heterosexual mode (see Lowndes *et al*, 2008, USAID, 2011a).

A comprehensive presentation of prevalence of the disease and its incidence covering the period of 1990 to 2011 in eleven West African countries are presented in **Table** 2.7.

Prevalence of HIV among the PAG in West Africa as indicated in the table has been highest in Cote d'Ivoire, followed by Nigeria and then Togo. In 1990, Cote d'Ivoire recorded a 5.8 percent prevalence followed by Burkina Faso, which had 3.7 percent and Benin with 3.2 percent figures. The Gambia and Sierra Leone recorded the least, which was 0.1 percent. By 1995, the rate in Cote d'Ivoire got peaked at 7.3 percent, the highest in the sub-region. Generally, prevalence has been falling in most of the countries as evident in the information contained in the table; however, it is observed that the rate in Guinea-Bissau has been on an increasing trend; from 0.3 percent in 1990 to 1.9 percent in 2005 and 3.9 percent in 2011. This may not be unconnected with the new HIV stain discovered in the country, which has the capacity to progress faster to AIDS (see Palm *et al*, 2014). In 2011, it is observed that, while majority of the countries recorded a little above 1 percent prevalence, Guinea-Bissau, Nigeria, Togo, and Cote d'Ivoire registered 3.9, 3.7, 3.4, and 3.4 percentage points respectively. With respect to incidence, it is clear from the table that Cote d'Ivoire, Guinea-Bissau, Nigeria and Togo are the worst hit. In 1990 and 1995, the rates were 1.03 percent and 1.08 percent respectively in Cote d'Ivoire. These figures appear high and suggest a heavy burden of the pandemic in the country; although periods after 1995 witnessed declined incidence values in the country until 2011 when the value which was 0.13 percent 2010 increased to 0.31 percent. Guinea-Bissau has continued to experience a persistent increase in HIV incidence since 1990. The 1990 rate, which was 0.07 percent in the country, rose to 0.14 percent in 1995, 0.29 percent in 2005 and 0.38 percent in 2011. Incidence of HIV in Nigeria has been on a fluctuating trend. Whereas, the 1990 statistic was 0.2 percent, by 1995, it had risen to 0.58 percent before it declined to 0.47 percent in 2000 and further to 0.35 percent in 2005. It suddenly increased to 0.42 percent in 2010, before it declined again to 0.36 percent in 2011.

Table 2.7. HIV Prevalence and Incidence (15-49 Years) in Eleven West African Countries, 1990-2011

	Prevalence of HIV						Incidence of HIV					
Country/Year	1990	1995	2000	2005	2010	2011	1990	1995	2000	2005	2010	2011
Benin	3.20	2.30	1.80	1.30	1.20	1.20	0.08	0.22	0.13	0.11	0.10	0.09
Burkina Faso	3.70	3.00	2.20	1.60	1.20	1.10	0.36	0.24	0.16	0.10	0.07	0.06
Cote d'Ivoire	5.80	7.30	6.60	4.60	3.20	3.40	1.03	1.08	0.45	0.22	0.13	0.31
Gambia	0.10	0.30	0.70	1.30	1.40	1.50	0.03	0.08	0.16	0.20	0.15	0.14
Ghana	1.00	1.90	2.20	2.00	1.50	1.50	0.24	0.30	0.24	0.15	0.09	0.08
Guinea	0.70	1.20	1.50	1.50	1.40	1.70	0.31	0.20	0.15	0.13	0.10	0.09
Guinea-Bissau	0.30	0.60	1.20	1.90	2.40	3.90	0.07	0.14	0.23	0.29	0.31	0.38
Mali	1.10	1.60	1.70	1.40	1.10	1.10	0.25	0.27	0.19	0.14	0.10	0.10
Nigeria	0.50	2.30	3.70	3.60	3.70	3.70	0.21	0.58	0.47	0.35	0.42	0.36
Sierra Leone	0.10	0.30	0.80	1.40	1.60	1.60	0.02	0.08	0.18	0.22	0.13	0.12
Togo	1.70	2.90	4.00	4.10	3.50	3.40	0.36	0.52	0.57	0.38	0.25	0.23

Source: World Bank (2013). World Development Indicators, and UNAIDS (2012 and 2013). Reports on the global AIDS epidemic.

Table 2.8 shows data on number of PLWHA, deaths due to AIDS and new infections in West Africa over the period 1990-2011. It is quite revealing that the PLWHA per thousand population appears to be high in countries like Nigeria, Cote d'Ivoire and Togo. However, the figure has been decreasing in the other two countries while Nigeria, which has the second largest number of PLWHA globally after South Africa, recorded 2.4 per thousand HIV/AIDS population in 1990, 10.9 in 1995, 20.0 in 2005 and 20.8 in 2010 (see National Agency for the Control of AIDS, NACA, 2012, and UNAIDS, 2013c). Togo posted 9.3 in 1990, 16.6 in 1995 and 25.9 in 2005 before it declined slightly to 24.9 in 2010. Cote d'Ivoire, which had 28 persons per one thousand population living with HIV/AIDS in 1990 suddenly recorded about 36.8 in 1995 followed by 35 in 2000 and then decrease from 26.1 in 2005 to 18.8 in 2010. Sierra Leone has the least figure in 1990, put at 0.3 persons per thousand population. The rate has continued to upsurge in the country, reaching 7.4 in 2005 and 8.2 in 2010. HIV infection is on the The Gambia, from 1.0 person per thousand population in 1990 to 3.7 persons in 2000 and 7.5 in 2010. Guinea-Bissau also has an increasing figure of HIV/AIDS population. The figure in the country rose from 1.5 persons per thousand population in 1990 to 11 persons in 2005, and further to 14.5 persons per thousand population in 2010.

AIDS-related deaths per thousand population continue to decline in the sub-region. In Benin, while 1.2 persons per thousand population died due to AIDS in 1990, 1.3 AIDS-related deaths occurred in 1995, but by 2010, it had reduced to 0.33. In 2010, Cote d'Ivoire, Nigeria and Togo were the major countries overbloating the number of AIDS-related deaths in the sub-region. The figures in these three countries in 2010 stood at 1.27, 1.33 and 1.66 respectively.

New infections follow the same pattern in all the countries. In 1990, the figures stood at 4.15, 2.04 and 1.96 in Cote d'Ivoire, Burkina Faso and Togo respectively. The 1995 statistics revealed Cote d'Ivoire as the worst country with 6.06. However, by 2005, Togo became the worst nation, recording 259 persons per hundred thousand population while Nigeria and Guinea-Bissau had 215 and 168 per hundred thousand population. In 2010, Nigeria became the leading nation, having new infections of about 240 persons per a hundred thousand population.

Table 2.8. Number of People Living with HIV; AIDS-Deaths; and New HIV Infections Per Thousand Population in Eleven West African Countries, 1990-2010

	Number of People Living with HIV/AIDS Per Thousand Population					AIDS Deaths Per Thousand Population					New Infections Per Thousand Population				
Country/Year	1990	1995	2000	2005	2010	1990	1995	2000	2005	2010	1990	1995	2000	2005	2010
Benin	16.34	12.74	10.28	7.86	7.12	1.17	1.29	1.00	0.72	0.33	0.84	1.33	0.84	0.67	0.55
Burkina Faso	19.31	16.83	13.01	9.16	7.29	1.29	1.50	1.30	0.92	0.46	2.04	1.59	1.06	0.70	0.45
Cote d'Ivoire	27.96	36.79	34.98	26.10	18.70	1.36	2.45	3.02	2.61	1.27	4.15	6.06	3.02	1.67	0.86
Gambia	1.04	1.69	3.70	6.52	7.52	0.10	0.09	0.39	0.67	0.58	0.57	0.53	0.66	1.33	0.81
Ghana	5.48	10.00	12.52	11.60	9.43	0.22	0.54	0.89	1.02	0.70	1.28	1.65	1.46	0.97	0.57
Guinea	3.99	6.35	8.27	8.85	8.42	0.17	0.36	0.56	0.69	0.44	1.63	1.20	0.92	0.83	0.60
Guinea-Bissau	1.48	3.47	6.93	11.00	14.50	0.10	0.18	0.40	0.73	0.66	0.49	0.89	1.37	1.68	1.85
Mali	5.65	8.65	9.74	8.35	7.16	0.29	0.61	0.82	0.75	0.46	1.27	1.43	1.15	0.84	0.60
Nigeria	2.36	10.91	19.40	20.00	20.80	0.05	0.36	1.05	1.50	1.33	0.98	2.91	2.67	2.15	2.40
Sierra Leone	0.25	1.28	4.35	7.37	8.18	0.03	0.05	0.24	0.39	0.46	0.13	0.41	0.97	1.16	0.72
Togo	9.28	16.64	25.03	25.90	24.90	0.41	0.91	1.52	2.03	1.66	1.96	2.94	3.55	2.59	1.83

Source: Author's Computation using data from UNAIDS (2011) and World Bank (2013) World Development Indicators

2.3.2 Policies aimed at Addressing HIV/AIDS Problems in West Africa

Some of the programmes put forward to address issues relating to the disease in West African countries include: setting up of National AIDS Control Programme, establishment of the national HIV network, antiretroviral therapy (ART), multinational support for HIV/AIDS activities from the United States; World Bank-led HIV/AIDS Abidjan-Lagos Transport Corridor project; the World Health Organization (WHO) 3x5 Initiative; the Global Fund to Fight AIDS, Tuberculosis and Malaria (GFATM), Voluntary counseling, testing and treatment services for infected and non-infected persons as applicable, Prevention of Mother to Child Transmission (PTCT) services, training of health workers in specific HIV/AIDS related services, and funding activities (see USAID, 2004, Lowndes et al, 2008; USAID, 2011a; AfDB, 2011b; ECOWAS and UNECA, 2012). However, whether these initiatives have achieved their objectives remain a subject of empirical research.

Detailed country-specific policies are considered below.

2.4 Country-Specific HIV/AIDS Information

It is essential to provide information on the status of HIV/AIDS and various response programmes put in place by governments, donor agencies and other bodies to combat the menace of the disease in each of the selected eleven countries of focus. The impact of such policies on the status of the pandemic is also relevant in this section. Moreover, facts presented here offer better understanding of circumstances surrounding HIV/AIDS as well as its dynamics in each of the countries of the sub-region.

2.4.1 Benin Republic-*HIV/AIDS Status*

Benin is a French speaking West African country, with a population of about 10.05 million people as at 2012 and this is growing at around 2.73 percent (World Bank, 2013). The first HIV/AIDS case in the country was reported in 1985 (see African Development Fund, 2004). Since this period, number of infections has continued to increase. Mazzeo (2004, p. 3) reported an increase in HIV infection rate from 0.3 percent in 1990 to 4.1 percent "in 1999 with rates as high as 13 percent in some areas and up to 67 percent for high risk groups." However, adult prevalence as at the end of 2012 was given as 1.1 percent (see UNICEF, 2013).

United States Agency for International Development (USAID, 2004) put the total number of PLWHA in 2003 in the country as 68,000. The agency however revealed that the figure provided by the National AIDS Control Programme (NACP) in its study was 71,950. The number declined slightly and by 2009, approximately 60, 000 persons were said to be living the virus in the nation (UNAIDS, 2010). The trend has begun to increase so that 72, 000 people were estimated to be infected with the disease as at the end of 2012 (UNAIDS, 2013d). Deaths occasioned by the pandemic in 2003 were put at 6,140 by USAIDS (2004) while the figure for 2009 was put at 2,700 (UNAIDS, 2010).

HIV prevalence in Benin has reached a generalized epidemic. According to USAID (2004), the median HIV prevalence in 36 antenatal clinics in 2002 was 1.9 percent. The agency stated further that in another study conducted in the capital city (Cotonou) of the country in 2002; the prevalence of 2.3 percent was discovered among adults while the rate among sex workers had declined from 60 percent in 1996 to 50 percent in 1999 and further to 39 percent in 2002. In addition, 44.7 percent prevalence was found among sex workers in other four urban areas. In 2003, about 5,700 children aged 14 and below were estimated to be living with the pandemic while "nearly 34,000 children under age 17 had lost one or both parents to" the disease.

Although HIV/AIDS in Benin has become a generalized epidemic, available evidence suggests its concentration among some specific groups appears high. For instance, USAID (2010a) reported that concentrated HIV epidemics could be found among at-risk populations such as "sex workers and their clients, truck drivers, blood donors, young people, and tuberculosis (TB) patients" in the country. Citing the findings of 2006 Demographic and Health Survey (DHS) conducted in the country, the estimates of the UNAIDS, Benin's Ministry of Health (MOH) and the 2008 survey data reported in the 2010 United Nations General Assembly Special Session (UNGASS), UNAIDS (2010) stated that there were 0.4 percent to 3.8 percent prevalence among pregnant women in different regions in addition to 25.5 percent female sex workers (FSWs) who tested positive to the virus. Furthermore, 3.9 percent prevalence was reported for clients of sex workers, 1.5 percent for truck drivers, 2.6 percent for drivers over age 30, 1.5 percent prevalence for women, 0.8 percent for men, 10.6 percent for women widow, 7.3 percent for divorced women, 1.3 percent for married women and 0.5 percent for unmarried/single women. In addition, 0.9 percent was reported for young people and children while an estimated 5,400 children under age 15 were HIV positive. Moreover, 29,000 children under age 18 were orphaned by AIDS.

Response Programmes

Various strategies were put in place by the government of Benin to address the menace of HIV/AIDS since its first reported case. The national strategies for the control of the disease were put in place period per period. This helped to promote awareness about the pandemic through provision of public information, education, and communication efforts as well as prevention, care, support, and treatment, which target youths, women, migrants, sex workers, and persons living with the virus. The establishment of the national HIV network in 2006, comprising young people with the integration of HIV/AIDS activities with other programmes in reproductive health, TB, and nutritional support assisted a great deal in fighting the disease.

Moreover, following the declaration of the government in 2004 to provide antiretroviral therapy (ART) free, there was an upsurge in the number of infected persons on treatment, and by 2007 between 31 percent and 50 percent of HIV/AIDS infected persons were on treatment (WHO, UNAIDS and UNICEF, 2008).[12] In a report by WHO (2013), about 21,000 HIV/AIDS patients were on antiretroviral treatment as at the end of 2011. USAID (2004) confirms that Benin has been receiving different "multinational support for HIV/AIDS activities from the United States; World Bank-led HIV/AIDS Abidjan-Lagos Transport Corridor project; the World Health Organization (WHO) 3x5 Initiative"; and the GFATM. Other areas of responses include training of health service providers, development of HIV/AIDS-prevention policies, behaviour surveillance survey and so on. Furthermore, the implementation of Benin's second National Strategic Framework (NSF) covering the period 2007-2011 is a further pointer to the government's resolve to address all issues that have to do with the disease.

12 According to WHO, standard ART combines three different antiretroviral (ARV) drugs, which suppresses the virus in order to stop the progression of the disease.

Funding of HIV/AIDS Related Issues

Funding of HIV/AIDS related activities is one of the strategies through which the scourge of the pandemic has been tacked in Benin. In 2003 a total sum of US$3.2 million was earmarked as national funding for HIV/AIDS programmes, which came from the federal budget and debt-relief funds (USAID, 2004**)**. USAID (2010a) indicated that the agency spent more than US$2 million yearly in the country on HIV/AIDS activities as part of effort by the government and donors to curb the scourge of the disease. Furthermore, the GFATM recently disbursed about US$5.5 million to Benin for an US$11 million, three-year project to expand programmes such as prevention, counseling, testing and provision of antiretroviral drugs to individuals infected with the virus in order to reduce the level of mother-to-child transmission (MTCT) (see USAID, 2010a). The agency further reported that GFATM in recent times approved a ninth-round grant of US$58.3 million for the country to intensify the fight against the disease. It noted that approximately US$39 million has been disbursed for HIV/AIDS funding since 2003. In addition, USAID gave out US$2.0 million to the country for the fiscal year 2009 for essential HIV/AIDS programmes and services.

Impact of Response Programmes

Various response propgrammes and policies put forward by the government of Benin yielded some results. For instance, HIV prevalence in the country reduced marginally from 1.9 percent in 2004 to 1.2 percent in 2009 according to the CIA (2013a). AIDS-related deaths in 2009 was estimated at 3,300 as opposed to the 2005 figure of 5,800 while the number of people living with the disease in 2009 was given as 60,000 down from the 70,000 recorded in 2001. However, in 2012, number of PLWHA in the country rose to around 72,000, which was due provision of ART for infected persons, the treatment which has assisted to improve their life span (UNAIDS, 2013d).

Furthermore, USAID (2010a) reported that more women benefited from counselling services dur to training activities in Prevention of Mother-to-Child Transmission (PMTCT) and by 2009, more than 40,000 pregnant women underwent counseling process while above 29,900 were tested for the disease. Moreover, the number of condoms distribution outlets increased from 19,400 in 2008 to 22,000 in 2009. In spite of these achievements, prevalence and number of PLWHA in the country appear a high.

2.4.2 Burkina Faso-*HIV/AIDS Profile*

Burkina Faso, a French speaking West African country is estimated to have about 15.75 million people as at July, 2011 and by the end of 2012, the population stood at 16.46 million (see CIA, 2013a; and World Bank, 2013). The first HIV/AIDS reported case was in 1986 (see Desclaux, 1997; and WHO, 2005b). In a country-summary profile for HIV/AIDS treatment provided by WHO (2005b), about 300,000 people were estimated to be living with the disease in Burkina by the end of 2003 while approximately 29,000 adults and children died from AIDS-related causes. However, number of PLWHA in the country fell from 120,000 in 2008 to 110,000 in 2012 and AIDS-deaths stood at 5,500 in 2012 (UNAIDS, 2013d). WHO (2004 and 2005b) reported that around 75 percent of PLWHA in the country belonged to the age bracket 15 to 40 years. Orphans caused by the disease appear to be on a rising trend in the country. Approximately 100,000 orphans were occasioned by the pandemic in Burkina Faso in 2008 while about 140,000 AIDS-orphans were estimated for the year 2009, which later declined to around 130,000 in 2012 (UNAIDS and WHO, 2009; and UNAIDS, 2010 and 2013d).

HIV prevalence has entered a generalized epidemic in Burkina Faso. WHO (2005b) gave the median prevalence among women who attended antenatal care clinics at five surveillance sites in 2002 as 4.2 percent, which showed a decline from the 2001 figure of 6 percent as given by WHO (2004). The most HIV/AIDS affected groups in this country are the female sex workers (FSW) which had an estimated prevalence rate of 59 percent in Ouagadougou, truck drivers with 13 percent prevalence and prisoners, which had 9 percent in Ouagadougou and 11 percent in Bobo Dioulasso (WHO, 2005b). Prevalence among the PAG (15- 49 years) as at the end of 2012 was 1 percent (UNAIDS, 2013d). Although HIV/AIDS in Burkina Faso has entered a generalized epidemic, density map for the country showed that the areas with greatest concentration of PLWHA are Bobo-Dioulasso, Koudougou and Ouagadougou (UNAIDS, 2014).

Response Policies

HIV/AIDS response policies in Burkina Faso center on: counseling, testing, treatment, education, training of health personnel and funding. The government of the country developed and implemented four short and medium term plans to combat the onslaught of the disease for the period 1987-2000. In addition, the NSF for HIV/AIDS was instituted for the plan period 2006-2010 as one of the response programmes, which focused on prevention, surveillance, care, antiretroviral drugs and treatment of opportunistic infections, and partnership-building activities.

Furthermore, the National AIDS Council (NAC) was established under the office of the President. The Council oversees the national multi-sectoral monitoring system which assists to monitor all relevant health sector information that are related to the care and treatment of people living with the disease in Burkina Faso (see Fitzgerald and Stash, 2013). In 1998, a national solidarity fund for people living with HIV/AIDS and AIDS orphans was established as part of efforts towards addressing the menace of the disease. In this country, various organizations, apart from the government are actively involved in programmes aimed at fighting the scourge of the disease. For instance, the UN (through the World Bank, WHO, UNICEF, UNDP, UNAIDS, the World Food Programme and the United Nations Population Fund), USAID, the Red Cross, community-based organizations and associations, employers, governments of China, Denmark, Belgium, the Netherlands, Italy and France, all continue to sponsor programmes and projects directed towards fighting the assault of the pandemic.

In Burkina Faso, a task-shifting strategy for HIV/AIDS was developed by the nation's health ministry in conjunction with a number of technical and financial partners, which among other health services covers treatment of the disease. This is necessitated by the limited capacity, both in quantity and quality of the available human resource in the health sector of the country to administer ART. As a matter of fact, there exists critical shortage of health workers in the country. Task-shifting strategy involves delegating tasks to less-specialized workers in a particular profession. With respect to HIV care, "it often includes enabling nurses to dispense antiretroviral therapy (ART) and capacitating community health workers to deliver a range of HIV services" (Bocoum *et al*, 2013, 1).

According to WHO (2005b), ART has been in public sector in Burkina Faso since 2003; with the national ART targets of 30 000 and 40 000 set for 2006 and 2007 respectively. The organization reported that by the end of 2003, between 1500 and 2000 infected persons were estimated to be receiving antiretroviral drugs while the estimates for September, 2004 was put at 2734. It went further to give the figure as at 31st March, 2005 as 4446 and by December 2005, the number had risen to 8214. Between 31 percent and 50 percent of infected people had been covered in the country by December, 2007 (WHO, UNAIDS and UNICEF, 2008).

Funding of HIV/AIDS Activities

Funding of HIV/AIDS related programmes in Burkina Faso is undertaken by different groups apart from the nation's government. Some of such groups include: governments of China, Denmark, Belgium, the Netherlands, Italy and France. In addition, the World Bank, WHO, UNICEF, UNDP, UNAIDS as well as the Red Cross Society commit substantial amount to combating the pandemic in Burkina Faso. WHO (2005b) reported that treatment of the disease has been highly subsidized and since 1987, the government has increased significantly her financial commitment to fighting the disease.

Estimates provided by the government indicated that funds gotten from multilateral sources (UNAIDS, the World Bank, UNDP, UNICEF, WHO, the United Nations Population Fund and the World Food Programme) during 2001 to 2005 period amounted to US$ 16 million. In May 3, 2005 alone, the World Bank approved a grant of US$5 million to provide additional funding for HIV/AIDS programme in the country (see World Bank, 2005); funds from bilateral sources (Belgium, China, Denmark, France, Italy and the Netherlands) for the same period amounted to US$14 million while fund from NGOs (Médecins Sans Frontières, the Red Cross/Red Crescent and others) during 2001 to 2005 plan period was put at US$2 million (WHO, 2005b).

Being one of the prominent development partners in Burkina Faso, the GFATM has given a total of approximately US$67,061,475 HIV grants as at March 2012 (GFATM, 2012; and Fitzgerald and Stash, 2013). **Table** 2.9 below shows summary of grants provided by Global Fund to Fight AIDS, Tuberculosis and Malaria (GFATM) in Burkina Faso since December, 2003 till date.

Table 2. 9. Summary of GFATM HIV Grants in Burkina Faso (US Dollars)

Grant	Principal Recipient	Total Signed Amount/Total Disbursement	Grant Period and Status
Grants Closed or in Closure			
Round 2: Project for the enhancement of HIV control	UNDP, Burkina Faso	Signed: $8,789,010. Disbursed: $8,789,010	December 1, 2003–July 11, 2006. Phase II closed
Round 2: Project for the enhancement of HIV control	NAC*	Signed: $5,363,024. Disbursed: $5,363,024	October 1, 2006–February 28, 2008.Phase II closed
Round 6: Extension and strengthening of the fight against STIs and HIV	NAC	Signed: $57,118,479. Disbursed: $48,209,298	October 1, 2007–October 7, 2011 Phase II in closure
Grants in Progress			
Round 10: Universal access through securing antiretroviral treatments, strengthening of PMTCT, and strengthening HIV prevention for MARPs**	Initiative Privée Communautaire	Signed: $10,684,322. Disbursed: $4013429	January 1, 2012– . Phase I in progress
Round 10: Universal access through securing antiretroviral treatments, strengthening of PMTCT, and strengthening HIV prevention for MARPs	NAC	Signed: $37,640,296. Disbursed: $686,714	January 1, 2012– . Phase I in progress
			TOTAL Disbursements of HIV Grants: $67,061,474 March 2012 (GFATM)

***** National AIDS Council to Fight HIV/AIDS

**** M**ost-at-risk populations

Source: GFATM. (2012) and Fitzgerald and Stash (2013).

Effects of Policies on HIV/AIDS Status

Efforts of the government, partners, NGOs and communities directed at addressing the problem of HIV/AIDS pandemic in Burkina Faso appear to have yielded some results. Information available from UNAIDS, WHO, WDI and CIA World FactBook indicates that prevalence in the country has declined from 6.5 percent in 2001 to 4.2 percent in 2002, 2.3 percent in 2005, and further to 1.6 percent in 2010. The number of PLWHA, which was 350,000 in 2001, has reduced to 110,000 in 2012 while AIDS-deaths had declined to 5,500 (UNAIDS and WHO, 2009; UNAIDS, 2010; and UNAIDS, 2013d). UNAIDS (2014) reported that AIDS-related deaths in Burkina Faso has decreased by 58 percent. However, the number of AIDS orphans is on the increase, from 100,000 in 2008 to 140,000 in 2009 with a slight decline to 130, 000 in 2012 (see UNAIDS, 2014).

About treatment and counseling services, greater number of infected persons were covered, particularly from 2006 to 2010. According to Bocoum *et al* (2013: p. 2), the number of "sites offering Voluntary Counseling and Testing (VCT) and PMTCT of HIV/AIDS services have increased," with 82 percent of health facilities providing PMTCT services in 2009 while 50 percent coverage of pregnant women having access to VCT was recorded in 2009 as against the 16 percent attained in 2008. The authors further report tripling of the number of infected persons on ART and follow up between 2006 and 2010; however, approximately 50 percent of persons in need of ART were not covered as at the end of 2010. **Table** 2.10 below presents trends in access to VCT and ART services in Burkina Faso from 2005 to 2009. It shows increases in the percentage of the nation's population with access to VCT services from 6 percent in 2005 to 10 percent in 2006, and further to 21 percent in 2007, and a decline to 16 percent in 2008. It is also observed that the figure for 2007 was the highest. This implies that not too many people in the country have access to this service. Furthermore, percentage of pregnant women with access to VCT services was 42 in 2005, 45 in 2006, 44 in 2007, 41 in 2008, and 51 in 2009. Number of new patients on ART showed a rising trend over the entire 5 years period. However, percentage of PLWHA on ART continued to fluctuate across the period of 2005-2009. While 25 percent of them enjoyed the services in 2005, 54 percent accessed it in 2006. The figure nonetheless, reduced to 37 percent in 2007, and then rose to 43 percent in 2008, and further to 53 percent in 2009.

Table 2.10. Trends in Access to VCT and ART Services in Burkina Faso (2005–2009)

Indictor	2005	2006	2007	2008	2009
Percent of general population having had VCT during last 12 months and been informed about the results (%)	6	10	21	16	-
Percent of pregnant women having had VCT during last 12 months and been informed about the results (%)	42	45	44	41	51
Number of new patients on ART	8136	12842	17263	21103	26448
Percentage of PLWHA who are under ART	25	54	37	43	53

Source: Bocoum *et al* (2013). Exploring the effects of task shifting for HIV through a systems thinking lens: the case of Burkina Faso.

Although the response programmes towards addressing the problem of HIV/AIDS in Burkina Faso have contributed to decline in infection rate and also assisted to extend life span of infected persons; nevertheless, some failure rates have been recorded in the ART. In a study conducted by Kouéta *et al* (2010) over a period of 54 months (July 2003 to December 2007) in *Charles de Gaulle Pediatric Hospital Center*, Ouagadougou where support for ART started in July 2003 with 250 children undergoing treatment in late 2007; about 12.8 percent failure rate of first-line ART was reported. Moreover, 25 percent deaths were reorded among children who failed to respond to first-line ART, which was as a result of the unavailability of a national second-line ART programme. WHO (2012) as cited in Hamers, *et al* (2013) reported around 5 to 15 percent levels of increasing prevalence of transmitted HIV drug resistance (TDR) in Ouagadougou.

2.4.3 Côte D'Ivoire- *HIV/AIDS Profile*

Côte d'Ivoire, a nation of about 19.84 million people as at 2012, growing at about 2.29 percent annually (World Bank, 2013) is one of the countries severely affected by HIV/AIDS in West Africa. The first case of the disease was reported in the country in 1985 (USAID, 2010b), and since this peiod, infection and prevalence of the pandemic have continued to increase, moving from concentrated to a generalized epidemic. As at 2009, approximately 450,000 people were said to be living with the disease in the country, which was a marginal decrease from 2008 figure of 480,000. It however rose to 460,000 by 2011 before it reduced to 450,000 in 2012 (UNAIDS, 2013d).

Adult prevalence peaked at 7.5 percent in 1997 before it began to decrease, and by 2000, it had declined to 6.8 percent (World Bank, 2014). UNAIDS and WHO (2009), gave the infection rate in the country as 6.5 percent while USAID (2010b) estimated that among adults ages 15 to 49 years, prevalence of the pandemic in 2009 was 3.9 percent with the estimated deaths arising from the pandemic put at 56,000 in 2007. Between this period and 2010 a significant decline has been experienced. According to World Bank (2014), prevalence among PAG declined from 3.3 percent in 2010 to 3 percent in 2011, and by 2013, it had shrunk to 2.7 percent.

Prevalence of the virus varies among regions, gender, income level and age group. USAID (2010b) reported the findings of the 2005 AIDS Indicator Survey (AIS) in the country, which shows prevalence in the North and South as 3.2 percent and 5.5 percent respectively. In addition, prevalence in the Center-West remained at 3.7 percent and the Center-Eastern rate was 5.8 percent. Furthermore, the urban prevalence was given as 5.4 percent, which is a little higher than 4.1 percent for the rural area. Specifically, prevalence in Abidjan, the capital and the largest city was 6.1 percent. The rate among sex workers in 2009 remained at 33.4 percent, the rate among men who have sex with men was 25.4 percent while Injecting Drug Users (IDU) had 22.2 percent prevalence.

Regarding AIDS-mortality in Côte D'Ivoire, UNAIDS (2010) reported about 38,000 and 36,000 deaths in 2008 and 2009 respectively. The number of women infected with the virus was 250,000 in 2008, which decreased marginally to 220,000 in 2009. Meanwhile, the number of HIV-infected children continues to escalate from 52,000 in 2008 to 63,000 in 2009. Orphans created by the epidemic in the country have also been unnecessarily high. In 2008 and 2009, around 420,000 and 440,000 AIDS-orphans were correspondingly recorded while the 2013 figure stood at 390,000 (UNAIDS 2013d).

Policy and Response Programmes

USAID (2010b) reports that the protracted conflict in Côte d'Ivoire had negative impact on meaningful programmes of the government aimed at combating the scourge of HIV/AIDS. However, following the signing of the 2007 Ouagadougou Peace Agreement (OPA), there was among other things a renewed response to the disease, not only by the government but also by NGOs, international donor agencies, and different other groups. Under the 2006–2010 National Strategic Plan (NSP) of the country, several HIV/AIDS response activities were organized (USAID, 2010b) and in 2009 there was a reviewed of the NSP by stakeholders who recommended a new NSP for the 2010–2013 period. One fundamental achievement under this plan since 2007 was the creation of 32 committees, which represent different sectors in the economy. Some of the sectors include: health, education, social affairs, defence, justice, transport, economy and finance, youth and sport, and agriculture.

Furthermore, the Ministry of Education went a step further to incorporate "life skills and HIV information into 29 subject areas across different grade levels and equipped 17 regional Ministry of Education offices." Private enterprises, civil society groups, and others have been at the vanguard of campaign against HIV/AIDS to create more and better awareness as well as enlighten people on preventive measures against the disease.

Funding of HIV/AIDS Related Programmes

Like in many African countries, in Côte d'Ivoire, most health expenditures come from private individuals. According to Koné *et al* (2011), in 1995, HIV/AIDS expenditures in the country stood at 4.3 billion Franc of the African Financial Community (FCFA), which represented about 8.5 percent of the total health expenditure in the country. They affirmed that AIDS expenditures from private sources were 50.3 percent, government sources, 42.0 percent and donor sources stood at 7.7 percent. USAID (2010b) stated that Côte d'Ivoire got over US$189 million between 2007 and 2010 to finance HIV/AIDS programmes. The agency further reported that in August 2010, the GFATM approved a ninth-round grant totaling US$56.2 million for the country in order to strengthen the national response to HIV/AIDS.

Impact of Response Programmes on HIV/AIDS Status

Response efforts in Côte d'Ivoire have led to appreciable decrease in the prevalence of the dreaded disease. HIV prevalence among the PAG has reduced substantially to 2.7 percent in 2013 (World Bank, 2014). The number of people receiving ART has also increased over the years. USAID (2010b) report showed that about 49,700 individuals received ART during the fiscal year 2009 while 105,500 PLWHA got care and support the same year. The report further revealed that approximately 95,900 orphans and vulnerable children (OVC) also received support, 224,900 pregnant women were given HIV/AIDS counseling with testing services for PMTCT, 7,800 HIV-positive pregnant women also got antiretroviral prophylaxis for PMTCT, 421,900 individuals "received counseling and testing, in settings other than PMTCT," 530,000 "individuals were reached with community outreach HIV/AIDS prevention activities that promote abstinence and/or being faithful" while 713,700 individuals were also covered with community outreach HIV/AIDS prevention activities, which "promote correct and consistent use of condoms and related interventions."

2.4.4 The Gambia- *HIV/AIDS Profile*

The Gambia is a very small country in West Africa with a total population of about 1.8 million people in 2012 (World Bank, 2013). The first case of HIV/AIDS was diagnosed in the country in 1986 (Asante and Fenny, 2009) and since then both number of PLWHA and prevalence of the disease among different age groups have been on the increase. According to African Development Forum (2000), since 1990, there has been data on HIV prevalence among women attending antenatal clinic in The Gambia, which has made it possible to monitor the spread of the disease. The forum noted that among women attending antennal clinic tested for the virus, prevalence increased from 0.1 percent in 1990 to 1 percent in 1997 while in some parts of the nation's capital, Banjul, between 1 percent and 4 percent prevalence was discovered among antenatal clinic women in 1997. Between May 2000 and August 2001, sentinel surveillance was carried out and according to the 2012 country progress report by Republic of The Gambia (2012) on the situation of the disease in the country, it was discovered that prevalence had reached 1.2 percent. The report further mentioned that after the 1986 diagnosed case of HIV/AIDS in the country, 810 cases were reported in 1999.

Asante and Fenny (2009) also revealed that about 90 percent of HIV/AIDS cases occured among adults within the age bracket 20 and 54 years in The Gambia while the peak ages amongst which the disease is more pronounced are ages 30 to 44 years for females, and 40 to 49 years for males. According to them, in terms of the number of PLWHA in the country, 54 percent were females while 46 percent were males. Furthermore, the bulk of infections among persons above 35 occured among males while females accounted for the majority of infections in the age group 15-34 years.

Available statistics from UNAIDS (2010) revealed that number of PLWHA in the country has been on the increase from an estimated figure of less than 1000 in 1990 to 1,300 in 1995. In 2000, around 3,500 persons were estimated to be living with the virus while the 2005 statistics stood at 8,900. This further increased to about 18,000 in 2009 with 2.0 percent prevalence among the PAG. AIDS-related deaths also appear to be on the increase, from less than 100 in 1990 to about 1000 in 2012 while orphans created by the pandemic rose to 2,800 in 2009 (UNAIDS, 2013d).

Among the various modes of transmitting the disease in The Gambia, heterosexual transmission has been the major one. Citing the reports of an Integrated Biological and Behavioural Surveillance Survey (IBBSS) conducted among most-at-risk populations (MARPs) and the National Sentinel Surveillance (NSS) study conducted among 6,120 antenatal women in 12 health facilities in 2011, Republic of The Gambia (2012) revealed that prevalence among heterosexual group has continued to be the highest.

Response Activities to HIV/AIDS

The Gambian government has been proactive in its response activities to the menace of the dreaded disease. The first step undertaken by the government was to establish a National AIDS Control Programme (NACP) and a National AIDS Committee (NAC) in 1986 and 1987 respectively, both of which were under the Ministry of Health. The programme and the committee took a bold step to involve other government sectors, religious leaders, community leaders, NGOs and even PLWHA to combat the menace of the pandemic. As stated in the 2012 progress report by the Republic of The Gambia (2012), the first national policy and guidelines on HIV/AIDS was developed in 1995 with two basic goals of prevention and control as well as reduction of social and personal consequences of HIV infection among infected persons and to those who have developed full-blown AIDS. According to the report, the 1995 policy had six component areas given as:

i) Prevention of transmission through sexual intercourse;
ii) Prevention of transmission through blood;
iii) Care and social support for HIV infected persons;
iv) Programme planning and management;
v) Programme monitoring and evaluation;
vi) AIDS/HIV/STD epidemiological surveillance.

Furthermore, the NAC was set up in 2001 under the office of the President, who also doubled as the chairman. The National AIDS Secretariat (NAS) was also established to coordinate national response activities to the epidemic. In the same vein, 2003 witnessed the development of a NSF covering the period 2003 to 2008. This framework covered about eight sections, namely: prevention of HIV; voluntary counselling and testing; treatment care and support; mitigation; cross-cutting issues; coordination; monitoring and evaluation; financing and resource mobilization for HIV/AIDS. It governed and coordinated all HIV/AIDS programmes and activities in the public sector, private sector, NGOs and in civil society as a whole in The Gambia.

According to Republic of The Gambia (2012), HIV/AIDS policy guidelines were revised in 2006 to cover the period 2007-2011 with the goal of providing a framework for action to stabilize and reduce HIV/AIDS prevalence as well as to provide equitable treatment care and support for people affected by the disease. The NSF for the period 2009-2014 had also been developed by the government together with stakeholders such as civil society group, international and local NGOs and the UN. The framework has the following intervention areas: strategic information, prevention, treatment care and support, impact mitigation, response management, and gender and HIV/AIDS.

Moreover, in The Gambia, there are health outreach programmes in which people have access to services, such as PMTCT as well as counselling and testing. These services are made more accessible to people through the efforts of some NGOs like The Gambia Foundation for Research on Women's Health, Productivity and the Environment (BAFROW), which provides VCT services. According to UNAIDS (2009a), as at 2009, there were 34 VCT sites in the country, 23 PMTCT sites and 9 ART sites with 802 PLWHA. In addition, 3,467 PLWHA were screened for tuberculosis.

In summary, The Gambia, government has demonstrated ingenuity in the way strategies to combat HIV/AIDS are included in several key national and sectoral programmes and policies. For instance provisions are made to address issues relating to the disease in programmes and policies such as: National Plan of Action (NAP) for OVCs, 2008-2011; National Reproductive Health Policy (NRHP), 2001-2006; National Population Policy (NPP); National Blood Transfusion Policy (NBTP), 2000; National Children Policy (NCP); Vision 2020 - the country's roadmap for national development; National Health Policy and Action Plan (NHPAP), 2007-2020; National Social Policies (NSP); National Education Policy (NEP), 2006-2015; Policy on Advancement of Women (PAW), 1999-2009; Poverty Reduction Strategic Paper (PRSP), 2007-2012; and

National Youth Policy and Action Plan (NYPAP), 1999-2008 among others. These show commitment by the government to eradicating the disease in the country.

Funding of HIV/AIDS Activities

Funding of HIV/AIDS programmes and activities in The Gambia focuses on some key areas of priorities, which according to Asante and Fenny (2009) include: Programme Management and Administration (PMA); Prevention Programmes (PP); Treatment and Care (TC); Human Resource Development (training) (HRD); Orphans and Vulnerable; Social protection and social services (SPSS); Enabling environment; and HIV/AIDS related research. All fundings are channeled towards these crucial priority areas in order to combat the pandemic from all angles.

Although facts on funding of HIV/AIDS activities are very scanty in The Gambia, it should be noted that major financing of programmes on the disease actually begun when the government of the country signed a credit agreement for a sum of “over US$15 million with the World Bank (WB) to implement an HIV/AIDS Rapid Response Project (HARRP)” (Republic of The Gambia, 2012: p. 7). Since then more funds have been secured to fight the disease. In 2004 the government of the country secured another funding under the GFATM to provide affordable treatment, care and support project for PLWHA between 2004 and 2008 (see Republic of The Gambia, 2006, 2008, 2012). Asante and Fenny (2009) identified three major sources of funding for HIV/AIDS response programmes in The Gambia, which are: public sources, external (international) sources and private sources, with the highest fund coming from the external source (more than 90 percent) while private source accounts for the least funding. Accordingly, these sources normally channel HIV/AIDS funding by using three main funding mechanisms-state budget, external partners and “vertical project funding which involves partners channeling funds directly to implementers.” In The Gambia, the total expenditure on HIV/AIDS related activities increased from $4,898,005 in 2007 to $4,981,325 in 2008.

Impact of Response Programmes on Status of HIV/AIDS

Available evidence on the status of HIV/AIDS in the country does not suggest that most of the response programmes are having appreciable impact on the spread of the disease.

For instance, both the prevalence and the number of persons living with the pandemic in the country have continued to increase. The number of PLWHA rose from less than 1000 in 1990 to 3,500 in 2000 and further to 18,000 in 2009, but fell to 14,000 in 2012 (UNAIDS, 2013d). Prevalence among age group 15 to 49 increased from 0.1 percent in 1990 to 0.5 percent in 2000 and then to 2.0 percent in 2009 (UNAIDS, 2010). Both AIDS-orphans and AIDS-deaths continue to rise as well.

Moreover, report by Republic of The Gambia (2012) revealed that the 2003-2008 NSF has ceased to be operational. HIV/AIDS Rapid Response Project (HARRP) also is no more in operation, and this has terminated the regional HIV/AIDS response structures created by the project. Such structures were the position of the Divisional AIDS Coordinators (DAC), which also made the Divisional AIDS Committees (DAC) dormant. All these notwithstanding, certain progresses have been achieved, some of which include the conduct of the National Sentinel Surveillance (NSS) among antenatal women attending clinic, increase in access to HIV/AIDS services in both urban and rural areas. According to Asante and Fenny (2009) and Republic of The Gambia (2012), as at 2007, 26 health facilities were already offering VCT services, 19 health facilities offering PTCT services, 562 health workers trained in PMTCT, 17,369 pregnant women completed the counselling and testing process, 350 HIV-1 infected pregnant women received a complete course on ART, 8 treatment centres offering ART with appropriate laboratory facilities were established and 321 health workers trained in the management of HIV related opportunistic infections (OIs). Additionally, 327 health workers trained in the provision of ART and 13 NGOs/private clinics providing HIV/AIDS services, while as at 2011, 45 VCT, 31 PMTCT and 10 ART centres were already built.

Other progresses recorded according to the two authors include: reduction in stigma, discrimination and denial, inclusion of HIV/AIDS issues into all poverty reduction and other national developmental programmes and strategies, training the trainers workshop, capacity building through the health systems strengthening programme, and greater information sharing and reporting to assist in addressing issues relating to the disease. Others were provision of nutritional and educational support to OVC and increase in comprehensive HIV treatment and cares services as well as a significant emergence of PLWHA support groups among others.

2.4.5 Ghana- *HIV/AIDS Profile*

Ghana is one of the English speaking West African countries, with population of about 25.37 million people in 2012 (World Bank, 2013). The first HIV/AIDS case in the country was reported in 1986 (WHO, 2005a) with the national infection rate of 1.5 percent. The disease has since spread, moving from concentrated to generalized endemic going by the WHO classification. Its prevalence increased steadily over some period of years and later began to fluctuate. Ghana AIDS Commission (2010) gave the median prevalence of the disease in 2000 as 2.3 percent, which rose to 2.9 percent in 2001, 3.4 percent in 2002 and 3.6 percent in 2003. It declined to 3.1 percent in 2004 and 2.7 percent in 2005. It rose again in 2006 to 3.2 percent and later declined to 2.6 percent in 2007 and 2.2 percent in 2008. The 2009 figure shows that the median prevalence has increased to 2.9 percent. The Ghanaian Ministry of Health as cited in Republic of Ghana (2008), gave the number of AIDS cases reported between 1986 and 2006 as 121,050. According to the report, about 297,000 Ghanaians were estimated to be living with the disease in 2007.

Facts provided by UNAIDS and WHO (2009) and UNAIDS (2010) indicate that the number of people living with the disease in 2009 was 260,000. Prevalence among PAG declined slightly from 1.9 percent in 2008 to 1.8 percent in 2009. AIDS deaths decreased from 21,000 in 2008 to 18,000 in 2009 while the number of orphans due to the pandemic have remained high at 160,000 in 2009 (UNAIDS and WHO, 2009; and UNAIDS, 2010). According to an estimation provided by Ghana AIDS Commission (2010), about 130 people contract the disease in Ghana on a daily basis, and in 2009, the daily deaths emanated from the pandemic was put at 125 people.

At the regional level, the Eastern region of Ghana has the highest HIV/AIDS prevalence while the Upper West and Northern regions have the lowest prevalence rate according to WHO (2005a). With respect to age distribution of the epidemic, it has been estimated that about 90 percent cases occur among PAG while women account for more than 56 percent of adults living with the virus. Younger women between the age bracket 15 and

24 living with the disease also doubled their men counterpart of the same age bracket. In 2012, the total number of PLWHA in Ghana stood at 240,000; AIDS-deaths was 12,000, prevalence among ages 14-40 was 1.4 percent, 8,000 new infections were recorded while 190,000 orphans were occasioned by AIDS (UNAIDS, 2013d).

Response Activities to HIV/AIDS Problems

The government of Ghana has been very strategic and proactive in its response programmes towards combating the menace of HIV/AIDS in the country. According to Ghana AIDS Commission (2010), the government established a Technical Committee on AIDS (TCA) in 1985 (interestingly, this was a year prior to 1986, when the first case of HIV/AIDS was recorded in Ghana), and in 1987, the National AIDS/Sexually Transmitted Diseases (STD) Control Programme (NACP) was established with the responsibility of co-coordinating the national response to the HIV/AIDS epidemic. NACP, which was under the nation's Ministry of Health, was saddled with the responsibility of overseeing all HIV/AIDS related activities ranging from prevention to management, as well as coordination. There was a short-term plan (STP1) developed in 1987 to prevent and control HIV/AIDS/Sexually Transmitted Infections (STIs). This plan lasted for a year (1987- 1988) and by 1989, the first Medium Term Plan (MTP 1) for the prevention of HIV/AIDS was formulated. This plan continued till 1993 and by 1996, a Second Medium Term Plan (MTP 2, 1996) was instituted with inputs from the private sector, NGOs and civil societies.

To further demonstrate greater commitment towards fighting the disease, the Ghana AIDS Commission (GAC) was instituted in 2000. The Commission pioneered a multi-sectorial approach to addressing HIV/AIDS problem in the country and was authorized "to formulate a national comprehensive HIV/AIDS policy, provide high level advocacy, effective leadership, direct and co-ordinate the national response to HIV/AIDS response" (Ghana AIDS Commission, 2010: p. 25). In Ghana, all 138 districts have counseling and testing services at 421 public and private facilities in order to prevent the spread of the disease. In 2007, it was reported that more than 154,899 persons benefited from the services provided by the facilities.

Funding of HIV/AIDS Activities

In the area of funding, USAID (2005a) stated that out of the US$18 million provided by the United States to Ghana annually, about US$7 million is spent on HIV/AIDS related activities. The report further stated that in 2001, the Government of Ghana set aside 15 percent of its health budget for HIV/AIDS activities and a directive was also given to all ministries to create an HIV/AIDS budget line. Furthermore, GFATM allocated US$6.7 million to support HIV/AIDS funding efforts in the country. In addition, about US$12 million came from multilateral partners, which included World Bank; while approximately US$8 million came from bilateral donors. USAID (2010c) posited that 30 percent of total funding from the government and other donors was used to support PLWHA in 2006, and since 2003, a sum of US$111.8 million had been disbursed by GFATM. In 2009, USAID disbursed a sum of US$14.3 million to Ghana for essential HIV/AIDS programmes and services, and in 2010, GFATM disbursed US$25.4 million "to a group of government and nongovernmental organizations through an eighth-round grant that aimed to accelerate access to prevention, treatment, care and support for HIV/AIDS" (USAID, 2010c: p. 3)

Impact of Response Programmes on HIV/AIDS Status

Efforts of government of Ghana, private sector, donor agencies and civil societies aimed at combating the menace of the pandemic seem to be paying off. For instance, the prevalence of the disease has declined from 2.4 percent in 1999 to 1.8 percent in 2009 among PAG. Furthermore, the number of people living with the virus, which was 350,000 in 2003 reduced to about 260,000 in 2009 while in 2012, it further declined to 140,000 persons (UNAIDS, 2013d). USAID (2010c) indicated that by 2009 approximately 45,000 people were reached with prevention and interventions while a good number of medical staff were trained in 30 clinics to provide HIV related services in order to reduce stigmatization and establish quality assurance programmes at the clinics. Also, the agency revealed that vocational training and economic support to 278 OVC were provided in addition to food supplements for 3,516 OVC.

2.4.6 Guinea- *HIV/AIDS Profile*

Guinea, whose population was about 11.45 million in 2012 (World Bank, 2013) had her first HIV/AIDS cases reported in 1986 (WHO, 2005c). Prevalence among the PAG was 1.1 percent in 1990, and by 1999, it had increased to 1.8 percent. Adult prevalence reached 3.2 percent in 2003 according to USAID (2005c) report on the country. HIV prevalence varies across the country, with Conakry, the capital city accounting for about 2.1 percent (USAID, 2010d). The Guinea's 2007 HIV/AIDS Behavioural and Biological Surveillance report showed that the prevalence among the commercial sex workers (CSWs) was 34.4 percent, the rate among truck and bus taxi drivers was 5.5 percent, 5.6 percent for fishermen, miners accounting for 5.2 percent and active military personnel having about 6.5 percent prevalence rate (see USAID, 2010d). In 2008, 87,000 people were estimated to be living with the disease while the number in 2009 reduced to 79,000 and by 2012, it has increased to 120, 000 (UNAIDS and WHO, 2009; UNAIDS, 2010; and USAID, 2013d).

Furthermore, the number of children ages 0-14 living with the disease increased from 6,300 in 2008 to 9,000 in 2009 and further to 14, 000 in 2012 while AIDS-related deaths stood at 4,500 in 2008, 4,700 in 2009 and 5,100 in 2012, with AIDS-orphans being 25,000 in 2008, 59, 000 in 2009 and 46, 000 in 2012 (UNAIDS and WHO, 2009; UNAIDS, 2010 and 2013d).

Response Activities to HIV/AIDS Problem

Response to HIV/AIDS menace in Guinea, centres on creation of awareness, prevention strategy, training of health personnel, provision of ART, treatment, and voluntary counseling and testing (VCT) services. In 1986, the Guinean government created the National AIDS Commission (NAC) and by 1998, a national AIDS control policy was signed into law. The policy according to the USAID (2010d: p. 2) "outlined the institutional framework of the national response at the central, prefectoral, and sub-prefectoral levels." Most of these response programmes were weak prior to 2002 "because of lack of governmental commitment, poor leadership, and inadequate resources" (USAID, 2005c: p. 1). However, by 2002, the national response programme was recognized. In 2002, a national survey data on HIV/AIDS prevalence was published. This served as an eye opener to the government, the NGOs, partners (both local and international), key stakeholders and other agencies to the seriousness of the havoc the disease could cause in the country and this helped to strengthen "high-level political commitment to" fighting the menace of the disease in Guinea.

The year 2002 also witnessed the birth of the Guinean National AIDS Committee (GNAC), which was saddled with the responsibility of coordinating all HIV/AIDS-related activities, including implementation of the first strategic framework of 2003-2007, created to fight against AIDS. The second strategic framework was established covering the period 2008-2012. This builds on the successes recorded by the previous 2003-2007 plan and also aimed to address some of the challenges faced by the first framework. USAID (2010d: p. 2) confirmed that Guinea continues to make use of the different ministries in the country to combat the disease. For instance, apart from the Ministry of Health (MOH), the government entrusted the management of behaviour change efforts to the Ministry of Communication even as "the Ministry of Planning supervises epidemiological research." The launch of the first national prevention strategy for youth in 2007 also assisted a great deal in enlightening and educating the youths against the ills of the disease and the need to protect themselves against it.

Funding of HIV/AIDS Related Programmes

Funding of HIV/AIDS related activities in Guinea cut across the government, NGOs and international partners. USAID (2005c) revealed that in 2005, about US$6.2 million of its support was meant for Guinea, out of which US$2.2 million was to target HIV/AIDS activities. Similarly, between 2004 and 2010, the GFATM has committed around US$8.6 million to fighting the disease in the country while USAID also gave out approximately US$2 million to Guinea in 2009 for essential HIV/AIDS programmes and services (USAID, 2010d).

Impact of Response Programmes on Status of HIV/AIDS

Response programmes to curtail the threat of HIV/AIDS in Guinea have had some positive impacts going by the available information on the status of the pandemic in the country. More awareness about the danger of the disease, mode of transmission and the need to confirm individual status of the pandemic has increased. Although prevalence, particularly among the PAG is increasing, it has been kept below 2 percent. As at the end of 2013, the rate among PAG stood at 1.7 percent (World Bank, 2014). AIDS-related deaths have also begun to decline in the country.

2.4.7 Guinea-Bissau- *HIV/AIDS Profile*

Guinea-Bissau is one of the smallest countries in West Africa with Portuguese as her official language. The country is populated by approximately 1.6 million people (GFATM, 2014). Her first diagnosed HIV/AIDS case was reported in 1985 (UNICEF, 2006). Since this period new cases were discovered and the number of people living with the pandemic and AIDS-related deaths continues to upsurge. Data provided by UNAIDS (2013d) showed that in Guinea-Bissau, about 38,000 and 41,000 people were living with the virus in 2009 and 2012 respectively while deaths due to the epidemic, which was less than 100 in 1990 and 1000 in 2000 had increased to 2,300 in 2012. According to the agency, new infection, which was 3,900 in 2000 declined to 3,600. However, AIDS-orphans increased from less than 100 in 1990 to 2, 400 in 2000 and further to 15, 000 in 2010, and by 2012, it had risen to 17, 000.

Recently, a new and aggressive HIV strain was discovered in the country and it is said to possess the potential of developing faster and rapidly into a full-blown AIDS within five years than the parent strains (see Palm, *et al*, 2014). This has contributed to the rising HIV/AIDS cases in the country.

Response Policies

In Guinea-Bissau, attempts have been made to create awareness about HIV/AIDS while prevention efforts have also been put in place. Other services such as training of medical personnel, provision of drugs, counseling, treatment and testing are all provided to fight against the menace of the virus. The government, NGOs, WHO, UNICEF, the World Bank and other partners are involved in the fight against HIV/AIDS in Guinea-Bissau. In 2006, UN news reported that all children in Guinea-Bissau who were HIV/AIDS positive would be provided free access to anti-retroviral medicines. Similarly, an alliance between UNICEF, UNAIDS, and the Brazilian and Guinea-Bissau governments was launched in 2006 to combat the scourge of the pandemic. The government also established the national technical secretariat to fight against AIDS in Guinea-Bissau (STNLS). This has been instrumental in responses against the disease.

Funding of HIV/AIDS Projects

The World Bank donated US$7 million to the government of Guinea-Bissau to fight HIV/AIDS. STNLS is responsible for the management of the donated fund. According to GFATM (2014), a total of US$68 million has been disbursed to Guinea-Bissau so far, of which US$22 million was paid out in 2013. The amount was to fight HIV/AIDS, malaria and tuberculosis. The agency further reiterated that based on the decision of Global Fund Board in March 2014, the country may receive additional grant of US$52.5 million for the 2014-2016 period to fight HIV/AIDS, tuberculosis and malaria.

Results of Response Policies

Response activities towards fighting HIV/AIDS in Guinea-Bissau seem not to have yielded significant result. This is apparent from available facts provided on status of the disease. Both prevalence and PLWHA have continued to increase. According to (UNAIDS, 2013d), the estimated number of PLWHA in the country rose from less than 1000 in 1990 to 18,000 in 2000 and by 2012, it was more than double the 2000 figure to stand at 41,000. AIDS-related deaths as well as AIDS-induced orphans remained very high at 2,300 and 17, 000 respectively in 2012. Prevalence among PAG, which was 0.3 percent in 1990, rose to 1.6 percent in 1999. It further increased to 2 percent in 2001 and 2.5 percent in 2009, and by the end of 2012 it had risen to 3.9. The increased trends of prevalence, PLWHA, AIDS-related deaths and AIDS-orphans are not unconnected with the new HIV strain discovered in the country, which has escalated infection rate.

2.4.8 Mali-*HIV/AIDS Profile*

Mali is occupied by about 14.85 million people as at 2012 (World Bank, 2013). Her first HIV/AIDS case was reported in 1985 (USAID, 2005b). Prevalence of the pandemic has remained a little above the 1 percent. USAID (2010e) reported an estimate of 1.5 percent rate for the country in 2007 with infections mostly concentrated in most-at-risk populations (MARPs). According to the reports of UNAIDS and WHO (2009), and UNAIDS (2010), about 100,000 people were living with the disease in 2008 in Mali, which was an appreciable decline from the 2003 figure of 140,000. In 2009, it had declined further to 76,000; however, by the end of 2012 the total number of PLWHA in the country was estimated at 100,000 (see UNAIDS, 2013d).

The number of deaths associated with the disease increased from 3,000 in 1995 to 8,700 in 2003, however, it decined significantly to 4,900 in 2012 (see UNAIDS, 2013d). AIDS-orphans increased from 44,000 in 2008 to 59,000 in 2009. USAID (2010e: p. 1) had maintained that HIV/AIDS epidemic in Mali is feminized, with women accounting for about “60 percent of infections among adults aged 15 and older” as against their male counterpart. Accordingly, the disease in Mali seems to be more localized with 3 percent of pregnant women in the Ségou region, 3.8 percent in the Koulikoro region, and 4.5 percent in Bamako district being HIV positive as indicated in Mali’s 2006 sentinel surveillance study cited by USAID (2010e). Prevalence among sex workers rose from 28.9 percent in 2000 to 35.3 percent in 2006. However, this has declined to 24.2 percent while prevalence among MSM ranges from 17-35 percent (USAID, 2013).

Response Strategies

Various response initiatives have been embarked upon to curb and eradicate the scourge of HIV/AIDS pandemic not only by the government of Mali but also by individuals, religious groups, local and international donor agencies, NGOs and the civil societies. The Government of Mali established a national AIDS Programme, which was restructured in 2002 with the creation of the Supreme National Council for AIDS (SNCA) known as *Haut Conseil National de Lutte contre le SIDA* (HCNLS). The government signed a national declaration of HIV/AIDS policy in 2004. The first national strategic plan for HIV/AIDS control was developed for the plan period 2001 to 2005 and the second one for 2006 to 2010, which builds on the first, “emphasized a multi-sectoral integrated approach to combating HIV, using methods sensitive to Mali’s socio-cultural norms” (USAID, 2010e: p. 2).

Access to antiretroviral drugs and related treatments has remained free in Mali following the declaration of the president in 2004. According to USAID (2005b), through the USAID supports epidemiologic and behavioural surveillance sentinel, HIV surveillance was carried out in 16 sites in 2003, and HIV testing was also included in a demographic and health survey (DHS) in 2001. The second national strategic plan has also been reviewed to pave the way for the third, which covers 2011 to 2015.

Funding of HIV/AIDS Projects

USAID has been at the vanguard of supporting counseling and testing sites as well as providing technical assistance and funding to the Ministry of Health to finalize national guidelines on counseling and testing. The agency in its 2010 report on Mali revealed that the World Bank funds the five-year, US$25.5 million Multisectoral AIDS Programme (MAP) in the country and has in recent time approved an additional US$6 million supplement for the purpose of building partnerships between the public and private sectors. In 2004, "the World Bank Board approved an International Development Association Multisectoral AIDS Programme (IDAMAP) grant of US$25 million to help Mali control the HIV/AIDS epidemic by reforming policy, building capacity, increasing awareness of HIV/AIDS, and increasing access to HIV services and care" (USAID, 2005b: p. 2). Between 2005 and 2010, GFATM has disbursed approximately US$49.9 million "to support HIV/AIDS programs in Mali" while an eighth-round grant has also been released "to support Mali's integrated and decentralized approach to fighting AIDS through community-based health care, which has had $8.7 million disbursed to date" (USAID, 2010e: p. 3). In 2009, USAID handed over about US$3.0 to the country "for essential HIV/AIDS programs and services."

Outcome of Response Initiatives

The impact of relevant HIV/AIDS response programmes continues to manifest in the level of awareness created about the disease among the people of Mali, reduction in the number of PLWHA and declines in the prevalence experienced in the country. Prevalence among PAG, which was 1.9 percent in 1997, reduced to 1.0 percent in 2009 based on the WDI data. USAID (2010e) cited the 2006 Demographic and Health Survey (DHS) carried out in the country, reporting 53 percent of women and 63 percent of men being able to identify the use of condom and faithfulness to one partner as ways of preventing the disease. More people who have tested positive to HIV/AIDS now have access to AVT. However, more still need to be done in this area, as adult access to the services has remained between 25 percent and 39 percent (UNAIDS, 2014).

2.4.9 Nigeria- *HIV/AIDS Profile*

Nigeria, the most populous African country accounts for more than 50 percent of the entire population of West Africa. The nation's population according to World Bank (2013) was 164.29 million. Her first case of HIV/AIDS was reported in 1986 (UNGASS, 2010a and NACA, 2012) and since then, the disease has spread from concentrated epidemic to a generalized one. Prevalence among PAG in the country increased from 1.3 percent in 1990 to 4.0 percent in 1995 as indicated by WDI statistics. The 2009 rate was 3.6 percent. Sentinel survey statistics indicated that HIV prevalence in the general population declined from 5.8 percent in 2001 to 4.4 percent in 2005, and rose slightly to 4.6 percent in 2008 (NACA, 2014).

The number of PLWHA remains high in the nation. The number, which was 3.3 million in 2003 reduced to 3.2 million in 2005, 2.6 million in 2008, and rose to 3.3 million in 2009 and further 3.4 million in 2012 (UNAIDS, 2010; and UNAIDS, 2013d). The 2013 figure stood at 3.3 million with 210,031 AIDS-related deaths while new infections the same year was 220,394 (NACA, 2014). AIDS-Orphans increased from 2.12 million in 2008, 2.18 million in 2009, and then to 2.2 million in 2012 (UNAIDS, 2010; and UNAIDS, 2013d). Nigeria was the third largest country with PLWHA in 2005 after South Africa and India; however, by 2009, she had overtaken India to occupy the second largest position after South Africa (Federal Ministry of Health, FMOH, 2007 and UNGASS, 2010a). This is not unconnected with her population size, being the most populated African country. The main mode of HIV transmission in Nigeria is heterosexual intercourse; IDU and homosexuality (UNGASS (2010a).

Response Strategies

Governments at various levels in Nigeria have put in place policy measures to control and combat the menace of the HIV/AIDS disease since the first case was reported. Information available from FMOH (2007) revealed that there has been a continuous monitoring of the HIV epidemic through repeated sentinel surveys, including biennial sentinel surveys among pregnant women attending antenatal clinics in the country. Such monitoring task focuses on female sex workers (FSW) (both brothel and non-brothel-based), men who have sex with men (MSM), IDU, transport workers (TW) and men and women in the uniformed services (armed forces and the police).

In 2001, the federal government established the Presidential Council on AIDS (PCA) and the National Action Committee on AIDS (NACA). NACA coordinates and oversees all HIV/AIDS related activities at the federal level while the State Action Committee on AIDS (SACA) and the Local Government Action Committee on AIDS (LACA) coordinate and oversee such activities and programmes at the state and local government levels respectively. According to (UNGASS, 2010a: p. 73), membership of PCA comprises ministers from all sectors, with the President as the Chairperson while NACA which “emphasizes a multisectoral approach to national HIV/AIDS response” has the following as members: “representatives from Ministries, the private sector, NGOs and networks of people living with HIV/AIDS.” In 2001, NACA developed the HIV/AIDS Emergency Action Plan (HEAP) and in 2009, a second NSF “was developed for the 2010–2015 time period and serves as a comprehensive strategic plan covering areas such as prevention, care, and treatment” (USAID, 2010f: p. 2 and 2012: p. 2). One of the important goals of the framework is to halt and reverse the spread of HIV infection and ease the impact of the disease by 2015 (NACA, 2014).

Funding of HIV/AIDS Related Strategies

In the area of funding, since the emergence of the disease in Nigeria, the federal government, state government, local government, donor agencies both within and outside the country have committed a lot of financial resources to fighting the pandemic. USAID’s assistance to Nigeria, which was mainly given to the NGOs prior to 1999 because of military government, focused on direct funding of HIV/AIDS. In 2000, the agency disbursed the sum of US$6.7 million fund HIV/AIDS programmes; and by 2001, the amount had increased to US$12.8 million (USAID, 2002). USAID (2010f: p. 4) reported that since 2003 about US$142 million in grants has been disbursed to support HIV/AIDS programmes in Nigeria and in 2009 alone the country through PEPFAR[13](the President's Emergency Plan for AIDS Relief), received US$438 million “for essential HIV/AIDS programmes and services.” In addition, the country received the sum of US$471 million for the fiscal year 2011 “from PEPFAR through USAID for essential HIV/AIDS programs and services” (USAID, 2012: p. 4).

13 This is America's initiative to combat the global HIV/AIDS epidemic and is also part of the Global Health Initiative

In summary, the United States' support for Nigeria, in the area of funding HIV/AIDS-related activities stood at US$70.9 million in 2004, US$111.4 million in 2005, US$163.3 million in 2006, US$304.9 million in 2007, US$447.6 million in 2008, US$442.3 million in 2009, US$459.2 million in 2010, and US$488.6 million in 2011, totaling approximately 2.5 billion US dollars (see PEPFAR). Brewer, *Charge d'Affaires* at the US Embassy in Abuja announced additional US$500 million to support HIV/AIDS project and reiterated that the government of the United States had committed more than US$3.5 billion to funding HIV/AIDS projects in Nigeria since 2004 (Punch, 2014). The World Bank in 2002 gave the country a US$90.3 million credit to support a 5-year HIV/AIDS Programme Development Project (HPDP), another US$50 million for HPDP spanning 2009 to 2013 had also been announced (Avert).

UNGASS (2008: p. 18) report on Nigeria indicates that it was impossible to capture expenditure on HIV/AIDS in Nigeria; however, using the National AIDS Spending Assessment (NASA) tool has shown that for the period 2006-2007 appreciable funds were received to administer HIV/AIDS projects. The Nigerian government disbursed approximately 7.4 billion naira, divided into about 4.2 billion naira from Debt Relief Gain (DRG) and 3.2 billion from ministries, departments and agencies. Additionally, the report revealed that about 5.9 billion naira was received from Global Fund, while funding by PEPFAR, Department for International Development (DFID), Canadian International Development Agency (CIDA), World Bank Multicountry AIDS Program (MAP) and the "UN System could not be captured using the NASA tool."

In a USAID (2009: p. 1) report on policy to support strategic planning for sustainable HIV/AIDS services in Nigeria, it was revealed that for the period 2010-2014, approximately US$600 million would be available per year to fund HIV/AIDS programmes. The agency noted that this amount excluded private out-of-pocket (OOP) expenditures, with around 85 percent of this fund being from foreign donors such as PEPFAR, the GFATM, the World Bank MAP, and DFID. As large as this amount may look, the agency reiterated however that "it falls far short of the resources needed to reach universal coverage in all programmatic areas." **Table** 2.11 below presents funding sources for HIV/AIDS programmes in Nigeria in US dollars.

Table 2.11. Funding Sources for HIV/AIDS Programmes in Nigeria (US$ millions)*

Financing Sources	2010	2011	2012	2013	2014
Federal Govt. Nigeria**	80.5	81.8	83.4	85.2	87.0
U.S. Govt.	427.0	427.0	427.0	427.0	427.0
DFID ENRHA	23.8	23.8	23.8	23.8	23.8
UN	10.0	10.0	10.0	10.0	10.0
GF Round 5	28.8	28.8	0.0	0.0	0.0
GF Round 8	0.0	11.1	11.1	11.1	11.1
Bill and Melinda Gates Fund	5.0	5.0	5.0	5.0	5.0
World Bank MAP2	27.0	27.0	27.0	27.0	27.0
Total	**602.1**	**614.6**	**587.4**	**589.1**	**590.9**

Note: ENRHA=Enhancing Nigeria Response to HIV/AIDS
*PEPFAR has not been reauthorized past 2009, so estimates are based on the assumption that 2009-level funding will be maintained for the next five years.
**The Federal Government of Nigeria funding amount includes the estimated cost of human resources for health required for biomedical HIV/AIDS programmes.

Source: USAID. (2009). HAPSAT Nigeria: policy modeling to support strategic planning for sustainable HIV/AIDS services.[14]

14 "Health Systems 20/20 is a five-year (2006-2011) cooperative agreement (No. GHS-A-00-06-00010-00) funded by the U.S. Agency for International Development (USAID). The project addresses the financing, governance, operational, and capacity-building constraints that block access to and use of priority population, health, and nutrition services by people in developing countries. Health Systems 20/20 offers global leadership, technical assistance, training, grants, research, and information dissemination" (USAID, 2009).

Result of Response Activities

Evidence provided by the UNGASS (2010a) revealed that some positive progress has been achieved in combating the menace of HIV/AIDS in Nigeria. According to the report, the percentage of people (both adults and children) with advanced HIV infection receiving antiretroviral therapy increased from 16.7 percent in 2008 to about 34.4 percent in 2010. The percentage of pregnant women living with the disease receiving antiretroviral medicines to reduce the risk of MTCT has increased from 5.3 percent in 2008 to about 21.59 percent in 2010. The rate of HIV/AIDS-induced tuberculosis persons who received treatment for both diseases rose from 55.95 percent in 2008 to 69.1 percent in 2010 while the percentage of persons aged 15 to 49 who underwent HIV/AIDS test increased from 8.6 percent in 2008 to 11.7 percent in 2010.

The report further stated that the proportion of persons within age bracket 15-24 who correctly identified ways of preventing sexual transmission of HIV/AIDS increased from 22.5 percent in 2008 to 24.2 percent in 2010. Percentage of young people aged 15 to 24 infected with the virus declined from 4.3 percent in 2008 to 4.2 percent in 2010. In the same vein, available facts have shown reduction in prevalence of the disease in the country, from 4.0 percent in 1999 to 3.6 percent in 2009 as provided by the WDI. One major problem among others is the increasing number of AIDS-orphans being 2.12 million and 2.175 million in 2008 and 2009 respectively (UNGASS, 2010a). Moreover, as at 2009 about 300,000 persons had been put "on life-saving antiretroviral treatment (ART)" while "hundreds of service delivery points for prevention of PMTCT and HIV counseling and testing (HCT)" were added to the existing ones (USAID, 2009, p. 1).

The above notwithstanding, the number of persons living with the pandemic in Nigeria has continued to increase while millions of orphans, some of, which are themselves HIV/AIDS positive have been created by the disease. USAID (2009: p. 1) maintains that with the estimate of over 800,000 of HIV-infected persons who "meet the clinical eligibility criteria for initiating ART described in national treatment guidelines, … less than half of the current need for ART is being met" while majority of those not on treatment do not know their HIV status. According to UNAIDS (2014), about 80 percent of persons living with HIV/AIDS in Nigeria do not access ART.

2.4.10 Sierra Leone- *HIV/AIDS Profile*

Sierra Leone, which was in war conflict for more than ten years (March 23, 1991-January 18, 2002) is inhabited by about 5.87 million people according to World Bank (2013). Her first HIV/AIDS case was reported in 1987 (UNAIDS, 2009b and USAID, *et al*, 2009). HIV prevalence among the PAG in the country rose from 0.2 percent in 1990 to 1 percent in 1995. It increased further to 1.2 persent in 2000, and 1.6 percent in 2009. In urban area, about 2.5 percent prevalence was recorded in 2008 while the rural area had just 1 percent, based on the annual ANC Sentinel Surveillance surveys. Prevalence among pregnant women according to UNGASS (2010b) and UNGASS (2014) was 4.4 percent in 2007, 3.5 percent in 2008 and 3.2 percent in 2010.

PLWHA in Sierra Leone grew from 49,000 in 2009 to 58,000 in 2012 while AIDS-deaths declined from 3,300 in 2008 to 2,800 in 2009, and rose to 3,300 in 2012 (UNAIDS and WHO, 2009; UNAIDS, 2010 and 2013d). AIDS-Orphans increased from 2, 600 in 2000, 22,000 in 2010 to 26,000 in 2012 (UNAIDS, 2013d). Percentage contributions to new infections include: "commercial sex workers, their clients and partners of clients contribute 39.7", "people in discordant monogamous relationships", 15.6, fisher folks, 10.8, traders, 7.6, transporters, 3.5, and mine workers, 3.2 while MSM and IDU had 2.4 and 1.4 respectively (UNGASS, 2014: p. 3).

Response Activities

In Sierra Leone, policies put in place to tackle HIV/AIDS include: National Response to HIV/AIDS (NRHA), NAC, Parliamentary Committee on HIV/AIDS (PCHA), National AIDS Secretariat (NAS), National AIDS Control Program (NACP), National AIDS Commission (NAC), District AIDS Committees (DAC), Technical and other Support Groups (TODG), greater involvement of PLWHA, Private Sector (PS), Government Workplace Public Sector (GWPS), the Media and the Uniform Personnel (MUP). Their focus areas include: funding, counseling, education, treatment, making of policies relating HIV/AIDS services, provision of leadership, monitoring and mobilization of resources meant for HIV/AIDS programmes, and so on.

Funding

The UNGASS (2010b) states that in 2006 and 2007 respectively, about US$7.6 million and US$9.2 million expenditures were made on HIV/AIDS related activities, with 2 percent of the funds from domestic source, 98 percent from international source and 0 percent from private source. In 2007, about 0.34 percent of the GDP of Sierra Leone was expended on HIV/AIDS programmes while 95.8 percent of all HIV/AIDS funding in the same year came from external sources (Haacker, 2009). In 2008 and 2009, about US$12.1 million and US$14.3 million were spent on HIV/AIDS related activities in the country (Sierra Leone, 2013). Statistics provided by UNGASS (2014) revealed that the total expenditure incurred on HIV/AIDS project in Sierra Leone in 2010 and 2011 amounted to approximately US$10.9 million and US$20.9 million respectively. The amount for 2010 was mainly from public and international sources alone, while that of 2010 came from public, private and international sources. Finally, GFATM spent about US$34.5 million on HIV/AIDS activities in the country in 2012 and 2013 while NAS got the sum of US$1,219,560 from *Krebital ftaltfür Wieberaufbas* (KfW), German Development Bank (GDB) as well as US$152 million from the government for HIV/AIDS programmes (UNGASS, 2014).

Impact of Response Programmes

The response programmes in Sierra Leone have not yielded appreciable results. The prevalence of HIV just reduced slightly from the 1.7 percent in 2007 to 1.6 percent in 2009. Although the activities have succeeded in creating more awareness about the scourge of the pandemic as well as increasing the number of infected people being treated, more still need to be done in order to reduce to the bearest minimum the number of HIV/AIDS infected persons in the country.

2.4.11 Togo- *HIV/AIDS Profile*

Togo is inhabited by approximately 6.47 million people in 2012 (World Bank, 2013). Her first HIV/AIDS case was reported in 1987 (Berger, 2014). The prevalence and the number of people living with the disease in Togo have remained high since this period. Facts provided by WDI indicated that HIV prevalence among adults age group 15 to 49 was 0.6 percent in 1990, however, by 2000 it has risen to 3.6 percent. It nevertheless declined to 3.2 percent in 2009. Prevalence among the general population in 2009 according to the government of Togo was 4.3 percent. As at 2001, about 130,000 people were estimated to be living with the disease in the country. The number of PLWHA in Togo decreased from 150,000 in 2004 to 130,000 in 2012 while deaths caused by the disease, which was 14,000 in 2002 reduced slightly to 10,000 in 2008, and further to 7,200 in 2012 (UNAIDS and WHO, 2009; and UNAIDS, 2010 and 2013d). Orphans resulting from AIDS, which stood at 1,700 in 1990, increased to 8,400 in 1995, and by 2000, it has risen further to 31,000. It got peaked at 92,000 in 2010 before it fell marginally to 90,000 in 2012 (UNAIDS, 2013d).

Response Strategies

HIV/AIDS response programmes in Togo focus on campaign against the disease by individuals, government, NGOs and civil society organizations. Through the HIV/AIDS grant proposal approved by the Global Fund for Togo in 2003, with the appointment of UNDP as the grant's principal recipient, the UNDP-Global Fund (UNDP-GF) continues to partner and collaborate with the Togolese government and many other partners to operate a comprehensive HIV/AIDS programme aiming at prevention and treatment services, which are in form of condom distribution, VCT services, as well as youth and community education. Furthermore, PLWHA have been treated through ART, antiretroviral prophylaxis had been provided for pregnant women infected with the disease, and efforts have been put in place to reduce MTCT of the virus.

Available in Togo as part of HIV/AIDS response activities is a military project called Defense HIV/AIDS Prevention Program (DHAPP). It is a programme that supports projects aimed at assisting the vulnerable and at-risk people in society. They include: PLWHA, OVC, widows and girls who are at risk of being drawn into activities which expose them unnecessarily to a high risk of HIV infection. The programme uses the approach of approving grants to funding activities developed and implemented by community-based groups or NGOs targeting the vulnerable and at-risk people in society. It is undertaken by the government of United States. Specifically, the Naval Health Research Center (NHRC), San Diego, California is the US Department of Defense (DoD) Executive Agent for the DoD HIV/AIDS Prevention Program (DHAPP). It partners with NGOs, governments of countries to fight HIV/AIDS.

Funding of *HIV/AIDS Programmes*

Funding is undertaken by both the government of Togo and donor agencies. Haacker (2009), providing data on expenditures on HIV/AIDS related cases in about 80 countries stated that Togo spent 0.47 percent of her GDP on HIV/AIDS cases in 2007 and in the same year 86.7 percent of all HIV/AIDS funds came from external sources.

Success or Otherwise of Response Strategy

Various efforts of the government, NGOs, local and international partners, civil societies as well as donor agencies have yielded positive results. For instance, the prevalence of HIV/AIDS among PAG in Togo, which peaked at 3.6 percent in 2000, has reduced marginally to 3.2 percent in 2009 as provided by WDI statistics. In 2013, prevalence among PAG reduced significantly to 2.3 percent (World Bank, 2014). In 2008, about 9,100 AIDS deaths occurred; however, by 2009 it has reduced to 7,700. Orphans resulting from the menace of the pandemic in Togo, which was 68,000 in 2008 reduced to 66, 000 in 2009 according to the information provided by UNAIDS (2010).

2.5 Treatment Coverage of HIV/AIDS Infected Persons in West Africa

Although efforts aimed at providing antiretroviral treatment globally to persons living with HIV/AIDS have intensified than previously (see WHO, UNAIDS and UNICEF, 2011), the West African sub-region still lags behind in terms of coverage. Statistics provided by USAID (2011a) suggest that only 23 percent of pregnant women who needed the services for the purpose of preventing PMTCT of HIV were covered in West and Central. **Figure** 2.1 below shows percentages of infected people in West Africa, who received treatment for the period 2001 to 2009.

Benin has the highest coverage, being 72 percent; followed by Mali, with 65 percent while Burkina Faso had 60 percent. Conversely, it is quite disturbing and paradoxical to discover that countries with very high burden of the pandemic in the sub-region such as Core d'Ivoire, Nigeria and Togo had very low coverage. As indicated in the figure, Nigeria, whose prevalence among PAG stood at 3.7, 3.6 and 3.2 percentage points in 2001, 2009 and 2012 respectively, in addition to having the highest number of PLWHA in the sub-region (2.5 million in 2001, 3.2 million in 2009, and 3.4 million in 2012), has just 31 percent treatment coverage. The same scenario played itself in Cote d'Ivoire and Togo whose treatment coverage was 39 percent for Cote d'Ivoire and 42 percent for Togo. These are countries where prevalence statistics were 6.2 and 4.1 in 2001 respectively, and 3.4 and 3.6 in 2009 for Cote d'Ivoire and Togo in that order.

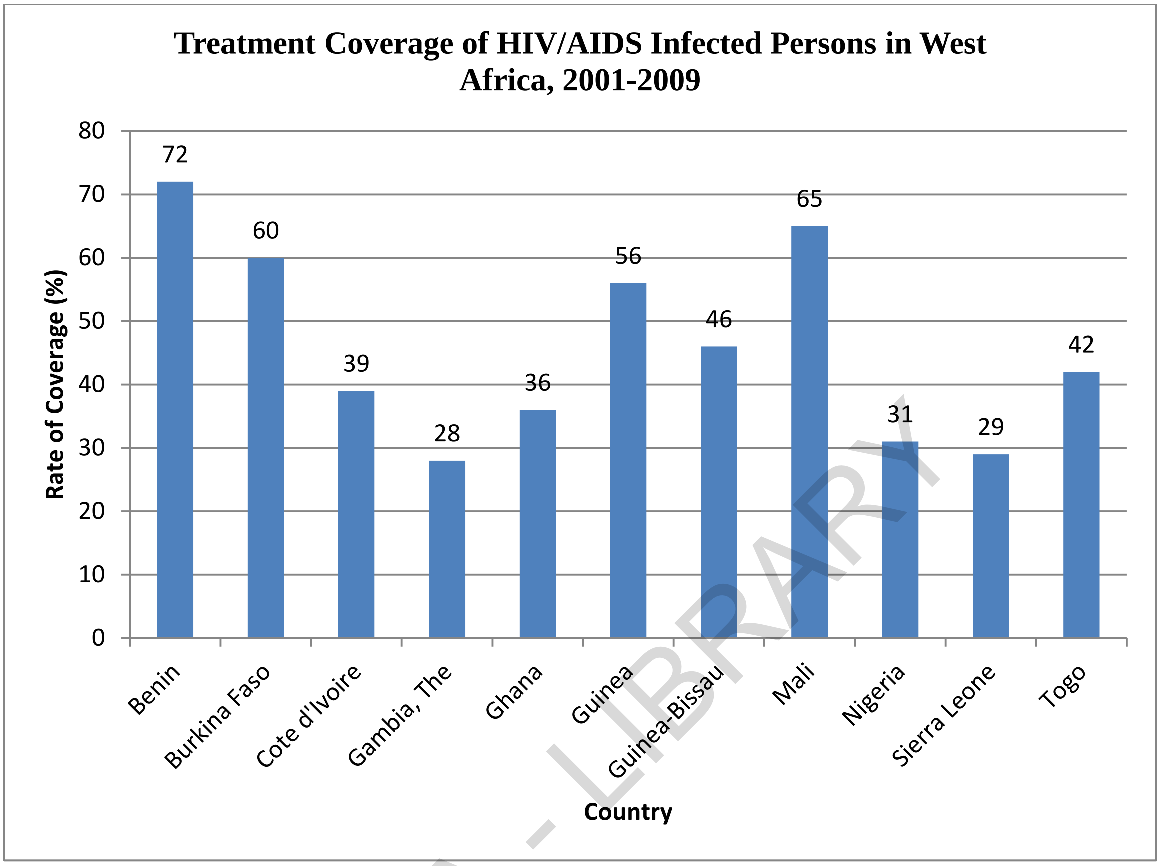

Figure 2.1. Treatment Coverage of HIV/AIDS Infected Persons in West Africa, 2001-2009

Source: USAID (2011a). HIV/AIDS health profile: West Africa

With respect to provision of treatment for persons living with the disease globally, it has been reported that very wide gaps still exist across regions. According to UNAIDS (2013c), only one out of every three HIV/AIDS infected persons, who need ART was covered. The agency reported that in Africa, out of the 21.2 million HIV/AIDS positive persons who were eligible for ART, only 7.6 million people were covered as at the end of 2012. It further noted that more than 80 percent of persons eligible for ART in at least 14 African countries could not access the service as at December 2012. **Table** 2.12 shows regional gap in access to ART in Africa for the period 2012 to 2013.

Very wide gaps still exist in access to ART in all regions in Africa. None of the regions can boast of 50 percent ART coverage of persons living with the virus. The only regions with a fairly encouraging figure are the East and Southern African regions, which have been able to attain 41 percent coverage. West Africa accounts for just 21 percent coverage of people living with the disease who needed the treatment for the period 2012 to 2013 while the largest gap in treatment is found in North Africa, where only 11 percent of infected persons were covered with ART. This is an indication that a lot still needs to be done in order to step-up treatment services to infected persons globally.

In a more recent report by UNAIDS (2014), access to ART by PLWHA as at the end of 2013 ranged between 25 percent and 39 percent in Benin, Cote d'Ivoire, The Gambia, Ghana, Mali, and Togo, while less than 25 percent of PLWHA could access the services in Guinea, Guinea-Bissau, Nigeria and Sierra Leone.

In conclusion, it is obvious based on the series of facts presented on growth, human capital and situation of the HIV/AIDS disease in the eleven countries of focus that the pandemic could be one of the probable factors impeding human capital development activities and economic growth in West Africa. This further justifies the present study.

Table 2.12. Regional Gaps in Access to Antiretroviral Therapy, Africa, 2012 – 2013

Region	Percent with Access to ART	Percent without Access to ART
Eastern and Southern Africa	41	59
Western and Central Africa	21	79
North Africa	11	89
Global Average	34	66

Source: UNAIDS. 2013c. Access to antiretroviral therapy in Africa.

CHAPTER THREE

REVIEW OF RELATED LITERATURE

This chapter provides comprehensive and in-depth review of existing conceptual, theoretical, methodological and empirical literatures relating to the economic impact of HIV/AIDS with specific focus on how the disease affects human capital and economic growth.[15]

3.1 Conceptual and Theoretical Discourse

Basically, this sub-section examines conceptual and theoretical issues that surround both human capital development and economic growth. Attempt is also made to discuss various ways both concepts are measured and modeled in the literature.

3.1.1 Human Capital: Theories and Measurement

The concept of human capital, though relatively new in the literature was embedded in the discussions of the classical economists. Karl Marx as cited in Ojo (1997) in his Das Kapital stated that all capital consisted entirely of labour expended in the past. This no doubt refers to human capital content in man and not a mere labour. Smith (1776) also discusses education as an investment that yields benefits to the individual and the society as a whole. This type of investment is in fact capital component of man.

Apparently, human capital literature acknowledges that education is one of the fundamental means of human capital development (Schultz, 1961; Becker, 1962; Nelson and Phelps, 1966; Becker, 1993; and Barro and Lee, 1993). Ojo (1997) reaffirms Smith's argument, asserting that the acquisition of talents through the maintenance of a person during the period of formal education, study apprenticeship, and so on always costs a real expense, which is capital fixed. Therefore, an educated

15 Studies on economic impact of diseases focus on consequences of failing to intervene at the household and societal levels as well as the gains that accrue to the society from timely interventions.

man could be likened to an expensive machine, which tends to perform better than those without education. Consistent with the aforementioned is the view of Alfried Marshall who posited that education is a national investment. According to him, the most valuable of all capital is the one invested in human beings, which invariable can be termed human capital. In the same vein, David Richardo also maintained that the output of workers varies according to the level of acquired and natural capabilities; and these are nothing other than human capital.

The foregoing justifies the assertion that human capital idea is not a new phenomenon. This notwithstanding, the classists did not incorporate the human capital "concept in the formal core of economics generally, and for a very long time economists failed to highlight the fact that people invest in themselves and that such investment have been quite substantial" (Ojo, 1997: p. 5).

The works of Schultz (1961), Harbison (1962), Becker (1964), Romer (1986) and Grossman (1972a and 1972b) bring to the fore the strategic position human capital occupies in the growth and development of nations' economies. These studies laid the foundation of modern discourse of human capital, and its critical role in development process. Schultz (1961) first used the term and argued that investments in human capital should be accounted for in the same manner as investments in plant and machinery. Noting that investment undertaken in education, health and internal migration as well as earnings foregone to attend school and on-the-job training, constitute investment in human capital, which helps not only to improve 'the quality of human effort' but also to enhance productivity.

Schultz in page 9 of his article identified five important means through which human capital could be developed. These are: i) investment in 'health facilities and services', which include all expenditures that affect the life expectancy, 'strength and stamina, and the vigour and vitality of the people'; ii) 'on the-job training, including old-typed apprenticeships organized by firms'; iii) 'formally organized education at the elementary, secondary and higher levels'; iv) 'study programmes for adults that are organized by firms, including extension programmes notably in farm'; and (v) 'migration of individuals and families to adjust to changing job opportunities.'

Although the five means of human capital formation given by Schultz are not exhaustive, it was a major ground breaking achievement, which serves as eye opener to the fundamental importance of human capital and its formation process in society. The author's attempt further elicited and opened up debates in human capital and economic growth literatures, which revealed human capital as an important contributor to growth of nations' economies over the years.

In the past, most empirical human capital studies focus exclusively on education until the work of Grossman (1972a and 1972b) on the demand for good health as a commodity, which assisted to shift attention on the contributions of health capital to economic growth and development.

One striking thing about human capital theory, its determinants and modeling is that they are all based on micro foundations, and as such most macroeconomic studies focusing on human capital depend to a large extent on the micro formulations. This justifies the argument of McDonald and Roberts (2006); and Gardner and Lee (2010) that no standard determinants of health capital for macroeconomic studies exist in the literature; however, the available ones are derived from micro theories.

The Concept of Human Capital

The term human capital has micro rather than macro origin. It focuses on individual instead of the overall economy, with its macro dimension being determined through individual aggregation. As reiterated by Stroombergen, Rose and Nana (2002: p. 3), "human capital is embodied in the individual, and the national stock of human capital can therefore be thought of as the sum total of the human capital of all those normally resident in its territory."

The concept of human capital is very wide, and as such different definitions have been given based on each author's perception. Some definitions centre on individual's innate abilities or acquired skills while others focus on the totality of human resources available in a given society or improvement in human capabilities through the means of education, training, health and other factors. Schultz (1961: p. 8) considers the term as "skill, knowledge, and similar attributes that affect human capabilities to do productive work.” This definition stresses skill and knowledge acquisition as essential for human capital, and suggests education and apprenticeship as its focal point.

Human capital however, appears broader than the definition given by Schultz. This is based on the existence of other critical factors that affect human capabilities. Moreover, the definition gives the impression that human capital should be viewed solely in the light of its impact on productive work without consideration for its other essentialities, not only in the area of productivity but as it also affects the overall wellbeing of an individual as well as the society at large.

Organization for Economic Co-Operation and Development, OECD (2001: pp. 18 and 20) tends to address this shortcoming in its definition, which views human capital as “the knowledge, skills, competencies and attributes embodied in individuals that facilitate the creation of personal, social and economic well-being. It argues further that asides developing human capital through the instrumentality of “formal education or training programmes”, it can also be formed “in informal interaction with others as well as through self-reflection and self-directed learning.” The definition sees human capital as not only affecting productivity of individual but also all other aspects of his/her life that in turn contribute to improving social life and the economic wellbeing of such individual. This is a comprehensive definition because an individual who is educated for instance has the chance of living a better life in society, contributes substantially to the betterment of such society and impact positively on family wellbeing.

World Bank (2006: pp. 23 and 87) also defines the concept as “the sum of knowledge, skills, and know-how possessed by the population or embodied in the labour force.” This is a macro rather than a micro definition, which implies that the knowledge, skills, know-how, capabilities and wherewithal enjoyed by a nation’s population or labour force are intangible assets, which are considered within the context of human capital.

One thing appears obvious from the definitions given above; human capital investments focus on people and are carried out in them. Evidently, the skills, attributes, know-how and ability of an individual, which are acquired and influenced by a lot of factors such as education, nutrition, health, experiences, attitude, training and apprenticeship that contribute to improved productivity in all areas of application, whether at individual, firm or national level, can be considered some forms of human capital.

Measures and Models of Human Capital

The task of measuring human capital has proved to be one of the most difficult attempts in the literature. Its measurement has been fraught with lots of difficulties and challenges, which are not unconnected with the different means through which it is developed. Besides, measures are also based on its different definitions, data availability, ease of measurement, and author's considerations, purposes and perception. World Bank (2006: p. 89) substantiates this argument when it noted that the difficulties encountered in measuring human capital could be associated with the variety ways the term is accumulated, immeasurable of some of the factors contributing to human capital formation and the fact that "the effect on values of human capital may vary from country to country" even where measures are possible. The above reasons account for while different suggestions have been made on ways of measuring the concept.

Wei (2008: p. 45) suggests that "all major factors that facilitate the formation and enhancement of productive capacities of human beings should be considered in developing comprehensive measurement of human capital." Schultz (1961: p. 8) in his article submits that measuring human capital through returns to its investment seems reasonable rather than employing expenditure or cost approach, which covers both consumption and investment expenditure. He argued that although any capabilities formed in man through investment cannot be sold, they however are "in touch with market place" and as such impart on his earnings.

Initially, when human capital was conceived and later became recognized in the literature; attention seemed to centre on education as the sole determinants against other measures. This narrow perception greatly influenced how the concept was measured.

Three basic approaches of measuring/modeling human capital are prominent in the literature. These include:

i) Output-Based Approach (OBA);

ii) Cost-Based Approach (CBA); and

iii) Income-Based Approach (IBA).

Output-Based Approach of Measuring Human Capital

As the name implies, output-based approach of human capital measure dwells basically on what is termed human capital outputs, majority of which are education variables such as enrolment rates, years of schooling, literacy rate, education attainment and so on. This has made some authors to refer to the technique as educational attainment-based approach (see Azariadis and Drazen 1990; Barro, 1991; MRW, 1992; Bils and klenow, 2000; Cohen and Soto 2007; Jones and Chiripanhura, 2010; Barro and Lee 2010; Christian, 2012; Hanushek and Woessmann 2012). Barro (1991) and MRW (1992) used school enrolment rates as measure of human capital based on this approach while Barro and Lee (2010) employed years of schooling. Test score was employed by Hanushek and Woessmann (2012), which falls into education output category.

Although this method has been used extensively in empirical literature due to its simplicity and data availability, it however continues to suffer from a major weakness of been unable to accommodate other identified means of human capital formation such as health, on-the-job training, apprenticeship and so on. Son (2012: p. 1) observed that literacy rate as a measure of human capital cannot capture "educational attainment or skill level of the workforce" while school enrolment rate ignores all population outside the school age. The author further maintained that using year of schooling as a human capital measure may not be able to "capture the multidimensional aspect of different kinds of skills required by the workforce to produce output." He also submits that even test scores as proxy for human capital may be hampered by the inability to "get a measurement that can be reliably extrapolated for the entire workforce."

Similarly, Laroche and Me´rette (2000: pp. 4-8) have contended that using school enrolment rates, which are flow variables rather than stock "only captures a fraction of the continuous accumulation of the stock of human capital." They further argued that the general practice of using gross enrolment as against net enrolment in the literature "introduces measurement errors related to the presence of grade repetition and dropouts." In addition, they also reiterated that although adult literacy rates are stock variables, which measure human capital stock, they tend to ignore other human capital investment activities that occur after this period of literacy, a period which is the "the first stages of human capital accumulation (reading, writing, and arithmetic)." According to the authors, even the use of average years of schooling may not capture properly human capital stock, since their computation is based on census data, which are conducted every ten years or more in some countries. Majority of educational measures employed as human capital proxies are restrictive and mostly fail to "reflect human capital obtained through informal training or through experience" while some of the measures may be affected by "survey and test limitations" (OECD, 2001: p. 20).

World Bank (2006) also made a case that although a human capital measure such as schooling are employed in empirical human capital literature because of data availability, the measure however is imperfect because of its inability to account for the quality human capital investment undertaken either in education, on-the-job training or other means of developing human capital.

In spite of the above observations, it is possible to incorporate non-education human capital measures into the output based approach. The following are relevant non-education human capital variables. They include: net migration, skill shortages in some specified areas, average life expectancy, mortality-infant, under-five and death rate, mortality and morbidity data.

Cost-Based Approach of Measuring Human Capital

This approach focuses on all expenditures incurred in the process of acquiring human capital. Such expenditures are then aggregated to arrive at a measure of human capital. The technique measures human capital from the perspective of what goes into its production process. It is more of an input-based approach, which could be termed a backward looking technique because of its focus on what has already been invested in human capital process. Many empirical works still employ this method, which also explains why some of them use education and health expenditures as measures of human capital. Kendricks (1976) and Eisner (1989) as cited by Laroche and Me´rette (2000: p. 3) emphasized that the approach involved the computation of "the depreciated value of investments made in education (including the opportunity cost associated with going to school), general training, and health and safety, as well as the value of investments in rearing and mobility."

Le, Gibson and Oxley (2005) have revealed that the cost based technique of measuring human capital has its origin in the work of Engel (1883). They noted that Engel employed this method to determine child rearing cost, which encompasses all costs incurred in the process of bringing up a person from conception to the age of 25 years. However, the current cost-based approach of human capital determination could be considered as improvement on Engel's method.

Engel's formula as presented in Le, Gibson and Oxley (2005: p. 4) is given as:

$$c_{xi} = c_{0i} + xc_{0i} + \sum_{1}^{x} k_i c_{0i} = c_{0i}\left\{1 + x + \frac{k_i x(x+1)}{2}\right\} \qquad (3.1)$$

This is based on the assumption that a person who is less than 26 years of age in different income class *i*, depending on the class (either 1 for lower income, 2 for middle income and 3 for upper income class) will have "cost at birth of c_{xi} and annual cost of $c_{0i} + k_i c_{0i}$ year" with the empirical value of each cost giving as: $c_{01} = 100, c_{02} = 200, c_{03} = 300$ marks while $k_i = k = 0.1$

Although this approach may be easy to compute, it is however not without some weaknesses. One of such is how to differentiate between what constitutes investment and consumption human capital expenditures, particularly at micro level. For instance, in the area of health, some consumption expenditures help to boost health status, which invariably has positive impact on productivity. Other shortcomings, which are well discussed in Le, Gibson and Oxley (2005: pp. 5 and 6) include: i) the issue of relating investment and output quality, since the value of capital depends on its demand and not on production cost; ii) the problem associated with determination of the rate of human capital depreciation (because such depreciation is very critical in this approach), and the method employed in its computation. Another important issue raised by Laroche and Me´rette (2000) is that rather than depreciates, empirical evidences suggest that human capital appreciates with working experience; and iii) the exclusion of the value of nonmarket activities from the computation of human capital via this approach constitutes other weakness.

Several benefits accrue to individuals from investment in human capital, which are not captured in this measurement. Examples of such cover individual fulfillment, ability to observe good health hygiene rule (which could extend longevity), more access to information of benefits, women empowerment with its attendant benefits, good parenting, as well as other social benefits.

One other important area of weakness of this technique has to do with its static nature of focusing exclusively on costs without consideration for benefits derived from human capital investment. As pointed out by Laroche and Me´rette (2000: p. 3) the approach "ignores the lengthy gestation period between the application of educational inputs and the emergence of human capital embodied in the graduates of educational institutions."

Income-Based Approach of Measuring Human Capital

This is a monetary measure of human capital. The approach focuses on returns that accumulate to an individual (private returns) as well as the society (public returns) from investment in human capital. It concentrates on the life-time earning of a person based on his/her level of human capital attainment, particularly education. It computes the stream of future or life-time earnings accruing to an individual or the society from human capital investment activities.

Le, Gibson and Oxley (2005: pp. 6 and 7) noted that while the genesis of the income-based technique could be traced to the work of Petty (1690) where he measured the human capital of England, the first truly scientific approach was developed by Farr (1853) who suggested the use of "present value of an individual's future earnings net of personal living expenses, adjusted for deaths in accordance with a life table" as a way to determine individual's earning capacity. They reported that Farr, through this method computed "average net human capital of an agricultural labourer" as £150, which was arrived at as a difference between an average gross human capital of £349 and average maintenance cost of £199, with an assumption of a 5 percent discount rate.

Different variants of this approach have been employed for empirical analysis. Prominent among them include: Mincer (1958 and 1974); Jorgenson and Fraumeni (1989, 1992a and 1992b). Mincer (1958 and 1974) employed what is termed "earning function" or "human capital equation" to determine returns to individual's investment in education. Mincer (1958) developed a human capital equation, which was adopted by Mincer (1974). In these two works, the author argued that basically, investment in education attracts both direct (financial cost) and indirect (time cost) costs. An individual who decides to invest in himself will not only postpone his/her earning (time cost) but will also reduce "the span of his earning life" asides the financial cost. By virtue of these associated cost, it is imperative for any human capital investor to consider the stream deferred income before such investment is undertaken. In fact, "if individuals with different amounts of training are to be compensated for the costs of training, the present values of life-earnings must be equalized at the time a choice of occupation is made" (Mincer, 1974: p. 284).

The basic Mincerian model began with a simple function. The version presented here is termed, "the schooling model", and can be found in Mincer (1974: pp. 9-11). It begins with a discreet discounting process equation given as:

$$V_S = Y_S \sum_{t=S+1}^{n} \left(\frac{1}{1+r} \right)^t \qquad (3.2)$$

Where: n = length of working life plus length of schooling and length of working life for persons without schooling. Y_S represents the annual earnings of an individual with *s* years of schooling while V_S shows the present value of an individual's life-time earnings at start of schooling. *r* stands for discount rate, *t* = 0, 1, 2, ... , *n* time in years; *d* = difference in the amount of schooling in years; and *e* = base of natural logarithms.

The continuous discounting process version is given as

$$V_S = Y_S \int_S^n e^{-rt} dt = \frac{Y_S \left(e^{-rs} - e^{-rn} \right)}{r} \qquad (3.3)$$

When the years of schooling (human capital investment) of a person is given as s-d, then his/her present value of lifetime earnings becomes:

$$V_{S-d} = \frac{Y_{S-d}}{r}\left(e^{-r(s-d)} - e^{-rn}\right) \quad (3.4)$$

When a person defers his/her years of schooling (human capital investment) by *d* years, then ratio $K_{S,S-d}$ of the person's annual earnings can be computed by equating $V_S = V_{S-d}$ to arrive at:

$$K_{S,S-d} = \frac{Y_S}{Y_{S-d}} = \frac{e^{-r(s-d)} - e^{-rn}}{e^{-rs} - e^{-rn}} = \frac{e^{r(n+d-s)} - 1}{e^{r(n-s)} - 1} \quad (3.5)$$

Where the equation shows clearly that $K_{S,S-d}$ is "greater than unity; a positive function of r; and a negative function of *n*." This intuitively implies that individuals with more investment in human capital earn higher pay; and the level of individual's investment in human capital will determine the rate of returns of such investment (a higher investment implies a higher rate of returns, and vice versa). In addition, the larger the difference in human capital investment returns, "the shorter the general span of working life."

Mincer maintains that at a large value of *n*, there exists a negligible difference between the value of any change in $K_{S,S-d}$ and a change in *s* and *n*; and as such the change could be treated as a constant, *k* which is given in algebra form as

$$\frac{\partial k}{\partial s} = \frac{r\left\{e^{r(n+d-s)} - e^{r(n-s)}\right\}}{\left\{e^{r(n-s)} - 1\right\}^2} > 0; \frac{\partial k}{\partial s} \to 0, \text{when } n \to \infty; \quad (3.6)$$

$$\frac{\partial k}{\partial n} = \frac{r\left\{e^{r(n-s)} - e^{r(n+d-s)}\right\}}{\left\{e^{r(n-s)} - 1\right\}^2} > 0; \frac{\partial k}{\partial n} \to 0, \text{when } n \to \infty;$$

With this, *n* was re-defined as "the fixed span of earning life" to arrive at the equations below:

$$V_S = Y_S \int_S^{n+s} e^{-rt} dt = \frac{Y_S}{r} e^{-rs}\left(1 - e^{-rn}\right); \quad (3.7)$$

$$V_{S-d} = Y_{S-d} \int_{S-d}^{n+s-d} e^{-rt} dt = \frac{Y_{S-d}}{r}\left(1 - e^{-rn}\right)e^{-r(s-d)} \quad (3.8)$$

Where $V_S = V_{S-d}$ yields

$$K_{S,S-d} = \frac{Y_S}{Y_{S-d}} = \frac{e^{-r(s-d)}}{e^{-rs}} = e^{rd} \quad (3.9)$$

With $k_{s,0}$ defined as $\frac{Y_S}{Y_0} = k_s$, and $k_s = e^{rs}$ based on equation (3.9). When this is linearized, the earning equation becomes:

$$\ln Y_s = \ln Y_0 + rs \quad (3.10)$$

With $Y_{s,}$ being earnings of an individual who invests in human capital to the level of *s* years of schooling.

Equation (3.10) can easily be empirically estimated or augmented, depending on the study objective or focus. What the equations imply is that "percentage increments in earnings are strictly proportional to the absolute differences in the time spent at school, with the rate of return as the coefficient of proportionality" (Mincer, 1974: p.11).

Mincer extends this function by looking at post-school investment function, focusing on the individual's earning profile as he or she continues to invest in human capital. According to him, it is impossible to observe Y_s since investment in human capital does not terminate at *s* years.

Different versions of the income-based approach have been applied for empirical works, some of which include: Mulligan and Sala-i-Martin (1997), Macklem (1997), Marin and Koman (2005), Wei (2008), Christian (2010 and 2012), Son (2012), and Gu and Wong (2012).

An important income-based approach of human capital measure is the version developed by Jorgenson and Fraumeni (1989, 1992a and 1992b). The authors try to define human capital from the perspective of a life-time labour income, which an individual earns over his/her life time. Based on this definition, they developed a model to determine human capital of all individuals in the economy of the United States. The model determines human capital stock by computing the discounted present value of life-long earnings accruing to an individual and by extension a nation from human capital investment activities. The approach has been noted as the most widely used in economic growth literature due to its sound theoretical base as well as the ease of obtaining data required for the analysis (World Bank, 2011).

Similarly, Son (2012) also developed a new human capital measure, which incorporates nine different levels of educational attainment in Viet Nam, using the Mincer (1958) and Becker (1964) earning functions. With this it was possible to determine human capital of individuals based on their levels of education, human capital for any socioeconomic or demographic group as well as for an entire economy, which could also be used for cross-country studies.

Although this approach seems to appeal to many researchers in the field of human resource and labour economics because of its "forward looking approach", it however appears to place emphasis solely on educational attainment without consideration for other important means of human capital. Furthermore, factors that affect income of an individual are not necessarily limited to human capital alone, it therefore becomes an onerous task to decipher which income are solely due to human capital factors.

It is apparent from all the three approaches of human capital modeling reviewed above that majority of them and their variants tend more towards education than other forms of human capital formation. Nevertheless, they can still be applied to non-education form of human capital.

Health as a Form of Human Capital

In human capital literature, health currently is considered as a type of human capital. The argument here presupposes that as physical capital is developed through investment, the same thing is applicable to health. Investment carried out in health whether at micro or macro levels is a form of capital formation while health in turn can also be consumed.

It is essential to mention here at the outset that the decision to single out and review briefly health capital does not isolate it from the three basic human capital measures considered above. It is purely for academic purpose and to also shed some light on what literature has to offer on this crucial concept as well as existing discussions on its strategic importance for human capital developmental activities. Suffice it to say that health capital measurement in some situations still falls within the purview of output-based, income-based and cost-based approaches.

The works of Grossman (1972a, 1972b, and 2000) have popularized the concept of health as human capital. Various empirical works have adopted and extended Grossman's model (see Muurinen, 1982; Liljas, 1998; Jacobson, 2000, Galama *et al*., 2012 and a host of others). As a matter of fact, the human capital model of Grossman "has great theoretical and intuitive appeal and has led to a rich body of literature and many useful insights in health economics (Galama *et al*, 2012: p. 2).

As demonstrated by Grossman, health is both consumption and production good, and as such could be demanded for and supplied. The difference of health from other types of human capital is underscored by the statement, which indicates that "a person's stock of knowledge affects his market and nonmarket productivity while his stock of health determines the total amount of time he can spend producing money earnings and commodities" (Grossman, 1972a, p. 224). This shows the significance of health in all human endeavours. According to Grossman, individual can demand for health for the purpose of deriving satisfaction or utility, since it is considered a commodity. Meaning that demand for health care services is a derived demand. Asides, good health also contributes to better productivity and greater earnings; therefore, health as well can be produced. It is based on this premise that demand function for health is specified subject to certain constraints. In addition, as a production good, health production equation can also be specified with certain input factors going into the function. Grossman developed his health demand function based on the household production framework.

His basic human capital model in the area of health is given as:

$$U = U(\alpha_0 H_0, ..., \alpha_n H_n; Z_0, ...Z_n) \quad (3.11)$$

Where

U is a consumer's intertemporal utility function; H_0 stands for the initial health stock inherited by the individual at birth, which is exogenous; H_i shows health stock at period *i* (this is assumed endogenous); α_i reveals the service flow per unit stock; with the total consumption of other commodities at period *i* given as Z_i. The total health services consumption can be specified as:

$$h = \alpha_i H_i \quad (3.12)$$

An individual's life span is also assumed endogenous, and so a person dies when the health stock at a particular age is less than the minimum. Accordingly, the life span of an individual is a function of "the quantities of health capital that maximize utility subject to production and resource constraints" (Grossman, 2000: p. 352). Since capital stock depreciates over time, the same thing is applicable to investment undertaken in health. Therefore, net health investment is the difference between gross investment in the stock of health and the depreciation of such health stock, given as:

$$H_{t+1} - H_t = I_t - \delta_t H_t \tag{3.13}$$

Where: H_{t+1} implies current period health stock, H_t is health stock in the previous year, I_t represents gross investment, which is non-negative while δ_t denotes the rate of depreciation, which is constant, exogenous and depends on the age of the individual. Since the household produces health, a set of its function can be specified as:

$$I_t = I_t(M_t, TH_t; E),$$

$$Z_t = Z_t(X_t, T_t; E). \tag{3.14}$$

Where I_t and Z_i remain as earlier defined (gross health investment and non-health care commodities consumed by the households respectively). M_t, which represents a vector of market goods purchased and consumed by households that contribute to gross investment in health was equated to medical care by Grossman. That is, these commodities are considered inputs into the health production process while X_t also represents such commodities that also contribute to the production of Z_i. "TH_t and T_t are time inputs" while E stands for knowledge stock possess by the household, which is also a human capital different from health capital, since there are other means of human capital development such as education and training.

The assumption behind the above production functions is that, they are homogenous of degree one in both goods and time inputs. Based on this, Grossman defines gross investment production function as:

$$I_t = M_i g(t_i; E_i) \tag{3.15}$$

With t_i being $\frac{TH_i}{M_i}$

So that

$$\frac{\partial I_i}{\partial TH_i} = \frac{\partial g}{\partial t_i} = g' \qquad (3.16)$$

$$\frac{\partial I_i}{\partial M_i} = g - t_i g' \qquad (3.17)$$

Equations (3.16) and (3.17) are marginal products of time and medical care respectively.

Goods budget constraint is then given as[16]:

$$\sum \frac{(P_i M_i + V_i X_i)}{(1+r)^i} = \sum \frac{W_i TW_i}{(1+r)^i} + A_0 \qquad (3.18)$$

Where P_i and V_i denote prices of M_i and X_i respectively while W_i, TW_i, A_0 and r are wage rate, work hours, discounted property income and rate of interest in that order. The time constraint is specified as:

$$TW_i + TL_i + TH_i + T_i = \Omega \qquad (3.19)$$

TL_i stands for any "time lost from market and nonmarket activities due to illness or injury" while Ω is the total time available at a given point in time, which according to him must be exhausted, with

$\frac{\partial TL_i}{\partial H_i} < 0$.

The full wealth constraint is therefore given as

$$\sum_{i=0}^{n} \left[P_i M_i + V_i X_i + W_i (TL_i + TH_i + T_i)\right]\left[(1+r)^{-1}\right] = \sum_{i=0}^{n} [W_i \Omega]\left[(1+r)^{-1}\right] + A_0 = R \qquad (3.20)$$

Equation (3.20) was arrived at by Grossman through the substitution of TW_i in equation (3.19) into equation (3.18). What equation (3.20) implies is that "full wealth equals initial assets plus the present value of the earnings an individual would obtain if he spent all of his time at work" (Grossman, 1972a: p. 228).

16 This budget constraint is the "present value of outlays on goods to the present value of earnings income over the life cycle plus initial assets (discounted property income)" (Grossman, 1972a: p. 227).

To determine the quantities of both *Z* and *H*, equation (3.11), which is the household's inter-temporal utility function can then be maximized; subject to the constraints given in equations (3.13), (3.14) and (3.20).

Depending on different assumptions and author's objectives, the empirical model of Grossman human capital model can be derived. A simple version of the model was presented by Case and Deaton (2005) in their work.

Although Grossman's human capital model has received a continued and favourable attention in the literature, it however has being criticized on certain grounds, some of which have to do with its neglect of uncertainty and information asymmetry associated with health demand (Muurinen, 1982; Kiiskinen, 2003; Zweifel, Breyer and Kifmann, 2009; Hren, 2012). In spite of the various criticisms, authors still find the model useful either in its original form, modified or extended version.

3.1.2 Economic Growth: Theories and Measurement

The importance attached to the growth of nations' economies and the role economic growth plays in the prosperity of nations, have stimulated the interests of economists to develop appropriate definitions and measures of the concept. The most widely used measure of economic growth in the literature is the gross domestic product (GDP) of a country. This could be real value, the per capita or the growth rate of either the real GDP or the growth rate of its per capita value. Most country-specific studies employ growth rate of GDP while cross-country studies adopt growth rate of per capita GDP.

Under this sub-section, attempt is made to review literature on the main economic growth theories. These range from the classical to neoclassical (otherwise known as the exogenous growth theory) and the new growth theory, also referred to as the endogenous growth theory.

Classical Economic Growth Theory

The foundation laying for classical growth theory could be ascribed to economists such as Adam Smith, David Ricardo and Thomas Malthus among others, who championed the discussion of this theory having pinpointed some shortcomings of Mercantilism.

Smith in his famous 1776 book titled "an inquiry into nature and the causes of the wealth of nations" as well as David Ricardo and Thomas Malthus have discussed extensively the importance of land, capital, population growth and trade in growth process coupled with such issues as "competitive behaviour, equilibrium dynamics, and the impact of diminishing returns on the accumulation of labour and capital" (Diaz-Bautista, 2006: p. 361). In fact, most modern growth theories could be regarded as off-shoots of the classical theory. Barro and Sala-i-Martin (2004: p. 16) contend that a good number of the features of modern economic growth theories are derived from classical economists, particularly "Adam Smith (1776), David Ricardo (1817), and Thomas Malthus (1798), and, much later, Frank Ramsey (1928), Allyn Young (1928), Frank Knight (1944), and Joseph Schumpeter (1934)." They indicate these features to include:

> basic approaches of competitive behavior and equilibrium dynamics, the role of diminishing returns and its relation to the accumulation of physical and human capital, the interplay between per capita income and the growth rate of population, the effects of technological progress in the forms of increased specialization of labor and discoveries of new goods and methods of production, and the role of monopoly power as an incentive for technological advance**.**

Under classical theory, the main determinant of growth is the physical capital and so, much emphasis is laid on investment init to spur growth in the economy. Fashola (2001) has noted that most of the classical growth theories that are common in economic literature stress the importance of capital formation and labour supply for economic growth while land limitation imposes diminishing returns on the marginal productivity of both labour and capital with the consequences of eventual hampering of capital accumulation and growing labour employment procedures as well as rendering further investment unprofitable.

One of the key classical economic growth theories, upon which modern growth theories and models are based, is the Harrod–Domar growth model. This was originally developed independently by Harrod (1939) and Domar (1946) for the purpose of analyzing business cycles. The model focuses on saving and capital productivity levels as explanations for growth. It was however adapted later to explain economic growth.

Assuming a closed economy without government intervention, national income (*Y*) at time *t*, spreads between consumption (*C*) and saving (*S*), such that

$$Y_t = C_t + S_t \quad (3.21)$$

In the same vein, the level of output within the economy is divided between the consumption goods produced by firms (*C*) and private investment goods (*I*); so that

$$Y_t = C_t + I_t \quad (3.22)$$

The implication of equations (3.21) and (3.22) is that

$$S_t = I_t \quad (3.23)$$

But investment is the accumulation of capital stock (K) in the economy, which is also subject to depreciation (δ). Therefore,

$$K_t = (1-\delta)K_{t-1} + I_{t-1} \quad (3.24)$$

Where:

K_t equals capital stock in the current period, K_{t-1} is the value of capital stock in the previous period , I_{t-1} stands for the previous period investment level while the rate at which capital stock depreciates is given as δ .

From the above, it is evident that output (*Y*) depends on capital stock (*K*). Thus,

$$Y = f(K) \quad (3.25)$$

It assumes that output is proportional to the input of capital.

Given the capital-output ratio as *k* and the net saving ratio as *s* (which is some fixed proportion of national output)[17], a Harrod-Domar type of economic growth model indicates that:[18]

$$S = sY \quad (3.26)$$

Equation (3.26) is net saving (*S*) equation, which shows net saving as some proportion, *s* of output level, *Y* in the economy.

Net investment (*I*), a change in the capital stock, *K* is expressed as

$$I = \Delta K \quad (3.27)$$

17 Capital-output ratio is "a ratio that shows the units of capital required to produce a unit of output over a given period of time" while net savings ratio is "savings expressed as a proportion of disposable income over some period of time" (Todaro and Smith, 2012: p. 112).

18 The structure of the theory presented in this thesis is due to Todaro and Smith (2012: pp. 112-113).

Going by the assumption of output being proportional to the input of capital, the capital-output ratio is given as

$$\frac{K}{Y} = \phi \qquad (3.28)$$

Taking the first derivative gives

$$\frac{\Delta K}{\Delta Y} = \phi \qquad (3.29)$$

The Harrod-Domar production function assumes constant returns to scale. Therefore, ϕ is constant.

It then follows that

$$\frac{\Delta K}{\Delta Y} = \frac{K}{Y} = \phi \qquad (3.30)$$

From equation (3.30), it follows that

$$\frac{\Delta Y}{Y} = \frac{\Delta K}{K} \qquad (3.31)$$

Meaning that the growth rate of output is also equal to the growth rate of capital, which further implies that

$$g = \frac{\Delta Y}{Y} = \frac{\Delta K}{K} \qquad (3.32)$$

Where g stands for the growth rate of output.

Furthermore,

$$\Delta K = \phi \Delta Y \qquad (3.33)$$

But savings provides funds for investment, which is consistent with equation (3.23) such that,

$$I = S \qquad (3.34)$$

Evidently, equation (3.34) can be re-written based on equations (3.26), (3.27), (3.33) as

$$S = sY = \phi \Delta Y = \Delta K = I \qquad (3.35)$$

Which also implies that

$$sY = \phi \Delta Y \qquad (3.36)$$

And from equation (3.36),

$$\frac{\Delta Y}{Y} = \frac{s}{\phi} \qquad (3.37)$$

Which is the same as

$$g = \frac{s}{\phi} \tag{3.38}$$

Equation (3.38) is a simplified version of the Harrod-Domar model based on classical economic growth theory. It states that output growth rate, g "is determined jointly by the net national savings ratio, s and the national capital-output ratio", ϕ (Todaro and Smith, 2012: p. 113). While a direct relationship exists between output growth rate and savings rate, both g and ϕ are inversely related. Therefore, an increase in saving rate will bring about economic growth while a decrease will reduce growth.

It should be noted that capital stock is subject to depreciation, and therefore, to determine capital stock change we have to deduct depreciation from investment. Based on this fact, the Harrod-Domar equation is usually expressed with respect to gross savings so as to reflect depreciation of capital stock. Therefore, equation (3.38) can be re-specified as

$$g = \frac{\Delta Y}{Y} = \frac{s^G}{\phi} - \delta \tag{3.39}$$

Where g is our output growth, s^G is gross saving but s is the rate of saving, ϕ is our capital-output ratio and δ is the rate at which capital stock depreciates. But depreciation and capital-output ration are constant by assumption and so, the only policy variable that can be manipulated to bring about changes in the economy is the saving rate. And since there is positive relationship between our g and s, then the higher the saving rate the more growth is recorded in the economy. This is because savings provide funds for investment and so, both investment and savings are very critical for economic growth. However, the growth rate of the economy is measured by $1/\phi$, which is the output-investment/capital ratio. Therefore, the rate at which the economy grows can be determined by multiplying the rate of new investment, $s = I/Y$, by its productivity, $1/\phi$.

Neoclassical Theory of Economic Growth

The neoclassical theory extends the Harrod–Domar model by incorporating labour as an important factor in the growth model as well as technology. Technological progress in this model is assumed to be given, (it is exogenously determined) and it also doubles as a residual factor, which explains long-term growth. While advancement in technology enhances long term growth, its stagnation retards long run output growth. Labour force and saving rate grow at an exogenous rate. The part of output which is unexplained by the growth in productive inputs is referred to as the Solow residual.

This theory was championed by Solow (1956) and Swan (1956) in their seminar on growth. It was however extended by Cass (1965) and Koopmans (1965) by incorporating an element of consumer optimization, which enables the saving rate to be determined from within the model (see Romer, 2012 and Barro and Sala-i-Martin, 2004). In fact, Barro and Sala-i-Martin (2004: p. 18) have observed that although the endogeneity of saving in the model "does not eliminate the dependence of the long-run per capita growth rate on exogenous technological progress" as well as the conditional convergence proposition, it however "allows for richer transitional dynamics." It is worth noting that "unlike the fixed-coefficient, constant-returns-to-scale assumption of the Harrod–Domar model, Solow's neoclassical growth model exhibited diminishing returns to labour and capital separately and constant returns to both factors jointly" (Todaro and Smith, 2012: p. 129). This implies the existence of constant returns to scale with respect to returns to both labour and capital jointly.

Some important implications of this model include: firstly, it is the total factor productivity that brings about sustained increases in per-capita income. Therefore, the ratio of capita per worker/total factor productivity has significant role to play in the determination of output per worker. Secondly, the model assumes conditional convergence (due to saving rate, population growth rate, and the position of the production function), which proposes a faster economic growth for economies with initial low levels of real output per worker (such as developing economies) relative to the long-run level. Conditional convergence is assumed because "the steady-state levels of capital and output per worker depend, in the Solow-Swan model, on the saving rate, the growth rate of population, and the position of the production function", which vary from country to country (Barro and Sala-i-Martin, 2004: p.17). Furthermore, the model operates on the assumption that each input displays positive and diminishing returns.

The main reservations of the theory remain in its inability to explain why the gap between the poor and rich countries had widened (anti-catch up) over the years even with the convergence hypothesis; the reason(s) some countries in East Asia had apparently grown consistently on the back of higher saving rates; and its modeling of technology as exogenous without explanation for how or why technological progress occurs, even beyond the influence of policy. These shortcomings led to the development of the endogenous growth theory.

It should be noted that the weaknesses observed above notwithstanding, exogenous growth model has continued to receive greater attention in growth literature, particularly in the area of cross-country studies. Additionally, empirical works have justified some of the assumptions of the theory, which have not been refuted by any work(s).

The structure of the model, which benefits from Mankiw, Romer and Weil (1992), MRW hereafter; Romer (2012) and Barro and Sala-i-Martin (2004), is presented below.

The basic neoclassical growth model of Solow and Swan type assumes a production function of the form

$$Y(t) = F(K(t), A(t)L(t)) \qquad (3.40)$$

Where Y = output, K = capital, L = labour, A = knowledge or technology, and t = time, which enters the production function through the right hand side variables. An increase in the amount of knowledge brings about technological progress. Furthermore, the model also assumes that AL, effective labour enters the equation multiplicatively.

The production function as stipulated by Solow displays constant returns to scale in its arguments (capital and effective labour), implying homogeneity of degree one.

For instance $F(\phi K, \phi L) = \phi F(K, L) \qquad (3.41)$

It is further assumed that saving, population growth and technological advancement are exogenously determined.

Another assumption of the neoclassical growth model is that each input displays positive and diminishing returns so that

$$\partial F/\partial K > 0,\ \partial^2 F/\partial K^2 < 0,$$

$\partial F/\partial L > 0,\ \partial^2 F/\partial L^2 < 0,$ (3.42)

Furthermore, *Inada condition* is assumed. This stipulates that as each input (capital or labour) approaches zero its marginal product approaches infinity; and as the input approaches infinity, its marginal products approaches zero. Functionally, it is shown as:

$$\lim_{K\to 0}(\partial F/\partial K) = \infty;\ \lim_{K\to\infty}(\partial F/\partial K) = 0$$

$$\lim_{K\to 0}(\partial F/\partial L) = \infty;\ \lim_{K\to\infty}(\partial F/\partial L) = 0 \quad (3.43)$$

The Cobb Douglas form of equation (3.40) is given as:

$$Y(t) = K(t)^{\alpha}(A(t)L(t))^{1-\alpha} \qquad 0<\alpha<1. \quad (3.44)$$

Based on the assumption of constant returns to scale demonstrated in equation (3.41),

let $\phi = \dfrac{1}{AL}$ (3.45)

Equation (3.44) can then be re-written in effective form as

$$y(t) = k(t)^{\alpha} \quad (3.46)$$

Assuming a competitive economy where each factor is compensated with its marginal product, it is easy to see from equation (3.46) that

$$\partial y/\partial k = f'(k) = \alpha k(t)^{\alpha-1} \quad (3.47)$$

The Solow model assumes that the initial levels of capital, labour and knowledge are given (exogenous) with both *L* and *A* growing exogenously as *n* and *g* respectively. Thus, the growth rates of labour and knowledge (which are constant and exogenous) are given respectively as:

$$\dot{L}(t) = nL(t) \quad (3.48)$$

$$\dot{A}(t) = gA(t) \quad (3.49)$$

Where *n and g* are exogenous growth rates of labour and technology respectively.

From equations (3.48) and (3.49),

$$n = \frac{\dot{L}(t)}{L(t)} \quad (3.50)$$

$$g = \frac{\dot{A}(t)}{A(t)} \quad (3.51)$$

Where

$\dot{L}(t) = \frac{dL(t)}{dt}$ and $\dot{A}(t) = \frac{dA(t)}{t}$ which are derivatives with respect to time.

The above equations (3.48) and (3.49) indicate that both labour and knowledge grow exponentially and as such given their initial levels, for instance at time 0,

$$L(t) = L(0)e^{nt} \tag{3.52}$$

$$A(t) = A(0)e^{gt} \tag{3.53}$$

The above also implies that effective labour unit, which is *L(t)A(t)*, grows at rate $n + g$. Since income is divided between investment and consumption, the proportion of income saved is what is invested. The model assumes that the fraction of income invested, *s*, is both exogenous and constant and "one unit of output devoted to investment yields one unit of new capital" (Romer, 2012: p. 14). It is further presupposed that the existing capital depreciates at the rate δ. Therefore,

$$\dot{K}(t) = sY(t) - \delta K(t) \tag{3.54}$$

Having assumed exogenous evolution of both labour and technology/knowledge, it is important to consider how capital, the third variable in the model behaves. This will lead to the determination of the critical equation of the Solow model.

From equations (3.45) and (3.46)

$$k = \frac{K}{AL} \tag{3.55}$$

Substituting equations (3.50), (3.51) and (3.54) into (3.55) gives

$$\dot{k}(t) = s\frac{Y(t)}{A(t)L(t)} - \delta k(t) - nk(t) - gk(t) \tag{3.56}$$

Given that output per unit of effective labour is

$$y(t) = \frac{Y(t)}{A(t)L(t)} = f(k) \tag{3.57}$$

equation (3.56) can then be re-written as

$$\dot{k}(t) = sf(k(t)) - (n + g + \delta)k(t) \tag{3.58}$$

The full derivation is available in Romer (2012: pp. 15-16).

Equation (3.58) is the fundamental/key equation of the Solow model. It states that the rate at which capital stock per unit of effective labour changes is the actual investment per unit of effective labour $\{sf(k)\}$ minus breakeven investment, $\{(n+g+\delta)k\}$. Saving rate, s is the only policy variable in the model and it is the variable that determines investment and level of growth.

Investment activities are essential to keeping the available capital stock from falling, since it depreciates over time. Additionally, stock of capital per unit of effective labour continues to grow; therefore, wisdom demands that investment is undertaken to keep this constant. For instance, if the growth rate of effective labour is $(n+g)$, capital stock is also expected to grow at $(n+g)$ in order to keep k steady in the economy.

The intuition here is that:

$k\uparrow$ as $sf(k)>(n+g+\delta)k$; which is the point where $k<k^*$. (Note that k^* is the steady-state value of k). $k\downarrow$ as $sf(k)<(n+g+\delta)k$. This is the point where $k>k^*$. When both terms are equal, k becomes constant, which is the point where $k=k^*$. The model stipulates that k normally converges to its steady-state value (k^*) irrespective of the position where it begins. This implies that the economy normally converges to the 'balanced growth path' (where each variable continues to grow at a constant rate) regardless of where it begins and along this path, it is stated that technological advancement is the sole determinant of 'the growth rate of output per worker.'

In Solow model, the saving rate, s is very strategic and critical, because it is the only policy variable in the model and when it rises permanently, the increase will only bring about temporary rise in the rate at which per worker output level grows. This is due to the fact that such increase will eventually reach a level whereby "additional saving" will only serve to maintain the higher level of per capita output growth rate, k. This is what is referred to as the **level effect** of any change in saving rate, which implies that changes in the saving rate can only produce a **level effect** and not a **growth effect**. According to Romer (2012), the only factor that facilitates growth is a change in the rate of technological advancement while changes in all other factors bring about level effects.

From MRW (1992), evolution of the stock of capital per unit of effective labour, k is governed by

$$\dot{k}(t) = sy(t) - (n + g + \delta)k(t) \tag{3.59}$$

Which is the same as

$$\dot{k}(t) = sk(t)^{\alpha} - (n + g + \delta)k(t) \tag{3.60}$$

Since k converges to its steady-state, k^*, meaning that $sk*^{\alpha} = (n + g + \delta)k*$, which could also be specified as

$$k* = \{s/(n + g + \delta)\}^{1/(1-\alpha)} \tag{3.61}$$

Equation (3.61) shows that the steady-state capital-labour ratio is affected positively by the saving rate and negatively related to the rate of population growth (MWR, 1992).

After deriving the steady-state output per unit of effective labour and taking the log of the equation, MWR came up with the steady-state per capita income equation as:

$$\ln\left\{\frac{Y(t)}{L(t)}\right\} = \ln A(0) + gt + \frac{\alpha}{1-\alpha}\ln(s) - \frac{\alpha}{1-\alpha}\ln(n + g + \delta) \tag{3.62}$$

The signs and the magnitudes of the coefficients on saving and population growth are predicted by the model because of the assumption that factors receive their marginal products. According to MWR, the share of capital in income, α is about $1/3$. The authors also gave the elasticity of income per capita with respect to the saving rate as 0.5 and elasticity with respect to $(n + g + \delta)$ as about -0.5. Technology, resource endowments, institutions, etc were proxied with the term $A(0)$, which could defer across countries. Therefore, the term is decomposed into

$$\ln A(0) = \alpha + \varepsilon \tag{3.63}$$

Where α is a constant and ε is a county-specific shock. The estimable equation showing log of income per capita at a giving time is

$$\ln\left\{\frac{Y}{L}\right\} = \alpha + \frac{\alpha}{1-\alpha}\ln(s) - \frac{\alpha}{1-\alpha}\ln(n + g + \delta) + \varepsilon \tag{3.64}$$

Since the capital share seems incredibly and questionably high relative to the capital share in national income, the above model was extended by MWR with the addition of human capital.

Augmenting equation (3.44) with human capital variable gives

$$Y(t) = K(t)^{\alpha} H(t)^{\beta} (A(t)L(t))^{1-\beta-\alpha} \quad (3.65)$$

Where H stands for human capital variable, α, the share of physical capital and β, the share of human capital.

Given s_k as the fraction of income invested in physical capital and s_h as the fraction of income invested in human capital, the evolution of the economy is then determined by

$$\dot{k}(t) = s_k y(t) - (n + g + \delta)k(t) \quad (3.66)$$

$$\dot{h}(t) = s_h y(t) - (n + g + \delta)k(t) \quad (3.67)$$

y, k and h are output per unit of effective labour, physical capital per unit of effective labour and human capital per unit of effective labour respectively.

Equations (3.66) and (3.67) imply that the economy converges to a steady state, defined as

$$k^* = \left[\frac{s_k^{\;1-\beta} s_h^{\;\beta}}{n + g + \delta} \right]^{1/(1-\alpha-\beta)} \quad (3.68)$$

$$h^* = \left[\frac{s_k^{\;\alpha} s_h^{\;1-\alpha}}{n + g + \delta} \right]^{1/(1-\alpha-\beta)} \quad (3.69)$$

MWR substituted equations (3.65) and (3.66) into the production function and taking the log gave an equation for income per capita as

$$\ln\left\{\frac{Y(t)}{L(t)}\right\} = \ln A(0) + gt + \frac{\alpha}{1-\alpha-\beta}\ln(s_k) + \frac{\beta}{1-\alpha-\beta}\ln(s_h) - \frac{\alpha+\beta}{1-\alpha}\ln(n + g + \delta)$$

(3.70)

Endogenous or New Growth Theory

The third growth theory-endogenous-attempts to overcome some of the drawbacks of exogenous theory. Although some variants of the theory existed in the 1960s, however, it was in the 1980s that it became more prominent. One of the critical reasons it was developed was to proffer an enhanced explanation for the process of long run growth. According to Romer (1994: p. 3), what distinguishes the endogenous growth from the neoclassical is its emphasis on economic growth as “an endogenous outcome of an economic system, not the result of forces that impinge from outside.” The theory holds that policy measures can affect long-run growth rate of an economy; therefore, knowledge and research have prominent roles to play in the process of long-run economic growth. This enables technological progress to become endogenous while increasing returns accrue to higher levels of capital investment. It further emphasizes private investment in research and development (R and D) as the central source of technical progress. Therefore, investment in human capital is strategic for growth.

The theory further assumes constant and exogenous saving rate while the level of technology remains fixed. Different versions of this model are available in the literature. Some of which are based on the works of Romer (1986 and 1990), Lucas (1988), Grossman and Helpman (1991 and 1994), Aghion and Howitt (1992), and so on.

The basic version of the endogenous growth model is the *AK*, developed in the 1960s. This does not differentiate between capital accumulation and technological advancement. Both human and physical capitals are grouped together in the model. The assumption of diminishing returns to capital does not hold, which is the key property of the model (Barro and Sala-i-Martin, 2004). In the version of Frankel (1962), it is assumed that the aggregate production function could show a constant or even increasing marginal product of capital as against diminishing returns. This is based on the premise that capital accumulation, particularly intellectual capital enhances technological progress, which operates to offset any attempt by the marginal product of capital to diminish (Howitt, 2008). Endogenous model further assumes constant and exogenous saving rate while the level of technology is fixed.

The *AK* version of the endogenous model is given as:

$$Y = AK \qquad (3.71)$$

Where Y is output, K is capital (both physical and human capital) and A is the level of technology, which is positive and constant.

Output per capita is $y = AK$ (3.72)

Average and marginal products of capital are constant at the level where *A > 0.*

The constant marginal product of capital is

$$MP_k = \frac{dY}{dK} = A \tag{3.73}$$

The model proposes that saving rate determines the long-run growth rate of the economy. Therefore, given the fraction of output saved, *s* (assumed to be constant), and a fixed depreciation rate, *δ*, aggregate rate of net investment becomes

$$\frac{dK}{dt} = sY - \delta K \tag{3.74}$$

See Howitt (2008).

Based on equations (3.72) and (3.74), growth rate equals

$$g \equiv \frac{1}{Y}\frac{dK}{dt} = \frac{1}{K}\frac{dK}{dt} = sA - \delta \tag{3.75}$$

The implication of equation (3.75) is that, an increase in the rate of saving, *s*, would bring about a permanently higher growth rate. This shows the possibility of a long-run growth in the economy.

The simplicity and the assumption of *K*, being a composite of human and physical capital in the model led to the development of more endogenous models such as the Research and Development (R and D) and growth models by Romer (1990), Grossman and Helpman (1991) and Aghion and Howitt (1992) as specified in Romer (2012). The models assumed that when investments are carried out in R and D, the profit levels of firms in the economy tend to increase, which in turn may lead to a positive externality on the productivity of other firms' R and D.

In the Romer (2012) textbook version of the models, the production function is given as

$$Y(t) = [(1 - a_K)K(t)]^{\alpha}[A(t)(1 - a_L)L(t)]^{1-\alpha}, \quad 0<\alpha<1 \tag{3.76}$$

Where: *Y* is output, *L*,labour, *K* stands for capital, *t* for time and *A* is for technology.

Equation (3.76) shows two sectors in the economy. These are goods-producing sector (this is where output is manufactured) and R and D sector (where addition to the stock of knowledge is produced). The available labour force and physical capital in the economy are shared between the two sectors. In the R and D sector an a_L proportion of the labour force is used while a fraction $1-a_L$ of the labour force is used in the goods-producing sector. In addition, a fraction a_K of the capital stock is expended in the R and D with $1- a_L$ used in the goods-producing sector. Meanwhile, the stock of knowledge is fully used in both sectors without any division. Equation (3.76) assumes constant returns to both capital and labour.

In order to produce new ideas, the quantities of capital and labour must be engaged in research and technology, implying that

$$\dot{A}(t) = G(a_K K(t), a_L L(t), A(t)) \qquad (3.77)$$

As indicated by Romer (2012), when a generalized Cobb-Douglas production function is assumed, equation (3.77) then becomes

$$\dot{A}(t) = B\{a_K K(t)\}^{\beta} \{a_L L(t)\}^{\gamma} A(t)^{\theta}, \quad B>0,\ \beta \geq 0, \gamma \geq 0, \qquad (3.78)$$

Where B is a shift parameter.

Equation (3.78), which is the production function of knowledge, shows that the returns to capital and labour are not constant. This is so because "in the case of knowledge production, exactly replicating what the existing inputs were doing would cause the same set of discoveries to be made twice, thereby leaving $\dot{A}$ unchanged" (Romer, 2012: p. 102). What this implies is that, there could be diminishing returns, constant returns or increasing returns in the R and D sector as the case may be.

The model assumed constant and exogenous saving rate with depreciation being zero, so that $\dot{K}(t) = sY(t)$ (3.79)

Population growth is also assumed exogenous, and therefore,

$$\dot{L}(t) = nL(t), n \geq 0. \qquad (3.80)$$

Some issues have been raised about endogenous growth theory. For instance, it is argued that the theory is just an extension of the neoclassical (exogenous) theory, with little alteration of its assumptions without changes to the fundamental factors that influence growth, and as such does not actually expand the existing concept of growth. The saving rate, which is critical for growth identified in the neoclassical theory still features in the endogenous theory. As a matter of fact, it has been argued that available empirical facts emerging from test of the theory did not prove it more successful than the neoclassical theory. Fine (2000) has also contended that endogenous growth theory draws upon microeconomic theories and as such does not have anything to do with the whole economy. According to him, the theory is heavily implicated in the traditional microeconomic foundation and also works to strengthen neoclassical economics.

Nedomlelová (2008) also maintains that the mathematical and econometrical methods of modelling endogenous growth represent a certain deficiencies because they do not allow implementing difficultly quantifiable variables such as political or institutional features. He further stresses that the models fail to describe the economic reality satisfactorily and they do not provide adequate solution to economic problem, rather, they only give recommendations for realizing inter-growth economic policy. The theory also fails to explain conditional convergence, which studies such as MWR reported in their findings using exogenous growth model. Additionally, assumption of diminishing returns to capital is doubtful. The above observations notwithstanding, endogenous growth theory has received numerous attentions in cross-country growth literature.

3. 1.3 Human Capital and Economic Growth

The views of both theoretical and empirical literature on the critical role human capital plays in growth and development of nations' economies stand clear. Asides being one of the important inputs into the production process, human capital has been shown to have facilitated technological improvement in various economies, imparted total factor productivity as well as being one of the factors that account for differences in growth among countries and regions of the world (see Nelson and Phelps, 1966; Romer, 1990; Barro, 1991; MRW, 1992; Aghion and Howitt, 1992; Benhabib and Spiegel, 1994; Barro and Sala–i–Martin, 2004; Wei and Hao, 2011; Hanushek and Woessmann, 2012).

Le, Gibson and Oxley, (2005: p. 1) reiterated that "human capital can boost growth through stimulating technological creation, invention and innovation, as well as facilitating the uptake and imitation of new technologies."

World Bank (2011) revealed that among the intangible wealth possessed by countries, human capital is the most important, particularly in high income countries and it has significantly influenced growth and development in many advanced and emerging economies. The study in its 105th page further indicates that "detailed analysis of human capital accounts for Canada, New Zealand, Norway, Sweden, and the United States unambiguously shows that human capital is a leading source of economic growth."

The experiences of China and some East Asian countries in terms of the unprecedented growth and development recorded over the years have been attributed among other factors to significant role played by human capital. In a study by Yueh (2013) on entitled "what drives China's growth", it was reported that while capital accumulation has played fundamental role in China's growth (about half), labour and human capital contributed a quarter of the nation's overall growth experienced over the years.

Using stochastic frontier approach to determine the impact of capital in China's provincial total factor productivity (TFP) growth over 1985–2004, Wei and Hao (2011) found that human capital has positive and significant influence on the growth of TFP in the provinces of Chinese. Even the inclusion of human capital (education) quality did not alter the significance and sign of the result while regional results also remain positive and significant, notwithstanding the various levels of schooling.

Additionally, asides its contribution to growth and development process, human capital plays critical role in reduction of income gap and poverty, women empowerment, improved living standard, technological advancement, efficiency in production activities, generation of more physical and social capital, enhancement of better human capital development, firm's profitability level, workers' absorption into the economy, private and social benefits, employment generation for individuals, increased labour market earnings, and reduced crime rate in society (OECD, 2001; Johansen and Adams, 2004; Sydhagen and Cunningham, 2007). Olaniyan and Bankole (2005) have observed that increasing the human capital of an individual will not only redress his poverty situation, but poverty would be reduced if human capital content in an economy rises.

Although human capital development has contributed to the growth performance of many economies in the world, it is observed that differences exist in its qualities, and this has impact on its contribution to economic growth and development in regions of the world. In their work on why development of Latin America has lagged behind other regions of the world in spite of relatively high initial levels of development as well as school attainment; Hanushek and Woessmann (2012) discovered that the growth difference between this region and the rest of the world was due to educational achievement. According to them, about half or two third of income differences between the region and the rest of the world could be attributed to human capital. The authors argue in the 497th page of their work that "while Latin America has had reasonable school attainment, the skills of students remain comparatively very poor" and this accounts for while both Latin America and Sub-Saharan Africa occupies the bottom of the international rankings with respect to student achievement on international tests.

Although many country-specific and cross country studies found positive and significant association between human capital and economic growth, few others have reported contrary results. Prominent among such include: Benhabib and Spiegel (1994) and Pritchett (2001). Benhabib and Spiegel, who ran a cross country growth accounting regression using year of schooling and enrolment rates as human capital proxies discovered that rather than human capital influencing growth positively, the impact was negative but insignificant. The use of alternative specifications as well as different data sources did not change their result.

Pritchett (2001) also reported a similar result in his study in which he found a negative and statistically significant influence of education attainment. While Pritchett did not dispute the developmental influence of human capital, which varies from country to country, he however noted that such impact has continued to fall short of expectations. According to him, three critical factors are responsible for this. The possibility of a perverse institutional or governance environment is one of the factors, which is prominent in developing countries, especially in Africa. The presence of very weak institutions and bad governance in most African countries are the banes of the problems confronting them. Even some African coutries that earn lots of income from mineral resources like Nigeria and other countries in the continent still suffer from inadequate and decay infrastructures, high rate of poverty, threatening insecurity situation as well as high level of unemployment.

The second factor he suggested could be responsible for ineffectiveness of education attainment in bringing about positive impact on economic growth is the issue of growing unemployment among the educated labour force with stagnant demand for their services. As a matter of fact, in some countries, demand for educated persons is falling, which is not unconnected with the unhealthy economic and political environment, occasioned by bad policies and high rate of corruption. Currently, some firms are folding up in some African countries while others are relocating to other countries with business friendly policies as well as better infrastructure.

The third factor is fallen standard and low quality of education. This is a very strong factor. Mirage of problems are confronting education sector in most countries of Africa; some of which include: decay and insufficient infrastructure, poor training, inadequate funding of research activities, corruption, occultism, insufficient commitment and desire to studying on the part of students; which all operate to reduce the standard and quality of education. In the latest 2014-2015 world university rankings, no African University feature among the best 100 in the world. In fact, the best three Universities in Africa (University of Cape Town, University of Witwatersrand, and University of Stellenbosch), are found in South Africa (see Times Higher Education).

Finally, other plausible issues that could have influenced the findings of the two authors could be found in the aspects of the methodology employed, technique of estimation adopted, the data set used and the education variable employed by the authors. For instance, Temple (1999) tried to replicate the results obtained by Benhabib and Spiegel (1994). Initially, his findings were consistent with that of the authors; however, further robust checks, using the least trimmed squares to study the coherent part of the data together with normality test produced positive and significant influence of human capital on economic growth.

3.2 HIV/AIDS, Human Capital and Economic Growth

The nature of diseases in terms of their direct impact on human health and wellbeing as well as level of morbidity and mortality among countries' population make them threat to developmental activities and progress in society. Diseases cause "pain, suffering, fear, and dread; loss of working time and income; worry, anxiety, and breakup of families; disruptions in the life and welfare of the community; and costs of care, coping, and prevention" (Hyder, Rotllant and Morrow, 1998: p. 196).

The emergence and wide spread of HIV/AIDS have aggravated levels of morbidity and mortality in affected nations with the attendant negative consequences on economic activities. These portend grave dangers for human capital formation as well as growth and development pursuits. This section centres on literature relating to the influence of the epidemic on human capital development activities and economic growth.

3.2.1 HIV/AIDS and Human Capital Development

The concentration of HIV/AIDS among persons in their prime and productive years, children and young women makes its case peculiar. This sect of people is a critical part of human resources while human capital activities are mostly carried out among them.[19] Any threat to these vital groups of persons cannot but have lasting negative implications for other developmental endeavour as well as economic prosperity of society.

HIV/AIDS has the inclination to "lower the school age population, reduce the share of the school age population that seeks to attend school, and impair the capacity of the education system to deliver on its mandate" (Arndt, 2006: p. 478). The virus does not only destroy existing human capital in the economy, but also obliterates mostly young adults and operates to weaken the mechanism that aids the transmission of knowledge and abilities from generation to generation (Bell *et al*, 2003 and 2004). Pennap, Chaanda and Ezirike (2011:p. 164) reiterate that HIV/AIDS does not only reduce "the stock of human capital but also the capacity to maintain the required turnover of many sought after skills and training like engineers, doctors, teachers, artisans." It is capable of "depleting scarce human capital and magnifies the need to replace skills lost across a wide range of occupations" (Johansen and Adams, 2004:p. 1).

Although other means of human capital development are essential, however, the focus of this section is on how the pandemic affects education and health, which are very strategic for human capital formation.

19 Human capital formation involves various investments undertaken in man through education, health, training and so on (Schultz, 1961; Becker, 1962, 1964 and 1993). These activities are carried out in man and since HIV/AIDS affects man directly, it can erode human capital stock, reduce productivity and increase level of poverty.

HIV/AIDS and Education

Education is fundamental for human capital development, and different studies have shown how critical it is in this process (see Jung and Thorbecke, 2001; Higgins, Lavin and Metcalfe, 2008; Jones and Ramchand, 2013).

The relationship between education and HIV/AIDS appears bi-directional. While the pandemic could have negative influence on education, education in turn can be employed as one of the strategic weapons to combat its menace. In the first case, which appears stronger, due to the concentration of the disease among young persons, its negative shock on education could be grave. HIV/AIDS tends to affect directly or indirectly young people who are of school age, with the resultant negative effect on their schooling. For instance, absenteeism and drop-out rates could increase when a child or his parent(s) or guardian contracts the disease. This could be triggered by many factors, such as psychological trauma on the part of the child, diversion of income to HIV/AIDS related activities, the child becoming a caregiver, his/her engagement in income generation activities to support the family, a child becoming household head, and so on. The situation becomes worst if either or both parents die. This is because most infected persons in countries hardest hit are low income earners; and therefore, poverty rate tends to increase and the child's education may completely come to a halt.

Furthermore, the disease could contribute to declines in the quantity and quality of teachers, which invariably may reduce the quality of education being imparted. In a nutshell, HIV/AIDS epidemic has the tendency to reduce the number of children that are able to enroll in school, number of teachers that are available to teach, teacher's productivity, education resources and increases costs of education, thereby reducing the quality of education passed on to the children as well as the quality and quantity of human capital formation (see World Bank, 2002; Vass, 2003; Katahoire and Kirumira, 2008; and Mahal *et al*, 2008).

Carr-Hill (2002) identified three key areas the AIDS epidemic could affect the educational sector whether at the local, district, provincial or national levels. They include: the demand for education, the supply of education and the quality and management of education. According to the author, the pattern of demand for education may change because the disease lowers the number of children being born due to early death of one or both parents. In fact, some of the children are born HIV positive and most die before reaching school-going age. Moreover, supply of resources such as: human (teachers, management and parents), material objects (reading and writing materials), payment of fees and other related costs may drop as a result of the disease.

Desmond and Gow (2002) found that about 60 percent decline in Grade 1 enrolment in Kwazulu-Natal, South Africa occurred compared to what it was in 1998. A greater proportion of this was ascribed to the menace of the HIV/AIDS pandemic. The authors noted that a historical growth pattern of enrolment in this level of education in the province was known to be between 3 and 5 percentage points. However, this trend was reversed to approximately 12 percent drop in 1999, and by 2000, a further decline of 24 percent was recorded. Accordingly, a significant school drop-out rate and a wide gap of gender access to education were reported in the study.

Besides the effect of the epidemic on demand for education evident in school drop outs, direct reduction in school enrolment and absenteeism; the disease could affect supply of education, which is always noticeable in the aspect of the quantity and quality of teaching force and educational resources at all levels. It is likely that when teachers get infected and the disease begins to reach advance stage, hours of teaching tend to decline, teaching quality appeared to be compromised (since illness may prevent proper and adequate preparation by such teacher) and eventually shortages in teaching force could set in due to demise of such teachers.

In addition, increased morbidity and mortality occasioned by AIDS among teachers and other educational personnel may compromise the quantity and quality of education being supplied. Furthermore, since the disease has the capacity to reduce the time available to teach and the number of teaching staff, it is not impossible to engender replacement of teachers who died from AIDS related diseases with inexperienced ones, which according to Vass (2003: p. 187), could have "the potential to severely affect the capacity of education and training to maintain and improve the skills of current and human resources." Data provided by UNESCO (2011) revealed that about 77 percent of shortages in teachers could be ascribed to the menace of the HIV/AIDS epidemic in countries severely affected while approximately 45,000 additional teachers were required in Tanzania to replace those lost to the pandemic in 2006.

World Bank (2002: p. xviii) maintains that reliable data limitation notwithstanding, there is the possibility of HIV/AIDS damaging both the quantity and quality of education as shown by the increase in mortality and morbidity "rates among teachers and administrators at all levels of education." Citing some earlier works in specific African countries such as UNAIDS (2000a); Kelly (1999); Gachuhi (1999); and Coombe (2000a and 2000b), the bank indicated that about 85 percent of teachers' deaths that occurred between 1996 and 1998 in the Central African Republic were due to AIDS while in Kenya, the disease increased deaths of teachers from 450 in 1995 to 1,500 in 1999 with 20 to 30 teachers' deaths in one of the eight provinces each month.

McPherson (2003) projects that in KwaZulu-Natal, South Africa, out of the 75,000 school teachers in 2003, about 68,000 of them would have been lost by 2010 as a result of the disease and employment poaching. He further reported that in Zambia, the death of school teachers exceeded the annual capacity of the teacher training colleges.

Although the facts presented above are indications of increased teachers' deaths due to AIDS, some empirical works have found low and insignificant influence of the pandemic on teachers. Bennell (2005) in his study on how the epidemic has affected teachers in SSA, it was discovered that the rate of HIV/AIDS related mortality is low among teachers even in a high HIV prevalence countries while in certain countries, teachers' AIDS-mortality had begun to decline. Some of the factors said to have been responsible for such decline include changes in behaviour among both infected and non-infected persons as well as the availability of antiretroviral drugs.

Education administrators and planners are also not immune from the menace of the disease. Even though, empirical evidence appears scanty, the pandemic has the capacity to impart negatively on administrators in the education sector. It is likely some of them are infected, which might later result to their demise, and this could further aggravate the magnitude of the problems confronting the sector.

Furthermore, HIV/AIDS has the tendency to increase cost of education in most countries affected. According to World Bank (2002: p. xviii), the disease could increase the cost of financing the Education for All (EFA) project by about US$450 million to US$550 million per year in 33 African countries. It further opines that as a result of HIV/AIDS menace, education sector budgets have had to increase due to upsurge in costs related to hiring and training to replace teachers who died of the disease and "the payment of full salaries to sick teachers who are absent and additional salary costs for substitute teachers." According to the report, Zambia estimated about US$25 million as financial cost of supplying teachers due HIV/AIDS between 2000 and 2010 while the estimate for Mozambique was about twice as much. Grassly *et al* (2003) also reported that in Zambia, the cost engendered on primary education by the disease in 1999 was estimated at between US$1.3 million and US$3.1 million while the projected cost from 1999 to 2010 was US$10.6-41.3 million. The cost covered 71 percent of salaries of teachers who could not come to work due to HIV/AIDS illness, 22 percent to train more teachers as a result of their attrition caused by the disease as well as 7 percent of funeral cost to the ministry of education for AIDS related deaths.

Apart from the negative impact of HIV/AIDS on education as a means of human capital formation, education has been found to be an important instrument through which the scourge of the pandemic can be combated. For instance, there are evidences in the literature suggesting that education does not only empower the poor, it has assisted a great deal in the area of improved health conditions, protection of women in the society, boosting economic growth and development as well as a means of bridging income gap in the nations of the world (see Barro, 1991; Birdsall and Hamoudi, 2004; Knesebeck, Verde and Dragano, 2006; and Barro and Lee, 2010).

Education can be employed as instrument with which awareness can be created about the operations of HIV/AIDS, its mode of infections, way of its prevention, treatment issues, how to control its spread, cost minimization, how to relate with infected persons, the need to know one's HIV/AIDS status and various researches about the pandemic (see World Bank, 2002; Meyer, 2003; and Lakhanpal and Ram, 2008).

In areas where people are still ignorant of the existence of the disease (in most rural areas of poor countries and educationally disadvantaged ones) education is very vital in disseminating information about its existence, mode of infections, prevention, its detection, and the associated serious health and socio-economic consequences. UNESCO (2012a: p. 84) also argues that education does not only provide information on the transmission and prevention of the dreaded HIV/AIDS disease but also offers life skills programmes through which young people could apply the knowledge they acquire to "reduce their vulnerability to infection."

World Bank (2002) observes that education can serve as protection against HIV/AIDS in the area of information provision beneficial for the reduction of the spread of the disease, minimizing cost required to fight the menace of the pandemic, particularly in countries with low prevalence and strengthening of responses to the scourge of the epidemic. It therefore suggests on page 8 that "countries need to invest in the education sector not only for the crucial benefits it yields-overall and in an AIDS context-but also because no other sector may be more fundamentally threatened by the epidemic."

Furthermore, a more educated person could offer themselves for HIV/AIDS counseling, test and also seek medical attention than a person without formal education, who may want to hide his status of the disease. In fact, there are instances where people suffering from other forms of illnesses decide not to seek medical attention for the fear of their HIV/AIDS status being discovered, since they erroneous believe that test for the pandemic may be conducted on them under the guise of being tested for another ailment in the course of any medical examination.

Meyer (2003) assets that there are proofs to suggest that basic education has helped to lower HIV/ADS infection as well as enlightened people on ways of catering for infected persons. Lakhanpal and Ram (2008: p. 15) in their work on educational attainment and HIV/AIDS prevalence noted that "increased schooling is likely to enable individuals and households to: (a) acquire and use more information about the nature of the disease and its transmission, (b) adopt efficient ways to avoid receiving or transmitting the virus, and (c) undertake optimal treatment if infected." They further reiterated that education can enhance "(i) acquisition of better health related information, (ii) attenuating health-reducing behaviors, (iii) more appropriate medical care usage, and (iv) health-preserving occupational and locational choices." The findings of the study indicated among other things that a significant inverse relationship exists between educational attainment and prevalence of HIV/AIDS.

Consistent with the above is the outcome of a study by Fylkesnes *et al* (2001) who reported reduced prevalence among higher educated group and stable/increasing prevalence among lower education group in Zambia. De Walque (2007) also investigated how effective HIV/AIDS information campaign could prevent the spread of the pandemic in rural Uganda and reported that in the early 1990s no significant association was established between HIV/AIDS prevalence and level of education in the country; however, by 2001, a strong and negative significant relationship was found to exist between higher educational level and lower HIV/AIDS risk.

Moreover, Mukandavire, Garira, and Tchuenche (2009), who attempted to model how educational campaign in the area of public health affects the transmission of HIV/AIDS in sub-Saharan Africa, support the above findings. Their discovery shows that an educational campaign of this nature has the capacity to slow down the spread of the disease, particularly when both sexually immature and sexually mature persons are targeted. The evidences provided above suggest that an increase in the level of education could assist to curtail the spread of the disease.

From the foregoing, it is apparent that education can be employed as a good strategic weapon to combat the disease.

HIV/AIDS and Health

The positive nexus between better health conditions and economic outcomes are well documented in the literature (see Bhargava, Jamison, Lau, and Murray, 2001; Acemoglu, Johnson and Robinson, 2003, Bloom and Canning, 2005; Weil, 2007; Price-Smith and Tauber, 2008, and Dauda, 2011).[20] Health is a critical factor in the determination of human contributions at micro and macro levels in all sectors of

20 In a study conducted by Price-Smith and Tauber (2008) to determine the implication of public health for level of educational attainment of a given population, it was discovered that health has positive and significant impact on the stock of education as well as acquired skills in the society.

society. Better health enhances the child's school attendance and performance, boosts human capital development, reduces level of poverty, and increases per capita income. The tendency is high that a person of good health status "will be more productive, will contribute more toward a nation's economy, and, keeping other things constant, will have a better life overall than a sick individual" (Desai, 1987: p. 604).

HIV/AIDS has been observed to pose tremendous challenges to the health of individuals, nations' health system and the overall health sector, particularly in countries severely affected by the pandemic. The disease targets the health of its victim directly, weakens the immune system as it progresses and eventually leads to gradual decline in productivity with the consequences gravely felt by all sectors in the economy.

Additionally, besides high level of attrition among health professionals due to HIV/AIDS, the disease has brought untoward increase in overall public and private health expenditure, aggravated excessive workload and continued to claim the lives of doctors and nurses in the developing countries (see Haacker, 2002; Marchal, De Brouwere and Kegels, 2005; Mahal *et al*, 2008; and Bhargava and Docquier, 2008).

In a United Nations (2004) study, several ways through which HIV/AIDS affect the health sector are documented. Some of these include:

i) Through contact with AIDS patients, health workers may contract the virus or other associated infections like tuberculosis, which could have negative implication for the supply of public health services.
ii) The morale of the health professionals may be dampened due to the stress involved in caring for AIDS patients. High levels of stress may lead to greater staff absenteeism, and staff may refuse to be transferred to high-prevalence regions within a country.
iii) In some cases the quality of services may also be affected by the attitude of the health staff towards HIV/AIDS patients. Fear of contracting the disease and the psychological stress involved in treating AIDS patients may lead to a reduction in the quality of services provided.

iv) HIV/AIDS contributes to increased health expenditures in both the public and private sectors and could divert resources towards the higher levels of care needed for its patients.

v) The added strains on public health finances, staff and other resources may force more people to seek private health care. Many households may have to choose between health care and other essentials such as food.

Furthermore, the disease could threaten the health and nutritional status of the child, increase household health expenditure, raise the number of underweight children, affect rate of fertility among women and reduce average life expectancy (Plamondon, Cichon and Annycke, 2004; Haacker, 2010; Magadi, 2011; Kalemli-Ozcan, 2012; UNDP, 2013a; and Snow, Mutumba, Resnicow and Mugyenyi, 2013).

Finally, the pandemic could aggravate brain drain, particularly among the health professionals (see Palmer, 2006; Bhargava and Docquier, 2008; Mills *et al*, 2011).

In summary,

> HIV/AIDS reduces life expectancy; increases child mortality, leaves large numbers of children without adult care, places intolerable strains on health care systems, undermines economic development through increased labour costs, and decreases availability of skilled human resources, and impoverishes households (Kelly and Bain, 2003: p. 40).

3.2.2 HIV/AIDS and Human Capital: Empirical and Methodological Evidences

The HIV/AIDS epidemic has already entered its third decades since the 1980s when the first cases were reported in the USA. In spite of this relatively long period, very few empirical literatures are available on how the disease affects human capital developmental activities. This section provides empirical and methodological evidences available in the literature on the impact of the disease on human capital.

Country-Specific Studies of HIV/AIDS Impact on Human Capital Development

A good number of country-specific studies conducted in the area of HIV/AIDS and human capital activities report negative impact to a large extent. For instance, Bell *et al* (2003 and 2004) who adopted the overlapping generations (OLG) model to examine how HIV/AIDS affects the economy of South Africa reported a detrimental impact of the pandemic on the existing human capital as well as the mechanism through which generational knowledge is transmitted. Although these studies present a brilliant modeling of the disease as it affects human capital, it main focus is on education as the only means of human capital investment. The other human capital means is child bearing and its quality. Additionally, its assumption of education being the only form of investment by the household is doubtful.

Arndt (2006) investigates the influence of HIV/AIDS on growth and human capital in Mozambique. The aspect of the work that relates to human capital employed the minimum cross entropy approach to estimate education and human capital transition matrices, with emphasis on demand for and supply of education. School enrolments were used as human capital measure. The findings revealed among others that AIDS deaths have contributed to decline in human capital accumulation in the country. One thing that makes this study differ from others is its employment of AIDS deaths rather than the general prevalence data many studies along this area have used. This notwithstanding, the study limits human capital accumulation to education without giving recognition to other measures. Secondly, the author used projection, rather actual data set, which was informed by the modeling approach he adopted.

In the same vein, Mahal *et al* (2008) carried out a study on healthcare utilization, spending and income forgone implications of the HIV/AIDS disease in Nigeria. In this study, which focuses on two states-Oyo and Plateau-, a 2004 random survey data covering 6400 persons were employed, with a sample of 482 individuals who tested positive to HIV/AIDS. The results suggest that the disease led to a significant increase in "mortality, healthcare utilization, public health facility use, lost work time and family time devoted to care-giving." About 56 percent of household income per capita was expended on HIV/AIDS related illness with 54 percent of the total economic burden of the disease going for "out-of-pocket expenses for healthcare."

Young (2005: pp. 425-426) examines how the HIV/AIDS disease affects the future standard of living of the South African people, by drawing inspirations from studies on Black Death, employing Becker's fertility choice model "embedded in a Solovian constant-savings macroeconomic framework" in which he "endogenizes participation, fertility, and education decisions with behavioral equations." In this model, the author assumes couples with human capital endowment (E_m for male, and E_f for female), and financial resources (Y) derive utility from quantity (n) and quality (q) of children, where such quality is measured by the human capital accumulated by the children; individual leisure, l_m for male and l_f for female; as well as material consumption represented by $C_{m.}$ The author then employed the 1995 October Household Survey (OHS) and the 1998 Demographic and Health Survey (DHS) data of South Africa for his analysis.

Although the overall aim of the study centers on how the disease affects the future standard of living of the South African people, in which a positive rather than negative relationship was found to exist between HIV/AIDS and the level of per capita income. However, with respect to human capital model, which employed education and fertility, the outcome indicated negative and significant influence of the disease on human capital accumulation process of orphans in the country as well as level of fertility. Two important factors that informed this finding according to the author were that people reduced their willingness to engage in unprotected sex while increase in labour scarcity and value of the time of women all acted to reduce fertility.

Other studies carried out, using education variables, overwhelmingly report negative impact of HIV/AIDS on education while few other ones found no significant influence of the disease on education outcomes.

Ainsworth, Beegle and Koda, (2005) investigated how increased orphans and adults deaths due to AIDS affect primary school attendance and hours spent at school in North Western part of Tanzania using a panel of household survey data (with maximum likelihood probit and ordinary least squares estimators), covering the period 1991-1994. Their findings showed delay in school attendance among "maternal orphans and children in poor households with a recent adult death" while no evidence was found to suggest school-drop-out among children ages 7 to 14. However, hours spent by children in school dropped in months preceding the death of adults in the household, which was significantly noticeable among girls while same recovered after such death.

In another study, which assesses the influence of HIV/AIDS on labour force participation rate and human capital accumulation in Tanzania over the period of 1990 to 2000, Wobst and Arndt (2004) employed education transition matrix using school enrolments. With data from the Tanzania's Integrated Labour Force Survey of 2000/2001 and 1990/1991, the results did not only show increased labour market participation rates among children age 10-14, it was also discovered that the tendency for children to drop out of primary school was increased due to the menace of disease. What this implies is that, children who are supposed to enroll in school are dropping out to join the labour market. It is possible such children have lost some of their parents to AIDS and can no longer cope with the cost of education. It could also be that they are joining the labour market in order to augment the household income probably due to death or incapacitation of the household head or breadwinners caused by the disease.

World Bank (2002) gave the number of out-of-school age children (children aged 6 to 12) in developing countries as above 113 million, with two-thirds of them being girls while about 25 percent of those who enroll in school drops out even before they could achieve literacy. The statistics of primary school age children who are out of school according to Institute for Statistics, UNESCO (2012a) is 61 million in addition to 71 million children who fall within the age of lower secondary school. Tanzania has been one of the East African countries with a high prevalence of HIV/AIDS, which was about 8 percent when the study was conducted. World Bank (2013) puts prevalence among ages 15-49 as at 2011 as 5.8 percent. Although the methodology may tend towards trend analysis, however, the fact remains that HIV/AIDS has the inclination to reduce human capital activities in the affected society.

In a cross-sectional study using the 2001/2002 National Survey of prevalence and characteristics of orphans in Ethiopia, Bhargava (2005) studied the well-being and school outcomes of children who lost their parents to AIDS and other causes. Employing logistic regression approach, the study applied three different models where two of them relate to school participation of the children before and after the death of their parents. Some of the right-hand-side variables used include death of mother due to AIDS, maternal age at death, number of children of the deceased among others. The results revealed that school participation was negatively affected due to premature deaths of mothers. Mother's death hinders girls' school participation than boys while AIDS orphans were more likely to participate in school than non-AIDS orphans.

Other country-specific studies, which are well reviewed in Guo, Li and Sherr (2012) include: Case and Ardington (2006); Evans and Miguel (2007); Oladokun, Brown, Aiyetan, Ayodele, and Osinusi (2009); and Kasirye and Hisali (2010).

Case and Ardington (2006) conducted a study in Umkhanyakude District of KwaZulu-Natal, South Africa, where HIV/AIDS prevalence is high, the authors employed ordinary least squares (OLS) and fixed effects regressions on Household Socio-Economic (HSE) Survey data collected in 2001, and 2003/2004 to investigate the influence of parental deaths on children. Using school enrollment and educational attainment variables; the results revealed significant negative impact of parents' deaths on children's school outcomes. A related study was conducted by Evans and Miguel (2007) in Kenya, where AIDS has led to significant deaths among parents and children. The authors used school attendance and enrolment in a panel data covering the period 1998-2002, and found a small decline in school participation before parents' deaths and substantial decline after the death of parents. In another cross-sectional study, which used the 2002/2003 Uganda National Household Survey data to examine impact of HIV/AIDS orphan status on school enrolment and grade progression, Kasirye and Hisali (2010: p. 12) found that "HIV/AIDS orphans are not significantly less likely to continue schooling but are by far more likely to fall below their appropriate grade" while the gap of schooling decline for poor HIV/AIDS orphans.

Oladokun *et al* (2009) compare the socio-demographic and clinical characteristics of AIDS and non-AIDS orphans in Ibadan, Nigeria, using a hospital-based survey data collected at the University College Hospital (UCH), Ibadan between 2005 and 2006. They employed Chi-square test and t-test found no significant difference between school enrolment among AIDS and non-AIDS orphans. None of the orphans covered in the study was institutionally cared for; all were taken care of within the family.

Furthermore, three related studies conducted outside Africa, precisely China-Ji *et al* (2007), Tu *et al* (2009), and Xu *et al* (2010)-employed survey data. Their findings support negative impact of HIV/AIDS on the education of children in the study area.

Ji *et al* (2007) focused on Anhui Province, where HIV/AIDS prevalence is observed to be high. Using qualitative and quantitative approaches, the results revealed among other things that HIV/AIDS is isolating family and children; having negative influence on their education and performance; and compromising children's health and nutrition.

Similarly, Tu *et al* (2009) analyzed the behaviour and performances of children infected with HIV/AIDS in rural central China, using self-report and teacher evaluation data, it was discovered that orphans and other vulnerable children were disadvantaged in school performance compared to their counterparts not affected by the disease in anyway.

In the same vein, Xu *et al* (2010) analyzed the situation of HIV/AIDS infected children with respect to their schooling, physical health as well as their interpersonal relationships in the South West part of China; the findings suggest negative impact of the pandemic on education, health and peer association of the children.

The three studies conducted in China report negative impact of HIV/AIDS on education outcomes; however, their findings cannot be generalized for the entire country, since they are micro studies focusing on specific areas. Furthermore, one of the problems with primary data is its sanity, which may influence the outcomes of the three studies.

Generally, certain limitations are peculiar to all the studies reviewed in this section. Most of these works concentrated on East and Southern African countries with the exception of Oladokun *et al* (2009), which focused on Nigeria, a West African country, while three were conducted in China. Furthermore, a good number of them are cross-sectional, based on survey data, a bulk of which are micro rather than macro studies. The main issue with cross-sectional studies is that they are conducted at a point in time, without consideration for events preceding and after the period. Any development that affects the subject before and after this period may be irrelevant. Conclusions based on studies of this nature may not be completely free from bias. They may "be misleading due to both omitted variables and endogeneity" problems (Evans and Miguel, 2007: p.

39). Moreover, socio-economic characteristics of AIDS orphans, particularly schooling, measured with enrolments appear to dominate the central focus of the studies.

Cross-Country Evidences of How HIV/AIDS Affects Human Capital

Even though not many studies have looked at the human capital implication of the disease at macro level, the few available ones have reported negative impact of the pandemic on human capital. Prominent among such studies include Arndt (2006); McDonald and Roberts (2006), Gardner and Lee (2010); Fortson (2011), and Ferreira, Pessoa and Dos Santos (2011).

McDonald and Roberts (2006) employed both short-fall in life expectancy and infant mortality as human capital measures, although only the results which used infant mortality were reported. Their study focused on the world, developing countries, OECD, Asia, Africa, and Latin America and Caribbean. The findings showed substantial negative effect of HIV/AIDS prevalence on human capital, particularly in Africa. Few of the reservations about their findings include: the use of only HIV prevalence data, which cover those in age bracket 15-49 whereas, the human capital proxy used focuses exclusively on infants. This seems to be acknowledged by the authors who suggest that infant mortality variable is more closely related to HIV prevalence among women than the general population. This is obvious from the result returned for Latin America and Caribbean for which significant 0.112 percent decline in human capital was returned. This is very unrealistic for region having less than 1 percent prevalence compare to the 0.024 percentage reduction reported for Africa, the continent accounting for the highest prevalence of above 5 percent. The data point used ended in 1999, which has left out current state of the disease in the study areas.

Gardner and Lee (2010) who also used short-fall in life expectancy as proxy for human capital discovered that HIV/AIDS prevalence reduced human capital formation significantly in 38 countries of Asia, Eastern Europe and Latin America using static panel data approach. Their study documented a 0.20 percent decline in human capital as a result of a percentage increase in HIV prevalence. The static panel estimation approach employed by these authors could have influenced the result, since the use of fixed effect estimator may not solve the problem associated with correlated specific effects (which is peculiar with heterogeneity among the cross sectional units). Also, there is nothing in the study to suggest while the preference for fixed effects estimator as against others in the family of static panel data technique of analysis.

Fortson (2011) estimated the effect of HIV/AIDS on mortality risk and human capital investment in some regions in SSA using a simple life cycle model of human capital investment. The author employed the Demographic and Health Surveys (DHS) data for 15 SSA countries collected at different periods (the earliest in 2001 for Mali, and the latest for Niger in 2006), and three education measures, namely: completed years of schooling, school attendance, and primary school completion. The findings revealed larger decline in school enrolment and completion in countries with higher levels of HIV than those with low rate of the disease. It was found that children who were living in those areas with higher HIV prevalence "are less likely to attend school, less likely to complete primary school, and progress more slowly through school."

Similarly, Ferreira, Pessoa and Dos Santos (2011) predicted a 40 percent significant reduction in schooling for five Southern African countries, namely Botswana, Zimbabwe, Lesotho, Swaziland and South Africa. This result should be understood in the light of the burden of the disease in the Southern African sub-region, which has the highest prevalence rate in the world. In actual fact, as at 2009, HIV prevalence among age group 15-49 according to UNAIDS (2010) stood at 24.8 percent, 23.6 percent, 17.8 percent, 25.9 percent and 14.3 percent in Botswana, Lesotho, South Africa, Swaziland and Zimbabwe respectively.

Apart from the above works reviewed, some studies, mostly cross-sectional which relate to human capital implication of HIV/AIDS were also reviewed. One thing peculiar to most of them is that the authors did not consider them as human capital studies; however, the explained variables employed fall within the context of human capital measures, particularly in the area of education.

The first of such work focuses on brain drain of medical practitioners in African countries. Although this issue has been an age long one, the HIV/AIDS pandemic has further aggravated the situation. Using a random effects framework in estimating a triangular system of equations to determine how HIV has affected medical brain drain in the SSA, Bhargava and Docquier (2008: p. 345) discovered that lower wages and higher HIV prevalence have strong association with the brain drain of physicians from SSA to organization for economic co-operation and development (OECD) countries. In quantitative terms, they reported that "countries in which the HIV prevalence rate exceeds 3 percent, a doubling of the medical brain drain rate is associated with a 20 percent increase in adult deaths from AIDS."

Mills *et al* (2011) investigated the cost in financial terms of doctors migrating from the sub-Saharan African countries to Australia, Canada, United Kingdom, and the United States. The study focused on nine countries in the SSA where HIV prevalence was 5 percent and above as well as where number of persons living with the disease is a million and above. In addition to this, the study also ensures that there is at least a medical school in each of the counties and data are available on the number of doctors practising in destination countries. The findings suggest that while there is variation in the financial costs of doctors lost to brain drain among countries, the overall finding shows that approximately US$2.17bn has been lost as returns to investment in doctors from these countries practising in the indicated destination countries. Accordingly, the figure for most affected countries was very considerable and substantial.

Bicego, Rutstein, and Johnson (2003) examine orphan crisis in 17 SSA countries using Demographic and Health Survey (DHS) data over 1995-2000. The first part of the study focuses on orphan prevalence in the region while the second part examines the vulnerability of orphans in the area of educational opportunities as well as their welfare in five out of the 17 countries- Zimbabwe, Kenya, Tanzania, Ghana, and Niger. Regarding educational opportunities, appropriate children grade level was used. A significant relationship was discovered between lost of parents and children's chances of being at the appropriate grade level as it relates to their age. Similar result was reported by Kürzinger *et al* (2008) who employed school enrolment and appropriate grade level in Tanzania and Burkina Faso, using a 2003 cross-sectional data.

Six West African countries are observed to have featured in the study by Bicego *et al*, while that of Kürzinger *et al* included one, which is Burkina Faso. Case, Paxson and

Bleidinger (2004) also included two West African countries (Ghana and Niger) in their study, which focused on ten countries in sub-Saharan Africa. They used 19 Demography and Health Survey (DHS) data collected between 1992 and 2000 to investigate examine how orphanhood affects school enrolment. Their findings revealed fewer enrolments among orphans than non-orphans. Moreover, Monasch and Boerma (2004) reported lower school attendance among orphans in their study, which employed household survey data covering the period 1999-2002 in 40 SSA countries.

Lastly, Ainsworth and Filmer (2006) focused on 51 countries divided into 15 East and Southern African countries, 20 West and Central African countries as well as 8 from Latin America, 2 from the Caribbean, and 6 countries in Asia. Household survey data collected between 1992 and 2003 were used with school enrolment being the outcome variable. The findings were mixed. Lower enrolment among AIDS and non-AIDS orphans were found, particularly in some low-income countries but majority of the results were insignificant. Enrolment gap was also influenced by household income level while no gender gap was found to exist in terms of enrolments among orphans.

The last five cross-country studies reviewed above (Bicego, Rutstein, and Johnson, 2003; Case, Paxson and Bleidinger, 2004; Monasch and Boerma, 2004; Ainsworth and Filmer, 2006; and Kürzinger *et al*, 2008), overwhelming support negative implication of the disease on education outcomes. It is also observed that all of them are cross-sectional studies; with three of them employing school enrolments while the other two used school outcomes of orphans. Finally, the reported findings were significantly influenced by the presence of HIV/AIDS in countries with higher prevalence.

Generally, virtually all the studies reviewed above are micro rather than macro researches. A good number of the cross-country works also dwelt more on cross-sectional data while the methodologies employed do not suggest rigorous analyses.

3.2.3 Summary of Literature-Impact of HIV/AIDS on Human Capital Development

Below is a table showing summary of the key literatures reviewed with respect to how HIV/AIDS affects human capital development. It covers authors, the methodologies employed and the main results.

Table 3.1. Summary of Key Literatures on Impact of HIV/AIDS on Human Capital

S/N	Authors	Scope/Coverage	Methodology	Results
1	Bell *et al* (2003 and 2004)	South Africa	Overlapping Generations Model	Negative impact on human capital
2	Wobst and Arndt (2004)	Tanzania	Education transition matrix, using school enrolments	Increase in the tendency for children to drop out of primary school
3	Ainsworth, Beegle and Koda (2005)	Tanzania	Maximum Likelihood Probit and Ordinary Least Squares, used on a panel of household survey data	Delay in school attendance among maternal orphans and children in poor households with a recent adult death. No evidence of school-drop-out among children ages 7 to 14. Hours spent by children in school dropped in months preceding the death of adults in the household.
4	Young (2005)	South Africa	Simple Beckerian household model	Negative effect on human capital accumulation of orphaned children. Decline in fertility. Minimal reduction in school enrolment.
5	Bhargava (2005)	Ethiopia	Logistic Regression	Decline in school participation rate among children and orphans due to premature deaths of mothers as a result of AIDS.
6	Arndt (2006)	Mozambique	Cross entropy approach employed to estimate education and human capital transition matrices	Reduction in human capital accumulation by AIDS deaths.
7	McDonald and Roberts (2006)	OECD, Asia, Africa, and Latin America and Caribbean	Health capital model	Decline in life expectancy and increased infant mortality
8	Bhargava and Docquier (2008)	SSA	Random effects framework	Increased brain drain among medical personnel
9	Gardner and Lee (2010)	38 Countries of Asia, Eastern Europe and Latin America	Health capital model	Decline in human capital
10	Fortson (2011)	15 sub-Saharan African Countries	Simple model of human capital investment	Decline in schooling
11	Ferreira, Pessoa and Dos Santos (2011)	Five Southern African countries	Overlapping Generations Model (OLG)	Reduction in schooling

Source: Author's compilation from key reviewed literature

3.2.4 HIV/AIDS and Economic Growth

The presence of diseases such as HIV/AIDS in any economy constitutes a grave challenge and burden. This is due to the increase in the risks of mortality, morbidity, disability, impairment, illness, injury and other risk factors emanating from such diseases, coupled with the associated consequences within the economy. Moreover, the macroeconomic performance of the country may remain a mirage if efforts are not geared towards combating its menace. This propelled the World Bank in 1992 to commission a (GBD)[21] study to provide a comprehensive assessment of disease burden in 1990, which attempts to quantify the health effects of more than 100 diseases and injuries for eight regions of the world.

Economic impact of HIV/AIDS occurs at both micro and macro levels. The micro end shock is observed on the part of households and firms while the macro effect takes place at the national or economy wide level. HIV/AIDS, being a devastating disease could exert great burden on the economies where it is prevalent. The upsurge in morbidity and mortality occasioned by the pandemic has the propensity to reduce labour hours supplied by infected persons and a total loss of labour services earlier supplied by people who die from AIDS related causes. In addition, morbidity and mortality caused by the disease tend to shrink the population of young and productive age group, thereby leading to direct reduction in the labour force, especially in countries severely hit. ILO (2004: p. 13) reiterated that HIV/AIDS is "one of the biggest causes of mortality in the world of work." Moreover, the epidemic has the tendency to affect the entire economy by increasing public and private health expenditure as well as destroying human resources (Kambou, Devarajan and Over, 1992).

To better appreciate how HIV/AIDS affects the economy, it is imperative to consider this under different channels, which are specifically discussed below.

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21 GBD analysis according to WHO (2011a) provides a comprehensive and comparable assessment of mortality and loss of health due to diseases, injuries and risk factors for all regions of the world. It presents a framework for integrating, validating, analyzing and disseminating fragmented information on mortality and health in populations in all regions of the world to assess the comparative importance of diseases and injuries in causing premature death, loss of health and disability in different populations (WHO, 2008).

Demographic Impact of HIV/AIDS

The first and noticeable effect of HIV/AIDS pandemic is on the population or demography of the affected society via increased morbidity and mortality. Beginning at the household echelon, it takes its toll on the family through ill-health and eventually by reducing its size when infected members die. These sum up to determine both morbidity and mortality from the pandemic at the national level. Accordingly, the productive capacity of infected persons is weakened and the number of labour hours tends to decrease nationally as more and more people get infected.

A clear picture of demographic impact of HIV/AIDS emerged from statistics provided by UNAIDS (2012a) and WHO and UNAIDS (2013) on the global trend of HIV/AIDS infection. According to the agencies, as at the end of 2011 and 2012, about 34 and 35.3 million persons respectively were already living with the disease globally. The hardest hit region is the SSA, which accounted for approximately 70 percent of infected persons worldwide and about 5 percent prevalence. The region is closely followed by the Caribbean and Eastern Europe as well as Central Asia, having 1.0 percent adult prevalence. Eventhough global infections have declined, a total of 2.5 million and 2.3 million people still got infected in 2011 and 2012 in that order, while 1.7 million deaths were recorded from AIDS-related causes in 2011 alone.

Table 3.1 presents HIV/AIDS data by region for 2001 and 2011 periods. From the table number of PLWHA has been on the increase globally. Exceptions are however found in the Middle East and North America, recording 320 thousand and 300 thousand in 2001 and 2011 respectively while global figure rose from 28.6 million in 2001 to 34 million in 2011. SSA is the region with the highest figure, where number of PLWHA rose from 20.5 million in 2001 to 23.4 million in 2011. The South and South-East Asia recorded 3.8 million in 2001 and 4 million in 2011 while Latin America had 1.3 million and 1.4 million PLWHA in 2001 AND 2011 RESPECTIVELY. The Caribbean has the least figure in 2001 while the Oceania recorded the least in 2011. Global infections declined from 3.1 million in 2001 to 2.5 million in 2011 while the number of deaths occasioned by AIDS reduced from 1.9 million in 2001 to 1.7 million in 2011. In SSA, new HIV infections declined from 2.2 million in 2001 1.8 million in 2011 while AID-deaths fell from 1.4 million in 2001 to 1.2 million in 2011.

Table 3.2. HIV/AIDS Statistics by Region (in million), 2001 and 2011

Region	People Living with HIV/AIDS		New Infections		AIDS- Deaths	
	2001	2011	2001	2011	2001	2011
Sub-Saharan Africa	20.50	23.40	2.20	1.80	1.40	1.2
South and South-East Asia	3.80	4.00	0.38	0.28	0.23	0.25
East Asia	0.38	0.83	0.09	0.09	0.06	0.06
Latin America	1.30	1.40	0.10	0.08	0.08	0.05
Western and Central Europe	0.63	0.90	0.03	0.03	0.01	0.01
North America	0.98	1.40	0.05	0.05	0.02	0.02
Eastern Europe and Central Asia	0.41	1.40	0.21	0.14	0.01	0.09
Caribbean	0.021	0.23	0.02	0.01	0.01	0.01
Middle East and North America	0.32	0.30	0.04	0.04	0.02	0.02
Oceania	0.04	0.04	0.004	0.003	0.002	0.001
World	28.60	34.00	3.10	2.50	1.90	1.70

Source: UNAIDS (2012a). Report on the global AIDS epidemic; and WHO, UNAIDS and UNICEF (2011). Global HIV/AIDS response: epidemic update and health sector progress towards universal access.

The trend of the disease among young age group is pathetic. According to the UNAIDS (2012b: p. 1), there are 1.6 billion adolescents and young age group 12 to 24 living on the planet today. Of the new infections recorded in 2010 among persons age group 15 and above, 42 percent of them are within ages 15 to 24 while 80 percent of young persons currently living with the disease are in SSA. The case of young women seems to be worse with the rate of infections among women of age bracket 15 to 24 being twice as high as in all young women. This age group also accounts "for 22 percent of all new HIV infections globally and 31 percent of new infections in sub-Saharan Africa."

Although the upsurge caused by the pandemic in mortality and morbidity remains very high, most especially in the region of SSA, the impact on population growth is minima (except for few countries such as Botswana, Lesotho, and South Africa, where population growth has slowed or become constant) due to the relatively high fertility and crude birth rates in this region (see Ashford, 2006; UN Department of Economic and Social Affairs, Population Division, 2011; and World Bank, 2013).

The demographic implication of HIV/AIDS also manifests in fertility and life expectancy. Literature has reported negative and significant influence of the disease on life expectancy (see Whiteside, 2001; Birdsall and Hamoudi, 2004; Batini, Callen and McKibbin, 2006; Haacker, 2010; and UNDP, 2013a). However, available evidence suggests its impact on fertility as mixed. Whereas, some report no effect or positive influence of the pandemic on fertility, especially among infected persons (see Fortson, 2009; Durevall and Lindskog, 2011; and Kalemli-Ozcan, 2012), others show that the disease has led to decline in the rate of fertility in the affected countries (see Whiteside, 2001; Kongnyuy and Wiysonge, 2008; Jeon, Rhyu and Shields, 2010, and Snow, Mutumba, Resnicow and Mugyenyi, 2013)

Whiteside (2001: p. 79) citing Gray *et al* (1997) and Carpenter *et al* (1997) reported that in rural Rakai district, Uganda "age-specific fertility rates for HIV infected women were 50 percent less than those for women who were not infected" while in another rural community known as Masaka, fertility rates reduced by 20 to 30 percent among HIV-infected women.

Finally, the large number of morbidity and mortality created by HIV/AIDS could increase dependency ratio as well as the number of orphans in countries hardest hit by the pandemic (see Whiteside, 2001).

Impact of HIV/AIDS on Households

The household unit is where the immediate impact of HIV/AIDS is always felt before it affects the entire economy. As a result of this, the effect is always devastating, especially in developing countries like Africa where most households still struggle with high rate of poverty. The disease constitutes a devastating shock on the household unit whenever any member is infected.

United Nations (2004) identifies three kinds of economic impact of HIV/AIDS at the households front in addition to psychological consequences. These include: i) loss of income of the family members, in particular if the infected is the breadwinner; ii) increase in household expenditures due to medical costs; and iii) indirect cost resulting from the absenteeism of members of the family from work or school to care for the AIDS patient. Bechu (1998) as cited in Stover and Bollinger (1999) reported that the expenditure of households with a member infected by the disease is twice as much on medical expenses than households without an HIV/AIDS patient.

At the household front, when an economically active member, for instance the bread breadwinner contracts the disease, the household income is diverted to catering for such person. The effects of this manifest in reduced household income level, decline in household productivity, savings, level of consumption and standard of living, since the infected person and other household members would be irregular at work. In fact, in the African setting, some members of the household could stop work to attend to the infected person; which may have negative impact on all other activities in the household, including the education of the children. Furthermore, peradventure the infected person dies, the household income would be completely lost and more debt could be incurred on funerals and other responsibilities.

Ojha and Pradhan (2006: p. 3) have pointed out that the loss of household earnings occasioned by HIV/AIDS epidemic could arise on various accounts; such as premature death of an infected household member, reduced earnings as a result of disability or reduced ability to work, loss of work-time of the non-infected arising from caretaking responsibilities and reduced employability linked with the stigma associated with the infection. They further reiterate that "lost earnings and increased expenditures have long-term adverse impacts on household savings and asset-holdings for a majority of the households as they are not covered by social security or health and life insurance" while human capital development activities in most infected homes will tend to reduce.

Another awful trend emerging in countries where the epidemic is prevalent is the rise AIDS-induced orphans. According to the US Global Health Policy (GHP) (2010), the number of orphans caused by the HIV/AIDS pandemic in 15 West African countries in 2009 was about 3.44 million; and of this number, Nigeria accounts for a total of 2.5 million while Côte d'Ivoire had 440 thousand and Ghana 160 thousand. Majority of these orphans could no longer continue in school, since they have lost either or both parents and no one is able to sponsor their education. The resultant effect is increased number of workers on farms and beggars-orphans. In addition, some of them have turned street hawkers and urchins while others become fosters. In some households, death of both parents has produced children as household heads while some relatively matured female orphans have become vulnerable to prostitution.

The impact of the disease at the household level is not limited to economic effect alone; in fact, the economic shock of AIDS threatens the integrity and welfare of families and households, and their survival as social and cultural units (Baylies, 2002; and Mathambo and Gibbs 2008). The disease could lead to the collapse of the household and some children may be sent to live with relatives. In addition, HIV/AIDS could alter household composition, cause disappearance of parental generation, turn grandparents and other relatives to caregivers, turn older children to "surrogate parents for their younger siblings, thus leading to increase in one-generation households headed by the older children" (United Nations, 2004: p. 39).

Impact of HIV/AIDS on Firms

Firms and businesses are not spared of the menace of the HIV/AIDS pandemic. Greater proportion of persons living with the disease falls within the working population age group. In view of this, workers who test positive are likely to be absent from the workplace often, leading to lost in labour hours, and eventually, demise or retirement on medical grounds of some of them could lead to decline in the number of available workers and consequently reduce the level of productivity, sales, profitability as well as the income of the firm. Additionally, death of some strategic skilled workers of the organization may not be easily replaceable; and if eventually replaced could be costly.

The demographic impact of the disease considered earlier no doubt could have negative and substantial implications for the labour force and the world of work. An ILO study in 2000 reported that by 2020, there would be about 24 million fewer workers as a result of the AIDS epidemic in countries like Botswana, Cameroon, Ethiopia, Cote d'Ivoire, Haiti, Kenya, Malawi, Mozambique, Namibia, Nigeria, South Africa, Tanzania, Thailand, Uganda and Zimbabwe. The study further projected that in eight African countries (Botswana, Kenya, Malawi, Mozambique, Namibia, South Africa, Uganda and Zimbabwe) where the prevalence rates were above 10 percent of the adult population, the labour force would be smaller by between 10 percent and 22 percent in 2010 than it would have been without HIV/AIDS, which would translate to about 11.5 million fewer workers.

Moreover, countries such as Cameroon, Cote d'Ivoire, Ethiopia, Haiti, Nigeria, Thailand and the United Republic of Tanzania with HIV prevalence rates below 10 percent of the adult population would have their labour force reduced by 3 percent to 9 percent than it would have been without HIV/AIDS. Specifically, Cameroon would have her labour force reduced by 4 percent, Ethiopia by 5 percent, Haiti by 4 percent, Cote d'Ivoire 7 percent, Nigeria 3 percent, Tanzania 8 percent and Thailand 1 percent. Whether these projections are true or not will be subject to empirical investigation, especially, now that antiretroviral drugs are made available to greater number of infected persons.

In the preface to Cohen (2002), Franklyn Lisk, the then Director of ILO programme on HIV/AIDS and the world of work, reiterates that the disease is concentrated in the working age population and its effects on the world of work has led to reduction in "labour supply and earnings, loss of valuable skills and experience, and decline in productivity and enterprise profits."

Presenting some facts on Malawi in his study, McPherson (2003) reported that more than 40 percent of the positions in a large number of departments in the Ministry of Agriculture became vacant and about 25 percent of the civil service would probably die by the end of 2005 due to the HIV/AIDS scourge. He further reported that nearly 75 percent of deaths in the police force in Kenya could be traced to AIDS.

Furthermore, ILO (2004: p. 13) gave the estimated number of people of working age living with HIV/AIDS in 2004 as 36.5 million. The agency further predicted that around 28 million workers would be lost to the scourge of the pandemic globally by 2005. The report further stated that "in the absence of increased access to treatment, the number of workers lost to the labour market due to HIV/AIDS would increase to 48 million by 2010 and 74 million by 2015." Other key findings of the study include: an increase in the global figure of workers who would not be able to work as a result of the HIV/AIDS pandemic from 500,000 in 1995 to 2 million in 2005, and further to 4 million by 2015. It also reported significant increase in economic burden carried by economically active workers and other adults in the household of infected person by 2015. It is essential at this juncture to state that it is not certain whether these projections actually held in both 2005 and 2010, as empirical works verifying this could not be tracked. This is an important existing gap in the area of HIV/AIDS studies.

There exist some arguments in the literature indicating that any labour lost to the HIV/AIDS pandemic could be replaced in countries where there are labour surplus due to strong population growth (Bloom and Mahal, 1997, UNDP, 2003, Ojha and Pradhan, 2006 and Cuesta, 2010). However, the labour surplus hypothesis may not hold in most African countries where both skilled and unskilled workers are affected in large proportion. It is obvious that in most African countries those who have acquired some critical skills and experiences either through formal education or other means such as on-the-job training may be difficult to replace. Literacy rate in this part of the world is already low and the level of brain drain seems to be growing on a daily basis compare to most advanced economies. Furthermore, labour replacement has some costs attached to it and it will be impossible to get them easily replaced. This is consistent with the argument put forward by Cohen (2002) that the reasoning that the 'unskilled' labour lost through epidemic diseases such as HIV can be easily replaced is based on fallacy.

HIV/AIDS and Productivity

The upsurge in morbidity and mortality as a result of the HIV/AIDS epidemic is likely to reduce life expectancy of infected person; and if this holds, then labour supply may decline, which could translate into lower productivity not only at the level of firms but also within the entire economy.

Terwin (2004) carried out a survey on firms in South Africa and discovered that HIV/AIDS has reduced labour productivity or increased absenteeism and raised the cost of employee benefits, with manufacturing firms being the worst affected. Moreover, 34 percent of the companies surveyed confirmed that the disease already had a negative impact on the firms' profits while more than half expect an adverse impact on profitability in five years' time.

In a related study undertaken by Jefferis *et al* (2006) in Botswana, it was reported that HIV/AIDS associates negatively and significantly with output, productivity and investment, with the greatest impact experienced by the firms that rely mostly on unskilled work force. United Nations (2004: p. 53) has maintained that the disease has the tendency to reduce directly number of workers and firms could lose their "institutional memory (the know-how accumulated through many years of experience) if some high level skilled workers that are important become ill or die" due to AIDS. The organization further argues that younger and less experienced workers could replace experienced ones and productivity reduced in the event infected workers die.

HIV/AIDS also raises both direct and indirect production costs of the firm. This is predicated on the fact that an increased number of infected workers could shoot up firm's medical expenses as well as the costs associated with benefits, recruitment and loss of productivity. Rosen *et al* (2004) study how the pandemic affects firms operating costs in southern Africa, employing company-specific employee figure, costs, and HIV prevalence. It was found that with prevalence among the workforce being between 7.9

percent and 25.0 percent, the disease among workers has added between 0.4 percent and 5.9 percent to the annual salary and wage bills of firms.

Finally, although the discovery of ART has helped to improve the immune systems of people living with the disease, the psychological effect of being tested positive tends to weigh a good number of them down, and most firms still find it difficult to retain infected workers in their employment. In addition, the ART coverage still appears relatively low in the affected countries (see UNAIDS, 2012a), and this has continued to exclude many infected persons from being treated.

Impact of HIV/AIDS on Agriculture

The bulk of the population of countries infected by HIV/AIDS is found in the rural areas where their major occupation remains agriculture. Kormawa (2008) revealed that agriculture provides livelihood for about 53 percent of the economically active population of Africa with approximately 84 percent of women engaged by the sector. The sector in this part of the world is highly labour intensive and the HIV/AIDS epidemic could inflict damage on it as long as the disease prevalence is high among its workforce. Ojha and Pradhan (2006: p. 4) submitted that HIV/AIDS would have negative impact on labour intensive sectors such as the agriculture because of its direct effect on young adults. According to them, the disease could bring about "acute labour shortage which, in turn, could lead to a severe decline in farm labour inputs." The authors cited a study carried out in Rwanda by Gillespie (1989) which reported about 50 percent decline in farm labour inputs due to "the loss of a female adult member of an agricultural household." The high level of famine being experience in Somalia, Niger and some parts of Kenya may not among other things be unconnected with the disease whose prevalence is high among rural dwellers in these countries. McPherson (2003) in his study reported that the Northern Province of Zambia which used to produce more than 1.2 million 90 kilogram bags of maize over a decade ago has had its production reduced to 350 thousand bags because of labour lost to the HIV/AIDS epidemic.

Furthermore, the fact that a large number of these farmers are illiterate and may not believe in the existence of this disease is a major concern. The reason being that majority of them might not bother to take any precaution against the disease and therefore, the pandemic may continue to cause havoc to their lives and livelihood, thereby reducing manpower and productivity in the sector. The presence of the disease among farm workers could increase rate of absenteeism amongst them, thereby leading to reduction in man hour or labour supplied on farm. Moreover, the loss of labour from AIDS-related deaths may reduce the area of land under cultivation as well as yields, resulting in declined food production and supply. In addition, farm productivity may fall eventually, which may lower income at household and national levels. The negative influence of the epidemic on agriculture could inadvertently create food insecurity as productivity and income of household members employed in the sector decline.

3.2.5 HIV/AIDS and Economic Growth: Methodological Review

Studies on economic impact of diseases focus on three specific methodological approaches. These include (i) the cost of illness (COI) method; (ii) the full-income method (FIM) or willingness to pay approach (WPA), which adds the value of health gains (health income or welfare) to income, and (iii) economic growth models (EGM) or production function method (PFM), which estimates cost of chronic diseases focusing on the impact on human capital or on labour supply (Abegunde and Stanciole, 2006). While the first two are mostly applicable to micro studies, the third approach is suitable for macro works.

Country-specific and cross-country macroeconomic studies of HIV/AIDS are rooted in the economic growth or production function method. Literature search produced four different methodologies that fall into this category. They include: Macro-econometric/Econometric Estimation Models, Aggregate Growth/ Macro-simulation Models, Computable General Equilibrium (CGE) Models, and Overlapping Generations (OLG) Model. These have been employed by studies focusing on the economic impact of the disease since its emergence in the early 80s.

Macro-econometric/Econometric Estimation Models

These are simple and large macro-econometric modeling which attempts to include HIV/AIDS as one of the factors that influence economic growth. The parameters of the variables are then estimated to determine the magnitude of their impacts on the growth rate of the real GDP. Depending on the assumption of the author, HIV/AIDS could be modeled through its impact on the dependent variable of the model or through some of the independent variables. The method has been employed for a few single country and cross-county studies by authors such as Over (1992), Bloom and Mahal (1997), Bonnel (2000), McDonald and Roberts (2006), Mahal (2004), and Gardner and Lee (2010).

Some reservations observed about this approach centre on its inappropriateness for few time series data set involving country-specific studies, since shortage of enough observations may prevent sufficient degrees of freedom required for such model to be statistically sound. In addition, in country where prevalence is low (less than 1 percent) the impact of HIV/AIDS on growth may be infinitesimal. Furthermore, econometric modeling of this nature may not be able to capture the sectoral adjustments in an economy as a result of the epidemic. These weaknesses notwithstanding, the modeling approach serves as one of the vital and veritable approaches for cross-country studies.

Aggregate Growth/ Macro-simulation Models

These are always based on simulation exercises. Jefferis *et al* (2007) stated that the approach involves the construction and calibration of simulation models to a specific economy and with the growth path simulated under different scenarios such as "with AIDS" and "without AIDS." Models of this nature, which aimed at assessing macro-economic impact of HIV/AIDS, are almost all the time modified versions of the one-sector neo-classical growth model (Ojha and Pradhan, 2006). The major advantages are obvious in their requirement of manageable data point as well as being suited for individual country analysis. In addition, they can easily capture the various channels through which the disease could affect economic growth. The above advantages notwithstanding, the models are only suited for country-specific studies and may be inappropriate in most cases for cross-country studies.

Furthermore, a model of this nature "cannot capture the sectoral readjustments which serve to mitigate the loss in aggregate output resulting from an AIDS epidemic", and for this reason, such "mitigation effect" is always ignored in these models (Ojha and Pradhan, 2006: p. 14). Macro-simulation models have been extensively used for country-level studies by Cuddington (1993a and 1993b), Cuddington and Hancock (1994 and 1995), Hancock *et al* (1996), Botswana Institute for Development Policy

Analysis, BIDPA (2000), MacFarlan and Sgherri (2001), Masha (2004), Jefferis *et al* (2007), Haacker (2002), Abdulsalam (2010).

Computable General Equilibrium (CGE) Models

CGE model, which is similar to the aggregate growth/macro-simulation models considered earlier, is a more complex modeling approach that incorporates many sectors of the economy in its analysis by disaggregating the entire economy into different productive sectors. According to Ojha and Pradhan (2006), the CGE modeling approach permits a variety of substitution mechanisms such as substitution in production, consumption and trade occurring in response to price changes. They maintained that the model also helps to simulate the workings of a market economy in which prices fluctuate to equate demand and supply for all goods and factors.

CGE model comprises a set of equations that describe the sectors in the economy in which the study focuses. While this type of modeling has the advantage of including possibly all sectors within the economy that enable sectoral impact of HIV/AIDS to be analyzed, it however cannot be applied for a cross country study, except in the case where regional CGE models are available. In addition, they are not suitable for panel analysis of HIV/AIDS economic impact for different countries.

Besides, Jefferis *et al* (2007) have noted that this modeling approach is quite demanding and require a balanced and consistent Social Accounting Matrix (SAM) constructed using specialized modeling software such as General Algebraic Modeling System (GAMS) and also the services of a dedicated CGE modeling expertise. Review of literature showed few studies have actually employed this modeling for macroeconomic analysis of HIV/AIDS for country-specific studies, some of which include: Kambou, Devarajan and Over (1992), Arndt and Lewis (2000), Arndt and Lewis (2001) and Ojha and Pradhan (2006). In the study of Kambou, Devarajan and Over (1992), which employed a CGE model of Cameroon to determine how AIDS induced labour supply reduction in the economy, eleven sectors were considered. One of the shortcomings of their model was its sole focus on macroeconomic impact of the pandemic due to declining labour supply arising from increased mortality associated with the disease.

Overlapping Generations (OLG) Model

Apart from the above major methodologies, Bell, Devarajan and Gersbach (2003), and Shorish (2007) have also employed the overlapping generations model (OLG) to study the macroeconomic impact of HIV/AIDS. This type of modeling is dynamic in nature with microeconomic background, incorporating households who are born at different stages/dates having finitely lived lifetimes.

3.2.6 HIV/AIDS and Economic Growth: Empirical Evidence

Since the detection of HIV/AIDS, studies on its economic implications have been more of micro rather than macro; however, there are few macro works either at country or cross-country levels. Relevant among them are reviewed in this section.

Country-Specific Evidences of HIV/AIDS Impact on Economic Growth

Greater proportion of most country-specific studies undertaken on economic effect of HIV/AIDS has focused on Southern and East African countries because of the very high rate of infection in these sub-regions. While several of them predicted negative impact of the disease on economic growth, others discovered that the pandemic affects economic outcomes positively while few others reported insignificant and no effect of the disease on growth.

The first set of studies by Kambou, Devarajan and Over (1992), Cuddington (1993a and 1993b), Cuddington and Hancock (1995), and BIDPA (2000) documented negative and significant effect of HIV/AIDS on growth in their respective countries of focus.

Using a CGE model of Cameroun, comprising 11 sectors, Kambou, Devarajan and Over (1992) reported sizeable negative macroeconomic effects of the disease, which stemmed from "the disproportionate incidence of AIDS on urban, skilled workers" in the economy (Kambou *et al* 1992: p. 111). Specifically, a reduction in the level of GDP growth of between 0.5 percent and 2.4 percent from the base case of 4.3 percent was reported. In addition, levels of output, exports, investment and savings within the economy of Cameroun declined substantially.

The study was rigorous, most specially given the methodology employed, it however suffers from too much emphasis on declined labour supply as the only effect of

HIV/AIDS without giving consideration to others. Ojiha and Pradhan (2006: p. 19) contend that some important issues, which are critical in the determination of economic effect of the disease were neglected by the authors, and therefore, the findings reported were grossly underestimated. Such issues include: labour productivity lost due to "debility and erosion of human capital", decline in overall productivity occasioned by "additional costs of hiring and training new workers needed to offset the loss in labour input because of increased absenteeism of AIDS-affected workers," as well as reduction level of savings owing to "additional expenditure incurred on healthcare." Another weakness observed in the study is found in data set employed by the authors, which covered the period 1979 to mid-1980. This was the early stage of the disease, when available information on it was still scanty. In actual fact, the period preceded 1985, when the first HIV/AIDS cases were diagnosed in Cameroon (see WHO, 2005d; Mbanya, Sama, and Tchounwou, 2008).

In the same vein, Cuddington (1993a) examines the macroeconomic impact of HIV/AIDS in Tanzania, building speculated demographic effects of the disease into a small macro-model of Solow type. The results of the simulation analysis indicated that the disease causing increases in morbidity and mortality rates would reduce GDP in the country by 15-25 percentage points while per capita income was to decline by between 0 percent and 10 percent by year 2010 if no decisive policy action was taken. The model employed by the author assumes full and efficient employment of labour and capital, which appear to be at variance with the reality of unemployment and underemployment situations in most African countries. Although the author tried to correct this assumption in a related study, Cuddington (1993b), using an extension of the same model on the Tanzanian economy by assuming underemployment of resources and possibility of the existence of dual labour-markets, the outcome however, did not show any divergence from the result of the previous study.

Cuddington and Hancock (1994) employ the same methodology of Cuddington (1993a and 1993b) to simulate the effects of AIDS on the Malawian economy, modeling medium and extreme case of AIDS prevalence in a simple one-sector model. The outcome of the study revealed declined average annual real GDP growth of between 0.2

percent and 0.3 percent while the result for the extreme case shows that the average real GDP growth rate would reduce by 1.2 percent to 1.5 percent between 1985 and 2010.

The same methodology as above was adopted in a two-sector macroeconomic model (formal and informal) by Cuddington and Hancock (1995) still on the economy of Malawi, comparing the scenario of with-AIDS and a counterfactual no-AIDS scenario. The authors found that AIDS would reduce real output by 10 percent in 2010 while between 0 and 3 percentage points decline in per capita income would be occasioned by the pandemic the same year in Malawi if nothing is done to check the spread of the disease. It should be noted that both studies assume and focus specifically on labour decline effect of the disease on growth; whereas, there are many more channels through which the epidemic could affect economic growth.

Cuddington (1993a and 1993b) model appears to have endeared itself to many researchers in the area of economics of HIV/AIDS, particularly as it relates to country-specific study. Using a dual labour-markets model similar to the one employed by Cuddington and Hancock (1995), and taking cognizance of the mineral sector in the Botswana economy, BIDPA (2000) examines the macroeconomic impacts of HIV/AIDS and discovered that the disease would bring about a reduction in the GDP growth rate by between 1 percent and 2 percent each year through to 2021. The result further indicated that the Botswana economy would experience a GDP decline to the tune of 20 percent to 40 percent due to the menace of HIV/AIDS.

Other country level studies predicting declining economic growth due to the influence of HIV/AIDS include: Hancock *et al* (1996), Arndt and Lewis (2000), MacFarlan and Sgherri (2001), Arndt and Lewis (2001), Zerfu (2002), Bell *et al* (2003 and 2004), Masha (2004), Jefferis *et al* (2006), Arndt (2006), and Abdulsalam (2010).

Hancock *et al* (1996) investigated the macroeconomic impact of HIV/AIDS in Kenya, and found that the GDP level of Kenya would be nearly 1/6th smaller than it otherwise would have been if there was no HIV/AIDS. In addition, it was shown that per capita income would decline by 10 percent while saving rate would fall by 15 percent by the year 2005. The study also gives the estimated present value of the indirect costs of AIDS as KSh76 trillion by 2005.

It is not certain, whether the findings and predictions of Hancock *et al* (1996) actually held as shown in this study. Specific works on macroeconomic implications of HIV/AIDS in Kenya appear scarce. The only work along this line was conducted by Were and Nafula (2003) which examined the effect of HIV/AIDS on the growth of Kenyan economy by way of simulation and using macroeconomic model for Kenya. The study found that due to 8 percent reduction in labour productivity in Kenya occasioned by the HIV/AIDS epidemic, growth rate of Kenya's economy reduced by 2.6 percent from the base line. The study, therefore predicted that by 2006, real gross domestic product of Kenya would decline by Ksh 330.

Arndt and Lewis (2000) employ the CGE model of South Africa to analyze the macroeconomic implications of HIV/AIDS in South Africa, with reference to the impact of the disease on total factor productivity, the result indicated that HIV/AIDS would reduce economic growth by 2.6 percent each year and a fall in the per capita GDP of 8 percent after the period of 10 years.
MacFarlan and Sgherri (2001) analysed the macroeconomic impact of HIV/AIDS in Botswana applying the same model as BIDPA (2000); although the effects of the pandemic on the economy were considered through the channels of formal and informal sectors, skilled and unskilled labour, as well as reduced productivity growth and low investment, the direction of economic impact of the disease was not different from what was reported above. In quantitative terms, the authors forecast declining real GDP growth rate by 3 percent to 4 percent between 2000 and 2010.

Drawing on the modeling approach of Arndt and Lewis (2000), Arndt and Lewis (2001) conducted a sectoral analysis of how HIV/AIDS imparts the economy, through the interaction of unemployment and AIDS in South Africa, the result revealed that virtually all sectors were affected by the menace of the disease. The construction and equipment sectors bcarried the greatest brunt of the disease while the medical and government services were the least affected. The authors argue that the fall in investment in the South African economy as a result of AIDS was the main reason construction and equipment sectors were heavily hit. The government and medical services however, were the least affected because the disease according to the authors directly increased demand for the outputs of these sectors.

Zerfu (2002) studies the macroeconomic impact of HIV/AIDS in Ethiopia, using a small macro-econometric model set-up in aggregate demand and supply framework. The results of the study, which covered the period 1980/1981 to 1998/1999 showed that the prevalence of the disease, which operates to lower active labour force has negative impact on the entire economy. It was reported that agricultural output would decline by 2.0 percent on the average while non-agricultural output would drop by 1.8 percent.

Bell *et al* (2003 and 2004) employed the overlapping generations (OLG) model to determine the long run effect of HIV/AIDS on the economy of South Africa, the authors found out that the disease has detrimental effects on the existing human capital as well as the mechanism through which generational knowledge is transmitted, thereby leading to decline in output per capita in the economy.

Masha (2004) conducted a study to assess the Botswana's NSF for HIV/AIDS where models, which focused on three different scenarios of "no AIDS", "with AIDS" and AIDS with intervention were employed. It was the first model that incorporates the effect of interventions in the study of the economic impact of HIV/AIDS. The author reported an overall economic growth declines in spite of intervention programme, which was attributable to the high costs of HIV/AIDS treatment that reduce savings and investment as well as human capital formation. Nonetheless, there was an increase in economic growth in the medium term due to a positive impact of intervention on the size and productivity of the labour force. The medium term growth however, would not occur without about 50 percent of the intervention cost met by donors. The study concludes that under the AIDS-with-intervention scenario, the indirect fiscal effects of a comprehensive prevention and treatment programme can contribute to the financing of such a programme.

In another study on Botswana by Jefferis *et al* (2006), which applies the model used by BIDPA but introduced a scenario of "AIDS with ART" and also refined the incorporation of investment and productivity effects into the model, the study projected that without ART, the average growth of the real GDP would reduce by 1.5 percent to 2.0 percent every year over the period 2001 to 2021, which may shrink by approximately between 25 and 35 percentage points due to HIV/AIDS than it would have been without this disease. The study also predicted a reduction in the population growth from 2.2 percent per annum without AIDS to 1.1 percent with AIDS not including ART. Also the average income growth in the Botswana economy would decline with the estimated growth rate of GDP per capita reducing by 0.5 percent to 1.0 percent yearly. This invariably would bring about lower average real incomes of between 10 percent and 15 percent after 20 years due to HIV/AIDS if the decline in economic growth outweighs the reduction in population growth.

Arndt (2006) examines how HIV/AIDS imparts growth and human capital in the Mozambican economy, employing a dynamic computable general equilibrium modeling approach, as well as a minimum cross entropy approach to estimate "education and human capital transition matrices." The author reported that as AIDS deaths bring about reduction in productivity growth, population growth and human capital accumulation as well as physical capital accumulation, the Mozambican GDP level would fall by 14 percent to 20 percent in 2010 while the per capita GDP growth would be between 0.3 percent and 1.0 percent lower per annum. One important aspect of this study that makes it unique centres on the use of AIDS deaths as against the prevalence data employed by most of the previous studies.

Abdulsalam (2010) develops a macro-econometric model of the Nigerian economy to examine the impact of HIV/AIDS on some macroeconomic outcomes in Nigeria using data covering 1980 to 2000 for the baseline model of the Nigerian economy. The author reported a declining influence of increased HIV/AIDS prevalence on output in the agriculture and manufacturing sectors while its impact on output in the oil and gas sector tends to be minima or even a positive. Additionally, it was found that upsurge in government's expenditure on treatment of the disease as well as prevention would operate to increase output across all industries; while gross fixed capital formation and capital expenditures would decline.

Contrary to reduction in economic growth reported by the studies cited above, Young (2005) discovered a 1 percent rise in per capita consumption in South Africa as a result of HIV/AIDS. Other studies which reported positive impact of HIV/AIDS on per capita income as cited by Jeffris *et al* (2007) include: Quattek (2000), Laubscher *et al* (2001), Haacker (2002), and BER (2006). One of the reasons in support of this is that increased mortality due to the pandemic reduces population, thereby bringing about increased per capita GDP. Greener (2004: p. 171) also noted that based on the predictions of some studies, the death of “large numbers of workers in the formal sector with relatively high incomes” which could be replaced from available surplus labour from the informal sector could raise average income. Moreover, he reiterated that according to the prediction of the neoclassical growth model, when the growth rate of the working population declines, capital-labour ratio could rise; which can increase both marginal product of labour and wage level.

Other studies take the middle position, arguing based on their findings that HIV/AIDS does not pose any significant threat to the growth of the economies of affected countries. Prominent among such works was Cuesta (2010), who analyzed the impact of mature AIDS on the growth of the economy of Honduras where prevalence of the disease was 2 percent, using macro simulation model. The results showed no threat of AIDS epidemic on economic growth either through labour or capital accumulation channels. It also reported that upsurge in expenditures on prevention; treatment subsidies and access would not affect economic growth prospects either. The main reason responsible for this results according to the author is that “critical factors that slash economic growth in Africa (such as human capital reductions and shifts in relative skills) are not strong in Honduras” (Cuesta, 2010: p. 3077)

One important observation obvious from the studies reviewed above is that most of them employed either simple macroeconomic or computable general equilibrium models, which is justified on the ground of the studies being country-specific. Eventhough such models could be applicable to cross country studies, they, however, appear more appropriate to be applied for country-level studies.

Cross-Country Studies of Macroconomic Impact of HIV/AIDS

Majorly, two strands of conclusions emerged from empirical works carried out at cross country levels on economic impact of HIV/AIDS. While some report adverse and significant influence of the disease on growth, others discovered insignificant and no significant association between HIV/AIDS and economic growth.

One of the earliest cross-country studies was undertaken by Over (1992) to determine the macroeconomic impact of AIDS in 30 SSA countries. The author developed a model for African growth, modeling AIDS through its effects on the explanatory variables after the initial growth projection with the model without AIDS. The findings indicate that the disease reduces growth rates of gross domestic product and per capita GDP, with the negative impact being severe in ten countries hardest hit by the epidemic. One of the major limitations of this study was that the HIV/AIDS data used was based on projection, which could have influenced the outcome of the study since the disease was still at its initial stage. Furthermore, UNAIDS data on the pandemic actually began in 1990. These observations notwithstanding, it was one of the main pioneer works that attempted to study macroeconomic implications of the disease at cross country level.

Bonnel (2000) also examined how HIV/AIDS and economic growth relate in Africa over the period 1990 to 1997, using ordinary least square (OLS) and two stage least squares (TSLS) estimators. The results indicated that HIV/AIDS reduced real GDP growth rate in Africa by about 0.7 percent during the period under consideration. The findings were facilitated by the negative influence of the disease on social capital, domestic savings and human capital according to the author. While the outcome is consistent with the previous ones, it is however observed that the use of OLS and TSLS appears to have influenced the results. Mahal (2004) has also noted that there is the tendency for the coefficients of the variables employed to proxy HIV by the author not to be robust under different specifications of the growth equation, since the HIV/AIDS variable was made a quadratic term in the specification.

Furthermore, Dixon, McDonald and Roberts (2001), focusing on 41 countries for the period 1960-1998 discovered a decline in growth rate of between 2 percent and 4 percent. Greater proportion of the data point employed by the authors covered the period when the virus was not yet discovered, and therefore could have influenced their findings, since the first case of HIV/AIDS was reported in the 1980s and not 1960s.

Similarly, McDonald and Roberts (2006) examined how the disease affects economic growth in more than 100 countries, using panel data analysis, covering the period 1984 to 1999 with HIV prevalence data. Their findings revealed 0.59 percent decline in per capita income due to a one percent increase in HIV prevalence. While their study fails to incorporate other channels through which HIV/AIDS affect economic growth, it however gave a clear linkage between HIV/AIDS and economic growth.

In a study conducted by Papageorgiou and Stoytcheva (2008) to determine the impact of AIDS on cross-country income levels using AIDS data for a panel of 89 countries over a 15 year period, 1986-2000, the findings reveal that the disease has a negative but marginally significant effect on the income level of the countries. When regional effects were controlled for, it was found that the negative effect was fundamentally driven by the sub-Sahara Africa and Latin America sub-samples. A further analysis using AIDS data by age group indicated that the disease has a significantly negative impact on income only via infected people between the ages 16 and 34.

Gardner and Lee (2010) carried out a panel study on 38 countries divided into 6 Asian counties (with only one having 1.98 percent prevalence while in the remaining 5 countries, prevalence as at the period of the study ranged between 0.5 and 0.1 percentage points); 20 countries in Eastern Europe (with only four of them having their HIV prevalence up to 1 percent); and 12 countries in Latin America (with only two countries entering a generalized epidemic while in others, prevalence was below 1 percent). The study, which focused on how HIV/AIDS affects health capital and economic growth, covered the period 1990 to 2005. The results show that HIV/AIDS prevalence has a detrimental impact on GDP per capita through its declining impact on health capital in the countries of focus. Although the findings reported by the authors appear consistent with several studies; the magnitude of the HIV/AIDS coefficients seem large (given low prevalence of the disease in the countries) compared with findings of other studies in highly endemic countries of Southern and East Africa. In addition, the study may have produced a different result with dynamic panel.

Studies which report insignificant effect of the disease on growth include: Bloom and Mahal (1997); Kirigia, Sambo, Okorosobo and Mwabu (2002; and Mahal (2004).

Bloom and Mahal (1997) investigated macroeconomic effect of HIV/AIDS in 51 developing and industrial countries from 1980 to 1992; using HIV prevalence data. The findings revealed insignificant impact of the disease on growth rate of real GDP in these countries. This result may not be unexpected going by the fact that their model employed data set that covered the period in which the prevalence rate of the disease was too low. In fact, there is no record that HIV/AIDS was reported in any country in 1980. Furthermore, as rightly observed by Bonnel (2000), the regression specification failed to correct for factors that could distort how both HIV/AIDS and growth of real per capita income relate.

Kirigia, Sambo, Okorosobo and Mwabu (2002) in their study covering WHO Africa region also discovered that HIV/AIDS morbidity and AIDS-related deaths have insignificant effect on the gross domestic product of Africa. However, the coefficients returned negative sign. The modeling approach adopted by the authors may have influenced the outcome of the study. For insatance, HIV/AIDS variables-number of persons living with HIV/AIDS and AIDS deaths- were included in their models as growth determinants. No attempt was made to investigate the impact of the disease on growth through other channels.

Finally, Mahal (2004) examines the existing relationship between HIV/AIDS and economic growth, using two econometric specifications. The results show statistically insignificant coefficient of the HIV/AIDS for the period 1980 to 1998 whereas the coefficient for 1990 to 1998 was statistically significant for both specifications.

3.2.7 Summary of Literature-Impact of HIV/AIDS on Economic Growth

Below is **Table** 3.3 showing summary of the key literatures reviewed with respect to how HIV/AIDS affects economic growth. The summary contains authors, the methodologies employed and the main findings.

Table 3.3. Summary of Key Literature on Impact of HIV/AIDS on Economic Growth

S/N	Author	Coverage	Methodology	Result
1	Over (1992)	30 African countries	Econometric Estimation and Simulation	Reduction in average annual GDP and per capita GDP growths
2	Kambou *et al* (1992)	Cameroun	CGE	Decline in GDP growth rate, savings, investment and exports
3	Cuddington (1993a and 1993b)	Tanzania	Macroeconomic /Macro-simulation Model	Reduced GDP and per capita income
4	Cuddington and Hancock (1994 and 1995)	Malawi	Macroeconomic /Macro-simulation Model	Fallen GDP growth and per capita income
5	Bloom and Mahal (1997)	51 countries	Econometric Estimation	Insignificant impact on income
6	Bonnel (2000)	70 developing countries	Econometric Estimation	Negative impact on growth
7	BIDPA (2000)	Bostwana	Macroeconomic Model	Decline in GDP growth
8	Arndt and Lewis (2000)	South Africa	CGE	Lower factor productivity and per capita GDP
9	MacFarlan and Sgherri (2001)	Botswana	Macroeconomic Model	Decline in real GDP growth
10	Zerfu (2002)	Ethiopia	Macro-econometric Model	Decline in agricultural and non-agricultural outputs
11	Bell *et al* (2003 and 2004)	South Africa	Overlapping Generations Model	Reduction in output per capita
12	Masha (2004)	Botswana	Aggregate Growth Model	Over all fall in GDP growth and increased GDP growth in the medium term due to intervention programme
13	Young (2005)	South Africa	Macroeconomic framework	Positive impact on per capita consumption
14	Arndt (2006)	Mozambique	CGE	Declines in GDP and per capita GDP
15	McDonald and Roberts (2006)	Some developed and developing countries	Macro-econometric /Dynamic Panel	No effect on growth for OECD countries but negative impact for African countries.
16	Bureau for Economic Research (BER) (2006)	South Africa	Macro-econometric Model	Decline in GDP growth but increase in per capita GDP of 0.28 to 0.43 percentage points
17	Cuesta (2010)	Honduras	Macro simulation model	No threat of AIDS epidemic on economic growth either through labour or capital accumulation channels.
18	Gardner and Lee (2010)	38 Countries of Asia, Eastern Europe and Latin America	Static Panel	Decline in Human Capital and Economic Growth
19	Abdulsalam (2010)	Nigeria	Macro-econometric Model	Reduction in output of agriculture and manufacturing sectors, decline in gross fixed capital formation but positive impact on oil sector performance.

Source: Author's compilation from key reviewed literature

CHAPTER FOUR

THEORETICAL FRAMEWORK AND METHODOLOGY

1.0 Introduction

The neo-classical growth theory is the theoretical root for this thesis. Specifically, the study employs an extended or augmented version of the Solow growth model in a technical sense; in which human capital variable is included as one of the drivers of economic growth.

Robert Solow in his growth model assumed a standard neo-classical production function with constant returns to scale, diminishing returns to each input and some positive and smooth elasticity of substitution between inputs (Zarra-Nezhad and Hosainpour, 2011). The theory also predicts absolute convergence among the economies of the world (where all countries converge to a universal level of per capita income and growth) due to decreasing returns to physical capital. The convergence assumption has been confirmed through empirical works carried out on the Solow growth model. However, rather than absolute, conditional convergence was said to exist, in which each country converges to its steady state value as a result of differences in rates of saving and population growth, coupled with the fact that structural variables such as trade policies, infrastructures, and so on vary across countries (see MRW, 1992; McQuinn and Whelan, 2007; and Zarra-Nezhad and Hosainpour, 2011). In addition, the Solow model takes the rates of saving and population growth as exogenous, and at the steady-state, a higher saving rate increases income and thereby making the country richer, whereas a higher population growth rate makes the country poorer.

The model employed in the present study is the standard growth model, using aggregate production function with growth rate of GDP per capita as explained variable (since it is a cross-country study). Following the methodology applied by MRW (1992), and also adopted and modified by McDonald and Roberts (2006), the Solow growth model is augmented by adding human capital variable. The HIV/AIDS disease then affects economic growth both directly (as epidemiological variable) and indirectly through its impact on human capital. This is based on the realization that cross-country studies of this nature where the influence of HIV/AIDS on human capital and economic growth is determined appear more consistent with neoclassical growth modeling than the classical and the endogenous growth models. MRW in their study argued that the Solow model explains much of cross-country variations in income with its decreasing returns assumption than the endogenous model. In actual fact, endogenous growth models are regarded as extensions of neoclassical models because they do not contain any fundamental variables different from that of the neoclassical growth models.

4.1 The Framework

The fundamental equation of Solow growth model specified as equation (3.58) in chapter three is

$$\dot{k}(t) = sf(k(t)) - (n + g + \delta)k(t) \quad (4.1)$$

However, evolution of the stock of capital per unit of effective labour, *k* is governed by

$$\dot{k}(t) = sy(t) - (n + g + \delta)k(t) \quad (4.2)$$

See MWR (1992)

Recall that $k = \frac{K}{AL}$ while $y = \frac{Y}{AL}$, which are capital per unit of effective labour and output capital per unit of effective labour respectively.

But $sy(t)$ implies $sk(t)$, So that

$$\dot{k}(t) = sk(t)^{\alpha} - (n + g + \delta)k(t) \quad (4.3)$$

meaning that k converges to a steady-state value k*, defined as

$$sk^{*\alpha} = (n + g + \delta)k^*, \quad (4.4)$$

and this implies that

$$k^* = \{s/(n + g + \delta)\}^{1/(1-\alpha)} \quad (4.5)$$

The implication of equations (4.4) and (4.5) is that the steady-state capital-labour ratio is positively affected by the saving rate and is negatively related to the rate of population growth. These are well spelt out in MWR. After deriving the steady-state output per unit of effective labour and taking the natural log of the equation, the basic Solow equation emerges, and this is shown as equation (4.6) below.

$$\ln\left\{\frac{Y(t)}{L(t)}\right\} = \ln A(0) + gt + \frac{\alpha}{1-\alpha}\ln(s) - \frac{\alpha}{1-\alpha}\ln(n+g+\delta) \qquad (4.6)$$

The signs and the magnitudes of the coefficients on saving and population growth are predicted by the model because of the assumption that factors receive their marginal products. The model assumes that the term A(0) reflects technology, resource endowments, institutions, and so on, which could defer across countries.

Based on this,

$$\ln A(0) = \alpha + \varepsilon \qquad (4.7)$$

Where α is a constant and ε is a county-specific shock. With this, equation (4.6) then becomes

$$\ln\left\{\frac{Y}{L}\right\} = \alpha + \frac{\alpha}{1-\alpha}\ln(s) - \frac{\alpha}{1-\alpha}\ln(n+g+\delta) + \varepsilon \qquad (4.8)$$ [22]

The basic model was extended by MWR by adding human capital. This was necessary because empirical studies have shown that the share of physical/fixed capital appears incredibly and questionably high relative to the capital share in national income. Therefore, given the fractions of income invested in physical and human capitals respectively as s_k and s_h, the evolution of the economy is then determined by

$$\dot{k}(t) = s_k y(t) - (n+g+\delta)k(t) \qquad (4.9)$$

$$\dot{h}(t) = s_h y(t) - (n+g+\delta)k(t) \qquad (4.10)$$

With y, k and h being output, physical capital and human capital per unit of effective labour respectively. The implication of equations (4.9) and (4.10) is that the economy converges to a steady state, which is invariably defined as

$$k^* = \left[\frac{s_k^{1-\beta} s_h^{\beta}}{n+g+\delta}\right]^{1/(1-\alpha-\beta)} \qquad (4.11)$$

22 MWR (1992: p.411) noted that this equation could be estimated using Ordinary Least Squares (OLS) estimator on the condition that both saving and population growth rates "are independent of country-specific factors shifting the production function." However, the result may be inconsistent if these assumptions are violated.

$$h^* = \left[\frac{s_k{}^{\alpha} s_h{}^{1-\alpha}}{n+g+\delta} \right]^{1/(1-\alpha-\beta)} \tag{4.12}$$

Substituting equations (4.11) and (4.12) into the production function and taking the log gives equation for income per capita as

$$\ln\left\{\frac{Y(t)}{L(t)}\right\} = \ln A(0) + gt + \frac{\alpha}{1-\alpha-\beta}\ln(s_k) + \frac{\beta}{1-\alpha-\beta}\ln(s_h) - \frac{\alpha+\beta}{1-\alpha}\ln(n+g+\delta) \tag{4.13}$$

When human capital is further divided into health and education, the dynamic equations for physical capital per unit of effective labour, education capital per unit of effective labour and health capital per unit of effective labour respectively then become

$$\dot{\hat{k}}_{it} = (s_{it})_K \hat{y}_{it} - (n_i + g_t + \delta)\hat{k}_{it} \tag{4.14}$$

$$\dot{\hat{e}}_{it} = (s_{it})_E \hat{y}_{it} - (n_i + g_t + \delta)\hat{e}_{it} \tag{4.15}$$

$$\dot{\hat{h}}_{it} = (s_{it})_H \hat{y}_{it} - (n_i + g_t + \delta)\hat{h}_{it} \tag{4.16}$$

Where $(s_{it})_K$ is the proportion of income invested in physical capital by county *i* at time *t*, $(s_{it})_E$, the proportion of income invested in education capital by county *i* at time $_t$ $(s_{it})_H$ the proportion of income invested in health capital by county *i* at time $_t$ and δ is the common depreciation rate.

From this juncture, the steady state of the three capital stocks per unit of effective labour can be determined.

These are given as

$$k^* = \left\{ \frac{(s_i)_K{}^{1/1-\beta-\theta} (s_i)_E{}^{\beta} (s_i)_H{}^{\theta}}{n_i + g_t + \delta} \right\}^{1/1-\alpha-\beta-\theta} \tag{4.17}$$

$$e^* = \left\{ \frac{(s_i)_K{}^{\alpha} (s_i)_E{}^{1/1-\alpha-\theta} (s_i)_H{}^{\theta}}{n_i + g_t + \delta} \right\}^{1/1-\alpha-\beta-\theta} \tag{4.18}$$

$$h^* = \left\{ \frac{(s_i)_K{}^{\alpha} (s_i)_E{}^{\beta} (s_i)_H{}^{1/1-\alpha-\beta}}{n_i + g_t + \delta} \right\}^{1/1-\alpha-\beta-\theta} \tag{4.19}$$

Taking the natural log of the three equations gives:

$$\ln k_i{}^* = \frac{1}{1-\alpha-\beta-\theta} \left\langle \ln\left\{ (s_i)_K{}^{1/1-\beta-\theta} (s_i)_E{}^{\beta} (s_i)_H{}^{\theta} \right\} - \ln(n_i + g_i + \delta) \right\rangle \tag{4.20}$$

$$\ln e_i^* = \frac{1}{1-\alpha-\beta-\theta}\left\langle \ln\left\{(s_i)_K{}^{\alpha}(s_i)_E{}^{1/1-\alpha-\theta}(s_i)_H{}^{\theta}\right\} - \ln(n_i + g_i + \delta)\right\rangle \quad (4.21)$$

$$\ln h_i^* = \frac{1}{1-\alpha-\beta-\theta}\left\langle \ln\left\{(s_i)_K{}^{\alpha}(s_i)_E{}^{\beta}(s_i)_H{}^{1/1-\alpha-\beta}\right\} - \ln(n_i + g_i + \delta)\right\rangle \quad (4.22)$$

The steady state physical, education and health capital stocks per unit of effective labour relate positively to the saving rate and negatively to the population growth rate as shown in equations (4.20) to (4.22). Output per unit of effectively labour can then be determined by substituting equations (4.20), (4.21) and (4.22) into the intensive form of the augmented production function given as

$$y_{it} = k_{it}^{\alpha} e_{it}^{\beta} h_{it}^{\theta} \quad (4.23)$$

Where *y =Y/AL, k = K/AL, e = E/AL and h = H/AL*. Implying that y_{it} = output per unit of effective labour in country *i* at time *t; k_{it}* = physical capital per unit of effective labour in country *i* at time *t; e_{it}* = education capital per unit of effective labour in country *i* at time *t*; h_{it} = health capital per unit of effective labour in country *i* at time *t*.

Therefore, output equation then becomes

$$\ln y_{it}^* = \ln A_{i(0)} + g_i t - \gamma_1 \ln(n_i + g_t + \delta) + \gamma_2 \ln s_{iK} + \gamma_3 \ln s_{iE} + \gamma_4 \ln s_{iH} \quad (4.24)$$

Where:

$$\gamma_1 = \frac{\alpha+\beta+\theta}{1-\alpha-\beta-\theta}, \quad \gamma_2 = \frac{\alpha}{1-\alpha-\beta-\theta}, \quad \gamma_3 = \frac{\beta}{1-\alpha-\beta-\theta}, \quad \gamma_4 = \frac{\theta}{1-\alpha-\beta-\theta}$$

s_{iK}, s_{iE}, s_{iH} are the proportion of output/income earmarked as investment into physical capital, education capital and health capital respectively. $A_{i(0)}$ represents country-specific initial technological endowment, climate, institutions, etc (MRW, 1992). Following the method used by MRW (1992) and McDonald and Roberts (2006), the alternative formulation of equation (4.24) can be derived, since disaggregated savings data are difficult to come by and this may pose some problems when trying to perform estimation. So, the alternative formulation is given as:

$$\ln y_{it}^* = \ln A_{i(0)} + g_i t - \xi_1 \ln(n_i + g_t + \delta) + \xi_1 \ln s_{iK} + \xi_2 \ln s_{iE} + \xi_3 \ln h_{it}^* \quad (4.25)$$

Where: $\xi_1 = \frac{\alpha}{1-\alpha}$, $\xi_2 = \frac{\beta}{1-\alpha}$, $\xi_3 = \frac{\theta}{1-\alpha}$

h_{it}^{*} is a steady state level quantity of health capital per unit of effective labour. Either of equations (4.24) and (4.25) could be estimated. Whereas equation (4.24) uses the rates of the accumulation of education and health capitals, equation (4.25) uses the levels of both education and health capitals.

When the conditional convergence predicted by the Solow model is considered another version of both equations could be specified as:

$$\ln y_{it}^{*} - \ln y_{i0}^{*} = \psi \ln A_{i(0)} - \psi \ln y_{i0}^{*} + \lambda_1 \ln(n_i + g_t + \delta) + \lambda_2 \ln s_{iK} + \lambda_3 \ln s_{iE} + \lambda_4 \ln h_{it}^{*} + \eta_t \qquad (4.26)$$

Where: $\psi = 1 - e^{\ell t}$, $\lambda_1 = -\frac{\psi\alpha}{1-\alpha}$, $\lambda_2 = \frac{\psi\alpha}{1-\alpha}$, $\lambda_3 = \frac{\psi\beta}{1-\alpha}$, $\lambda_4 = \frac{\psi\theta}{1-\alpha}$, and

$\eta_t = \varphi_t t$

Equation (4.26) could be estimated directly or augmented with other growth determinants that are outside the original Solow's model. Durlauf, Johnson and Temple (2005) have argued in support of this.

For a step by step derivation of the equations, see *Appendix A*.

From the foregoing, it is obvious that the three capital stocks-fixed, education and health- are vital determinants of growth. However, the three can depreciate in value. One of the key factors that can occasion depreciation of health stock is disease, such as HIV/AIDS. When this occurs, individual productivity in the economy tends to be affected negatively.

4.1.1 Growth Framework and HIV/AIDS Disease

The salient question to pose here has to do with how disease (HIV/AIDS) variable enters the growth framework.

There are different ways disease variables can be incorporated into the growth model. For instance, diseases could affect growth directly or through its impact on growth drivers such as population, labour force, savings, human capital, and so on. In this study, two approaches were employed. Firstly, empirical literature on diseases and growth has allowed explicit inclusion of disease variables into growth model as one of the regressors (see Mahal, 2004; Asante, Okyere and Kusi, 2005; Weil, 2010; and Percoco, 2010). The present study adopts this approach. Secondly, the study also investigated the influence of HIV/AIDS epidemic on economic growth through human capital variables.

Following Acemoglu and Johnson (2007), and Cervellati and Sunde (2011), the impact of the disease on growth through human capital can be model thus:

Assuming a closed economy aggregate growth model in the spirit of Solow with a production function, which exhibits constant returns to scale, we have:

$$Y_{it} = \left(A_{it} H_{it}\right)^{\alpha} K_{it}^{\beta} L_{it}^{1-\alpha-\beta} \tag{4.27}$$

Where: K, L and H imply fixed capital, land and human capital stock respectively, with $\alpha + \beta \leq 1$. A_{it} stands for productivity efficiency of technology. i and t denote individual country and time respectively. Assuming land is fixed across all countries, then our L can take the value of 1, and the function is left with the other growth determinants in the function.

Furthermore, it is assumed that a direct relationship exists between output level and the level of human capital, and so, any improvement in human capital will enhance output in the economy whereas, erosion of human capital will decline output level.

Available stock of human capital in the economy at a given point in time could be denoted as

$$H_{it} = h_{it} N_{it} \tag{4.28}$$

Where h_{it} is the level of individual human capital, and N_{it} stands for population size.
The prevailing epidemiological environment affects productivity and human capital stock, which could occur through some of the determinants of human capital. When disease prevalence is high in a particular economy, it tends to have negative impact on productivity as well as human capital, and this in turn reduces output level.

Given human capital determinant, e.g. health as C_{it}, and assuming its impact on productivity and human capital in a reduced isoelastic relationship, we have

$$A_{it} = \overline{A}_i C_{it}^{\rho}, \ \rho \geq 0 \text{ and,}$$

$$h_{it} = \overline{h}_i C_{it}^{\eta}, \qquad \eta \geq 0 \tag{4.29}$$

Where C_{it} is determinant of human capital, with $\overline{A}$ and $\overline{h}$ being baseline differences across countries.

Furthermore, improved human capital determinant, which in this model is assumed health, has the tendency to boost population. This could occur directly or indirectly. For instance, improved health condition can increase life span as well as number of births. Following from this, population size could be given as

$$N_{it} = \overline{N}_i C_{it}^{\gamma} \tag{4.30}$$

Assuming human capital determinant, health changes from C_{it0} to C_{it1}, which could be due to disease or any factor. When this occurs, level of productivity as well as human capital will be affected while the total fixed capital stock remains constant. Substituting equations (4.29) and (4.30) into equation (4.27) and linearizing it gives

$$y_{it} = \beta \ln \overline{K}_{it0} + \alpha \ln \overline{A}_i + \alpha \ln \overline{h}_i - (1-\alpha)\ln \overline{N}_i + \left[\alpha(\rho+\eta) - (1-\alpha)\gamma\right] x_{it} \tag{4.31}$$

Where:

$$y_{it} = \ln\left(\frac{Y_{it}}{N_{it}}\right), \text{ and } x_{it} = \ln X_{it} \tag{4.32}$$

The import of equation (4.31) is that when human capital determinant is enhanced, it has the tendency to improve per capita output if its impact on productivity and human capital {measured by $\alpha(\rho+\eta)$} exceed the potential negative effects arising from the increase in population due to constancy of land and fixed capital stock, $(1-\alpha)\gamma$.

Now, assuming the change in human capital determinant is a negative change, occasioned by HIV/AIDS disease. Then, the effects, $\alpha(\rho+\eta)$ on productivity and human capital become negative, given as $-\alpha(\rho+\eta)$ or $-(\rho+\eta)\alpha$ while increased mortality due to the disease reduces population size. The overall effect of the disease on output per capita therefore will be negative if declines in productivity and human capital exceed positive effect arising from reduced population.

Additionally, if fixed capital is assumed to change due to changes in productivity, human capital and output level, then equation (4.31) changes to include a term for saving rate, as shown in the Solow model.

If a constant saving rate, s_i is assumed, whereby $s_i \in (0,1)$ while capital depreciates at $\delta_i \in (0,1)$. The evolution of capital becomes

$$K_{it+1} = s_i Y_{it} + (1-\delta)K_{it} \tag{4.33}$$

If human capital determinant, health (C_{it}) changes from C_{it0} to C_{it1} after the adjustment of population and human capital stock, capital stock at the steady state then becomes

$$K_{it+1} = \frac{s_i Y_{it}}{\delta} \tag{4.34}$$

When equations (4.27), (4.29) and (4.30) used together with equation (4.34), the long run relationship between human capital and per capita output then becomes

$$y_{it} = \frac{\alpha}{1-\beta}\ln \overline{A}_i + \frac{\alpha}{1-\beta}\ln \overline{h} + \frac{\beta}{1-\beta}\ln s_i - \frac{\beta}{1-\beta}\ln \delta - \frac{1-\alpha-\beta}{1-\beta}\ln \overline{N}_i + \frac{1}{1-\beta}\left[\alpha(\rho+\eta)-(1-\alpha-\beta)\gamma\right]x_{it} \tag{4.35}$$

The major difference between equation (4.31) and equation (4.35) is the inclusion of saving rate in the latter, which enhances better human capital effect on per capita income. The effects of changes in productivity, human capital on per capita output due to HIV/AIDS as discussed earlier still holds.

4.1.2 Human Capital Framework

Virtually, all existing human capital frameworks are micro based. This justifies why most macro studies relating to human capital are derived from micro frameworks. In chapter three of this thesis, attempt was made to review the available theories and methodologies of human capital in the literature. Specifically, three important approaches of measuring human capital were reviewed; cost-based, income based and output-based approaches.

The model employed in this study benefits from the works of Grossman (1972a) and Ben-Porath's (1967) human capital production functions, which fall within output-based framework. While Grossman's concept of human capital focuses on the health aspect, Ben-Porath concentrates on the aspect of education. In both works, individuals invest in themselves (which could be in schooling, training, health, etc), thus producing a form of human capital with some input combinations in the human capital production function. However, this investment has cost involving both opportunity cost of time and money element. In addition, human capital investment enhances and raises individual productivity not only in the "market sector of the economy, where he produces money earnings" but also "in the nonmarket or household sector, where he produces commodities that enter his utility function" (Grossman, 1972a: p. 223).

In producing human capital, individual normally begins with certain stock, which is acknowledged in the models of both Grossman and Ben-Porath. Other inputs into the production function cover economic, social and environmental variables; some of which are income, education, health and so on.

Following from the above, the human capital framework for this study is specified as:

$$h_{it} = f(h_{it-1}, \boldsymbol{d_{it}}, \boldsymbol{x_{it}}) \qquad (4.36)$$

Where h_{it} stands for human capital stock, h_{it-1} is the initial or lagged human capital stock, $\boldsymbol{x_{it}}$ signifies all socio-economic and other factors that influence human capital production, and $\boldsymbol{d_{it}}$ captures the epidemiological environment. This variable is very critical, since disease infections could jeopardize human capital investment activities; whether in the area of education, health, training, migration or on-the job training. HIV/AIDS disease is captured in this variable.

The epidemiological environment of a given country is very significant for her growth and development. A country plague with chronic and infectious diseases will no doubt have a lot of health, economic, social and developmental challenges to combat. This is because health is very strategic for the level of productivity in an economy. In fact, it is "a direct source of human welfare and also an instrument for raising income levels" (Bloom and Canning, 2008: p. iv) and as such issues militating against good health deserve more attention. Diseases can reduce life span, create psychological disorder, lower productivity and income level, aggravate poverty and reduce living standard, mar developmental efforts, constitute a drain on nations' resources, and shrink human capital developmental activities (Hyder, Rotllant and Morrow, 1998; Acemoglu, Johnson and Robinson, 2003; Abegunde and Stanciole, 2006; Acemoglu and Johnson, 2007; Nugent, 2008; and Andersen, Dalgaard and Selaya, 2011).

Human Capital Measures

The multi-dimensional nature of human capital has engineered the use of different measures for empirical researches. For instance, education enrolments, literacy rates, educational attainments, expenditures on education and health, infant mortality, life expectancy among others are some of the available measures of human capital in the literature. In this study, three different human capital measures were employed. These are primary school enrolment, life expectancy and a human capital index, developed by the author. One important motivation for using life expectancy is based on the fact that HIV/AIDS has a lot to do with health, and life expectancy is health capital. Data availability is one other justification for adopting the measure. Similarly, primary school enrolment was employed as a measure of human capital (education capital) because of data availability. The third variable, human capital index combines both health and education variables.

It is imperative to note that a single measure of human capital has its limit and more importantly, it may not capture this concept comprehensively. Although no perfect measure of the term exists in the literature, the index of human capital (which combines health and education variables) following the methodology of the United Nations Development Programme (UNDP) provides a better human capital measure through which HIV/AIDS impact could be determined.

4.2 Methodology

4.2.1 Human Capital Index Computation

The index was developed, using the methodology normally employed by UNDP to compute human development indices (see UNDP, 2010 and 2013b; and Klugman, Rodríguez and Choi, 2011).

Determination of Human Development Index (HDI), UNDP Methodology

The critical issues involved in the determination of HDI are:

i) Dimensions;

ii) Indicators; and

iii) Dimension Index

Dimensions

There are three dimensions with their corresponding indicators. The first dimension is long and healthy life, whose indicator is life expectancy at birth. The second is knowledge, with its indicators as mean years of schooling for the adult population and expected years of schooling for children of school-entrance age. The former "is the average number of years of education received in a life-time by people aged 25 years and older" while the latter is the average number of years of schooling that children of school-entrance age today are "expected to attain in adulthood if enrolment rates stay at their current levels" (Klugman, Rodríguez and Choi, 2011: p. 19, and UNDP, 2013c). The third dimension is "a decent standard of living", which has its indicator as "GNI per capita (PPP $)".

Dimension Index

The dimension index for "long and healthy life" is "life Expectancy index" while the one for "knowledge" is "education Index." The dimension for "a decent standard of living" is "GNI Index".

Steps in Computing HDI

There are two steps involved in the computation of HDI; these are: determination of dimension indices and summation of the various indices created to arrive at HDI.

The formula for calculating the dimension index is given as:

$$DI = \frac{AV - MiV}{MaV - MiV} \qquad (4.37)$$

Where: DI = dimension index; AV = actual value; MiV = minimum value; and MaV= maximum value, of the variables employed for index computation. The purpose of the minimum and maximum values is to transform the indicators into indices between 0 and 1. “The maximums are the highest observed values” while “the minimum values can be appropriately conceived of as subsistence values.” The minimum value for life expectancy is 20 years while the minimum for both education variables is 0 year (UNDP, 2013b: p. 2).

The above formula suffices for any dimension index that involves a single variable. For instance, using the formula to compute life expectancy index for a particular country means that the actual life expectancy for the country will be required together with goal post of the accepted or observed minimum and maximum values. In the 2013 UNDP human development report, the observed maximum average life expectancy employed was the 2012 value for Japan, which stood at 83.6 years while the minimum value was 20 years. So, with these values, computing the life expectancy index for a country like Ghana, whose average life expectancy is approximately 64.2 according to the World Bank (2013) WDI will be:

$$LEI_{Ghana} = \frac{64.2 - 20}{83.6 - 20} = 0.695$$

For any dimension index, having more than single variable as the case with education index, above formula is employed to compute the index for each of the variables or sub-components; thereafter, a geometric mean of the indices is computed after which the dimension index formula is reapplied to the geometric mean to arrive at education index.

The final step is to determine the HDI. This is simply the geometric mean of the three dimension indices (life expectancy index, education index, and GNI index). The geometric mean approach was introduced by the UNDP in its 2010 human development report, which was the 20th anniversary edition to address certain problems inherent in the previous approach of arithmetic mean, which has been used for several years (see UNDP, 2010 and 2013b; and Klugman, Rodríguez and Choi, 2011).

Given a set of data $\{x_1, x_2, x_3, ..., x_n\}$, its geometric mean can be computed as:

$$\{x_1 x_2 x_3 ... x_n\}^{1/n} = \sqrt[n]{\{x_1 x_2 x_3 ... x_n\}} = \left\{\prod_{i=1}^{n} x_i\right\}^{1/n} \quad \text{Or} \quad Anti\log\left\{\frac{\sum_{i=1}^{n}\log x_i}{n}\right\} \tag{4.38}$$

It should be noted that equation (4.38) is only applicable for ungrouped data. For any distribution involving grouped data, the expression changes slightly thus

$$Anti\log\left\{\frac{\sum_{i=1}^{n} f_i \log x_i}{\sum_{i=1}^{n} f_i}\right\} \tag{4.39}$$

Where *n*= number of observations, *x* = observations, and *f* = frequency.

Since the human capital index developed in this thesis is a combination of health and education capital, the indices of both life expectancy and education were compiled from various issues of UNDP human development reports for the period under consideration, after which their geometric means were calculated. GNI index is left out because it is not a measure of human capital. In any case, per capita income is one of the determinants of human capital development.

For detailed explanation of steps involved in the computation of HDI, see UNDP (2013b); various issues of technical report of UNDP human development report; and Klugman, Rodríguez and Choi (2011).

Steps in Computating Human Capital Index

These follow all the steps highlighted above, with the exception of non-inclusion of the dimension that has to do with a decent living standard, which uses GNP per capita as its indicator, since it is anot a measure of with human capital.

So, the steps include:

i) Identifying the dimensions;
ii) Specifying the indicators; and
iii) Creating the dimension Indices

Dimensions and Indicators

Two dimensions together with their corresponding indicators were considered. The first dimension is "long and healthy life" whose indicator is life expectancy at birth. The second is "knowledge" with its indicators as "mean years of schooling" and "expected years of schooling."

Dimension Index

The dimension index for "long and healthy life" is "life expectancy index" while the one for "knowledge" is "education index."

Creation of Dimension Indices

Life Expectancy Index

This involves two values referred to as the goalposts. They comprise the minimum and maximum values. The minimum value for life expectancy is 20 years while the maximum value is 83.6 years according to UNDP.

The formula for calculating life expectancy index is given as:

$$LEI = \frac{AVL - MiVL}{MaVL - MiVL} \quad (4.40)$$

Where: *LEI* = Life Expectancy Index; *AVL* = actual value of life expectancy; *MiVL* = minimum value of life expectancy; and *MaVL*= maximum value of life expectancy. The actual value depends on the value for each country at the particular year of interest.

Education Index

The minimum value for both mean years of schooling and expected years of schooling is zero (0) year while the maximum values were 13.1 and 18 years respectively. The actual values are then based on each country's values.

The formula for both indices is:

$$MYS = \frac{AVS - MiVS}{MaVS - MiVS} \quad (4.41)$$

Where: *MYS* = Mean year of schooling index; *AVS* = actual value of mean year of schooling; *MiVS* = minimum value of mean year of schooling; and *MaVS*= maximum value of mean year of schooling.

$$EYS = \frac{AVE - MiVE}{MaVE - MiVE} \tag{4.42}$$

Where: *EYS* = Expected year of schooling index; *AVE* = actual value of expected year of schooling; *MiVE* = minimum value of expected year of schooling; and *MaVE*= maximum value of expected year of schooling.

Education Index (EI)

$$EI = \sqrt{\left[\left(\frac{CMYS - MYS_{\min}}{MYS_{\max} - MYS_{\min}}\right)\left(\frac{CEYS - EYS_{\min}}{EYS_{\max} - EYS_{\min}}\right)\right]} \tag{4.43}$$

Where: *CMYS* = Computed mean year of schooling; MYS_{min} = minimum mean year of schooling; MYS_{max} = maximum mean year of schooling; *CEYS* = Computed expected year of schooling; EYS_{min} = minimum expected year of schooling; EYS_{max} = maximum expected year of schooling.

Human Capital Index

The Human Capital Index (HCI) is finally arrived at by determining the geometric means of life expectancy index (LEI) and education index (EI). Since this involves two variables, the square root of both indices will produce the same result as thre geometric mean. Therefore,

$$HCI = \sqrt{(LEI)(EI)} \tag{4.44}$$

This value ranges between zero (0) and one (1), where 1 signifies the best and zero implies the worst human capital development cases.

4.2.2 Empirical Model Specification

Human Capital Model

For the purpose of empirical analysis, a reduced form of human capital model for this study is specified as:

$$h_{it} = \delta h_{i,t-1} + d'_{it}\lambda + x'_{it}\beta + \varepsilon_{it} \qquad (4.45)$$

Where h_{it} is human capital, δ is a scalar, d'_{it} is *1 X K* matrix (*1 by K*), which comprises epidemiology variables, where HIV/AIDS, the variable of interest is captured while λ is *K X 1*. x'_{it} is *1 X K* matrix (*1 by K*), comprising all other explanatory variables (control variables), β is *K X 1*, i=1,2,...,N indexes individual country, t=1,2,...,T indexes year, and ε_{it} is composite stochastic error term, which consists of other components; given as:

$$\varepsilon_{it} = \mu_i + \nu_{it} \qquad (4.46)$$

The term μ_i represents country specific effects and ν_{it} the remaining stochastic disturbance term, assumed to be normally distributed and has a zero mean with constant variance. Symbolically, $\mu_i \sim IID(0, \sigma^2_\mu)$ while $\nu_{it} \sim IID(0, \sigma^2_\nu)$.

The variables captured in x_{it} include: per capita income, primary school enrolment (whose choice was based on data availability), dependency population, percentages of population without access to improved water while HIV/AIDS and malaria variables are captured in d_{it}

Most human capital literature acknowledges the importance of variables such as income, education and health status as human capital determinants. Income is very critical in the acquisition of human capital. It addresses the money cost element required for investment undertaken in training, education, health, and other means of human capital formation at the level of individual and society. Education enriches knowledge acquisition, which is essential in the area of healthy behaviour and utilization of health care services. It also empowers individuals and can enhance better employment opportunities required for more income generation as well as higher level of productivity. Good health likewise encourages better labour market participation and acquisition of more human capital as well as time devoted to producing human capital stock. These variables are important determinants of human capital.

The other variables in the model, such as dependency population and water availability can also affect a person's health status, which has implications for human capital developmental activities. For instance a high dependency ratio could exert pressure on household income, living little or nothing left for human capital investment while lack of access to good/improved water sources could portend danger for the household health, schooling, training and migration; thereby imparting negatively on human capital activities, since it could lead to the outbreak of diseases, which hinders investment in education as well as other means of human capital development.

Following from the above, the empirical human capital model, which is semi-logged and dynamic, is explicitly specified as:

$$\ln HC_{it} = \alpha_0 + \alpha_1 \ln HC_{i,t-1} + \alpha_2 HIV/AIDS_{it} + \alpha_3 \ln MAL_{it} + \alpha_4 WAT_{it} + \alpha_5 \ln DEP_{it} + \alpha_6 \ln PCGDP_{it} + \alpha_7 ENR_{it} + \mu_i + v_{it} \tag{4.47}$$

Where: *HC* is human capital variable. *PCGDP* stands for per capita gross domestic product, *ENR* signifies primary school enrolment, *WAT* implies proportion of population without access to improved source of water, *DEP* depicts dependency population, *MAL* represents reported and confirmed malaria cases while *HIV/AIDS* stands for incidence of HIV/AIDS, prevalence of HIV/AIDS, number of people per thousand population living with the disease and AIDS deaths. μ_i represents country-specific effects and v_{it} the remaining stochastic disturbance term as earlier defined.

Theoretically, $\alpha_1 > 0; \alpha_2 ... \alpha_5 < 0$ while α_6 & $\alpha_7 > 0$

Brief Discussion of Variables-Human Capital Model

Literature is clear on determinants of human capital. Prominent among them are education, health, income and household size. Apart from these, there are other important variables whose list is quite large.

Primary School Enrolment

This is an education variable. School enrolment according to UNESCO (2009: p.9) is the "total enrolment in a specific level of education, regardless of age, expressed as a percentage of the eligible official school-age population corresponding to the same level of education in a given school year." It shows the degree of school participation at a specific level. Mathematically, it is expressed according to the organization as:

$$GER_h^t = \frac{E_h^t}{P_{h.a}^h} * 100$$

Where:

GER_h^t = Gross Enrolment Ratio at level of education, *h* in school year *t*;

E_h^t = Enrolment at the level of education *h* in school year *t*; and

$P_{h.a}^h$ = Population in age group *a*, which officially corresponds to the level of education, *h* in school year *t.* It is expected that this variable helps to improve the level of human capital through empowerment and development of skills, which in turn enhances income level for the individual as well as the entire economy. Literature suggests a positive relationship between education and level of human capital development. It is also important to note that enrolment could be used as a measure of human capital.

Life Expectancy

Life expectancy is a human capital variable in the area of health. This has been employed in the empirical literature. An improved life expectancy is not only expected to enhance economic growth and development, but it also serves as an important boost to human capital development activities. Therefore, a direct relationship exists between human capital and health, otherwise measured with life expectancy. However, just as with school enrolment, life expectancy is also a measure of human capital.

GDP Per Capita

Just as household income level determines the quantity and quality of human capital investment activities, the same thing is applicable at the national level. Level of income in an economy, is expected to influence human capital formation in the area of investment in education, health, training and so on. Therefore, per capital income theoretically should associate positively with human capital development in any society.

HIV/AIDS Variables

Diseases, whether at the household, firm or national levels are considered disturbances or debilitating phenomena, which could sap and drain income/resources, reduce productive hours, weaken individual’s immune system, and deplete human resources. The case of HIV/AIDS is not an exception, and as such it is expected to decrease human capital. The motivation for employing the HIV/AIDS variables (incidence, prevalence, number of people living with HIV/AIDS per thousand population, and AIDS deaths) is based on the following facts. According to De Walque (2007), incidence is based on current infections while prevalence depends on behaviour, which is affected by mortality. Furthermore, as rightly pointed out by the author, incidence appears more accurate in terms of the current state of the pandemic because it reveals current behaviour with respect to the pandemic. Also, while prevalence data employed here cover persons ages 15 to 49; number of people living with the pandemic covers all age groups. Finally, AIDS deaths are distinct from the other variables because it has to do with deaths recorded due to HIV/AIDS related causes as against other HIV/AIDS measures, which concerns infected persons who are still alive. Finally, while most HIV/AIDS related macro studies employed prevalence, this study considered it necessary to employ all the four variables.

Cases of Malaria Reported and Confirmed

Malaria is one of the prevalent diseases in SSA. The same negative association expected between HIV/AIDS and human capital is applicable to malaria. In other words, an inverse relationship is present between this disease and human capital development.

Percentage of Population without Access to Improved Water Source

Water is critical for survival, and lack of access to a good source can pose lots of health challenges. There are numerous water borne diseases and as such the higher the proportion of a country population without access to hygienic water source, the worse the health situation, which may culminate into negative influence on economic outcomes. Therefore, an inverse relationship is expected between this variable and human capital investment.

Dependency Ratio

This is age dependency as percentage of working-age population. This serves as a burden in the society if the rate is too high. It is one of the problems of developing countries. The number of children, unemployed youths and the elderly appear to outweigh the income generated by the working age group. The implication of this is low income per capita, high poverty level as well as increase in crime rate. A high dependency ratio will reduce human capital formation.

Economic Growth Model

Two variants of growth models are specified and used in the study. The first incorporates HIV/AIDS variables into the growth model while the second model contains human capital measure through which HIV/AIDS affects growth. In other words, the disease variable does not enter directly into the growth model; rather its impact on growth is determined through its effect on human capital.

Following from equations (4.24), (4.25) and (4.26), the first growth model is specified as

$$PCGDPg_{it} = \lambda_0 + \lambda_1 PCGDPg_{i,t-1} + \lambda_2 HIV/AIDS_{it} + \lambda_3 \ln MAL_{it} + \lambda_4 \ln DEP_{it} + \lambda_5 LBFg_{it} + \lambda_6 \ln FC_{it} + \lambda_7 \ln HC_{it} + \lambda_8 OPE_{it} + \mu_i + \nu_{it} \qquad (4.48)$$

Theoretically, $\lambda_1 > 0;\ \lambda_2 ... \lambda_4 < 0$ while $\lambda_5 ... \lambda_8 > 0$

While the second growth model is given as:

$$PCGDPg_{it} = \beta_0 + \beta_1 PCGDPg_{i,t-1} + \beta_2 \ln HC_{it} + \beta_3 \ln MAL_{it} + \beta_4 \ln DEP_{it} + \beta_5 \ln LBF_{it} + \beta_6 \ln FC_{it} + \beta_7 OPE_{it} + \mu_i + \nu_{it} \qquad (4.49)$$

Theoretically, $\beta_1 > 0;\ \beta_2 ... \beta_4 < 0;$ while $\beta_5 ... \beta_7 > 0$.

μ_i represents country specific effects and ν_{it} the remaining stochastic disturbance term, and it is assumed to be normally distributed and has a zero mean with constant variance. The implication symbolically is that $\mu_i \sim IID(0, \sigma_\mu^2)$ while $\nu_{it} \sim IID(0, \sigma_\nu^2)$.

PCGDPg = growth rate of per capita GDP measured in purchasing power parity (PPP). This is a measure of economic growth. It is the most appropriate as cross-country growth measure. This represents the output variable y_{it} in equation (4.25). *FC* = Fixed/Physical capital (variable k_{it} in equation 4.25), whose impact on output is positive. *HC* = human capital variable; which are life expectancy (variable h_{it}), enrolment (variable E_{it}), and human capital index developed in the present study. All these have direct relationship with output level in the economy. Other variables with which the model is augmented include: *DEP* = dependency population; *MAL* represents reported and confirmed cases of malaria while HIV/AIDS stands for incidence and prevalence of HIV as well as number of people per thousand population living with HIV/AIDS, and AIDS-related deaths. *LBFg* = labour force growth, which measures labour in the economy; and *OPE* = Trade openness.

$(n_i + g_t + \delta)$ is assumed away for the following reasons:

i) n and g are growth rates of population and knowledge/technology respectively. However, they are assumed exogenous factors.

ii) δ is the rate at which fixed capital and human capital stocks depreciate. This value is difficult to determine.

iii) MRW indicates elasticity of per capita income with respect to the variable $(n_i + g_t + \delta)$ as 0.5; however, this may be biased since the value for δ may be difficult to come by. Even if a value is assumed for this term, it may prejudice the result since there may not be sound theoretical basis for such assumption, particularly for developing economies like the West African countries upon which the present study focuses.

Brief Discussion of Variables- Economic Growth Model

The variables employed for growth model analysis are:

Growth Rate of Per Capita GDP (PPP)

This is the standard in cross-country growth literature. The one employed here was generated from the data provided by the World Bank (2013) WDI.

Explanatory Growth Variables

Fixed Capital

This is investment in physical capital. All economic growth models contain this variable. It is one of the important determinants of growth. Its absence in any growth model may render such model incomplete. Fixed capital and economic growth are directly related. The proxy used in this study is Gross capital formation.

Labour

As with fixed capital, labour is a critical factor in growth determination. It associates positively with economic growth.

Human Capital

This is a relatively recent development in growth literature, particularly with the emergence of both exogenous and endogenous growth theories. Prior to this period, little attention was given to human capital as an important determinant of growth; however, in recent time, theoretical and empirical literatures support its inclusion, particularly as greater proportion of nations economic performances are being ascribed to this factor. Most country-specific and cross-country growth studies considered heath and education capital either separately or jointly in their estimations. In this study, depending on the nature of the model, in some cases both were included while in others, they were considered separately. Moreover, where human capital index was used, other human capital variables such as life expectancy and enrolment were excluded. Human capital and economic growth are suggested to be positively related.

Trade Openness

Most trade literature shows positive relationship between growth and trade openness, which is not an exception in this study. This is computed, using the formula

$$\frac{(X+M)}{GDP}\cdot\frac{100}{1}$$

Where: *X* stands for export values; *M* implies import values; and GDP equals values of gross domestic products.

Dependency Population

This variable was included as a demographic variable, which could influence growth negatively.

Malarial and HIV/AIDS variables

Just as discussed under human capital, these variables affect level of growth negatively.

4.2.3 Data Descriptions and Sources

Table 4.1. Data Requirement, Definition and Source

Variable	Definition	Source
PCGDP	Gross Domestic Product per capita	World Bank (2013). WDI
LBF	Labour Force	World Bank (2013). WDI
PCGDPg	Growth rate of per capita Gross Domestic Product	Computed by author from World Bank (2013). WDI
FC	Fixed/Physical Capital	United Nations. (2012). National accounts main aggregate database
ENR	Primary School Enrolment Rate	World Development Indicators (2012) and African Statistical Yearbook (ASY) (2010 and 2011)
LEP	Life Expectancy	World Bank (2013). WDI
WAT	Percentage of population without access to improved drinking water	WHO/UNICEF Joint Monitoring Programme (JMP) for Water Supply and Sanitation
OPE	Trade Openness	Computed by author from World Trade Organization (2012). Statistics databse-international trade statistics
HIVI	Incidence of HIV	UNAIDS (2011 and 2013d)
HIVPR	Prevalence of HIV/AIDS	World Bank (2013). WDI and UNAIDS (2011 and 2013d)
HIVP	Number of people living with HIV/AIDS	UNAIDS (2011 and 2013d)
AIDSD	AIDS Deaths	UNAIDS (2011 and 2013d)
MAL	Malaria cases reported and confirmed	WHO (2012). The world malaria report.
DEP	Dependent population	Author's computation from World Bank (2013). WDI data
HCI	Human Capital Index	Developed by author using data from UNDP human development report (various issues)

Source: Author's Presentation

4.2.4 Reliability of HIV/AIDS Variables

HIV/AIDS data from the indicated sources are reliable. According to McDonald and Roberts (2006), HIV prevalence figures have attracted researches in recent times and are increasingly based on robust epidemiological data such as blood samples taken at ante-natal clinics. The authors cited Swartlander *et al* (1999: p. 2455) who argued that the "HIV sentinel surveillance systems are generally rather extensive when compared with surveillance systems for other communicable diseases." They further cited Garnett *et al* (2001) who affirmed that the current estimates of HIV prevalence are superior to estimates for the prevalence of other diseases.

Akpa and Oyeloja (2008) applied the UNAIDS Estimation and Projection Package (EPP) to HIV/AIDS epidemic in the North central zone of Nigeria for the purpose of (i) proposing a statistical model for the course of the epidemic in the zone, and (ii) to generally investigate the level of trend inherent in the epidemic over the years. The EPP was used as the point of reference. The data employed in the study were those obtained from previous HIV/AIDS Sentinel Surveillance Survey (HSSS) in the zone and published by the Nigerian Federal Ministry of Health. The "Sentinel Surveillance Programme was based on the unlinked anonymous method, using the screening for Syphillis as entry point" with all the samples "stripped of identity, recorded by state, site, and age, properly stored and sent for HIV testing with Capillus and Genie II kits as specified in the protocol." The outcome of the study revealed that the UNAIDS package was a great support to HIV/AIDS modeling in Nigeria and very reliable.

In actual fact, UNAIDS and WHO depend largely on

> "surveys of pregnant women attending antenatal clinics; population-based surveys (conducted at the household level); sentinel surveillance among populations at higher risk of HIV infection; case reporting; demographic data; and information on antiretroviral treatment programmes and programmes to prevent mother-to-child transmission" (UNAIDS, 2011: p. 11).

The estimation is then done for countries and regions using spectrum software package.

4.2.5 Panel Econometric Modeling and Estimation Issues

Panel data technique, which involves the combination of both cross-section and time series dimensions of observations is attracting increasing interest and gaining a wider relevance and popularity in applied research in the field of economics in our contemporary days. This is not unconnected with some of the crucial roles it plays in solving certain econometric problems, which are peculiar to cross-section and time series observations.

Asides providing solution to the problem of bias in estimate that may arise as a result of unobserved heterogeneity, uncertainty in modeling, and so on, panel data technique offers the researcher access to larger number of observations, which may not have been possible with cross-section or time series data, and this helps to increase the precision and accuracy of regression estimates. Hsiao (2003) argues that panel data provide the researcher a larger number of data points, increase the degrees of freedom and help to reduce any collinearity that may exist among explanatory variables, which all act to improve the efficiency of econometric estimates.

According to Hu (2002: p. 2499), "panel data expand our opportunities to study more complex economic relationships by, for example, allowing for individual heterogeneity and dynamic feedback."

The strategic importance of panel data in enriching empirical research is articulated in the literature. Citing Hsiao (2003) and Klevmarken (1989), Baltagi (2005: pp. 4-7) enumerates advantages of using panel data as:

i) the possibility of controlling for individual heterogeneity, which involves the inclusion of individual-specific variables in the model;
ii) the liberty for "more informative data, more variability, less collinearity among the variables, more degrees of freedom and more efficiency";
iii) making better the study and capturing of "dynamics of adjustment" that may be impossible in cross-sectional data;
iv) the opportunity "to identify and measure effects that are simply not detectable in pure cross-section or pure time-series data" is made better with panel data;

v) "panel data models allow us to construct and test more complicated behavioral models than purely cross-section or time-series data";

vi) "micro panel data gathered on individuals, firms and households may be more accurately measured than similar variables measured at the macro level. Biases resulting from aggregation over firms or individuals may be reduced or eliminated"; and

vii) "macro panel data on the other hand have a longer time series and unlike the problem of nonstandard distributions typical of unit roots tests in time-series analysis."

Finally, "panel data models are usually used to harmonize regional policies[23]."

Panel Regression Models

There are two main modeling approaches in panel data. These are static and dynamic models. One notable difference between the two is that whereas, static panel does not contain lagged dependent variable as one of the explanatory variables, dynamic panel model does.

A conventional panel model could be specified as:

$$Y_{it} = \alpha + \sum_{K=1}^{J} \beta_K X_{Kit} + \varepsilon_{it} \qquad k = 1, \ldots J \tag{4.50}$$

The error term can be disaggregated into a one-way or a two-way error components.
A one-way error disaggregation is given as

$$\varepsilon_{it} = \mu_i + \nu_{it} \tag{4.51}$$

In a one-way modeling, each cross-sectional unit has its own constant term; however, the slope estimates are constrained across units (Olubusoye, 2013).

A two-way error component occurs when the error is further disaggregated. Thus, equation (4.51) then becomes

$$\varepsilon_{it} = \mu_i + \lambda_t + \nu_{it} \tag{4.52}$$

23 Salisu, A. 2011. Dynamic Panel Data Modeling. A paper presented at the CMD Econometrics Workshop, Lagos, on 24th October, 2011.

Where: *i* indicates the cross-section units and *t* being time dimension. α is a scalar and β is a *K x 1* vector of coefficients of explanatory variables. From equations (4.51) and (4.52) it is obvious that the stochastic disturbance term ε could be divided into two or three components. $\mu_{i,}$ is the unobserved individual specific effect, λ_t denotes unobserved time effect and ν_{it}, the remaining disturbance term.

Static Panel Models

Variants of static panel models abound; however, two basic ones are highlighted in this study. They are fixed effects (FE) model and random effects (RE) model.

Fixed Effects (FE) Models

It is possible to assume that the intercepts and coefficients of a static model are constant for all cross-sectional units, and therefore, the model could be estimated using the Ordinary Least Squares (OLS) estimator. However, this may not be the case; the assumptions may hold and therefore; the estimates then become biased. For this reason, there are other specifications to overcome the problem. One of such specifications is the Fixed Effects (FE) modeling approach. This approach is an improvement on the pooled regression model. Wuth this, the intercept could be allowed to vary for the different cross-sections, since it is possible for each of the cross-sections to have peculiar characteristics different from one another. Furthermore, a constant slope with different intercepts could be assumed across sectional units and could differ or may not differ over time. The model is specified in several ways. A particular type may contain constant slope and different intercepts (which may or may not vary over time) for each cross-sectional unit (a cross-sectional unit in the case of the present study is country).

There can also be another variant in which the intercepts vary over time but the slopes are constant so that the cross-sections would show no significant differences. In another instance, the FE model may contain a constant coefficient with different intercepts across cross sections and time. Furthermore, a FE model could have both intercepts and slopes varying according to cross sectional units. Other variant could allow variations in both intercepts and slopes across cross-sections and time. Fixed Effect (FE) Estimator is employed when "the cross-sectional units are not randomly sampled" and when "the regressors are correlated with the specific effects", which "implies endogeneity of all regressors with the FE estimator" (Salisu, 2011: p. 11).

Equation (4.50) is a type of FE model, with the error term disaggregated into two or three components as shown in equations (4.51) and (4.52). In both equations, when μ_i and λ_t are assumed fixed parameters, then the model becomes a fixed effects.

Random Effects (RE) Models

A random effect model is used when the cross-sectional units are randomly selected/ sampled (hence, the name REM) and when the explanatory variables do not correlate with the specific effects or other regressors. It is "a regression model with a random constant term" (Greene, 2012: p. 347). This type of modeling is economical in degrees of freedom, as we do not have to estimate N cross-sectional intercepts" (Gujarati and Porter, 2009: p. 613). In a random effects modeling, μ_i and λ_t in equations (4.51) and (4.52) are assumed random, hence the name RE model. This modeling approach is used to overcome the problem of losing degrees of freedom, peculiar to the FE model due to too many dummies, which increase the number of parameters estimates.

Dynamic Panel Data Model

Several "economic relationships are dynamic in nature and one of the advantages of panel data is that they allow the researcher to better understand the dynamics of adjustment" (Baltagi, 2005: p. 135). These dynamics of adjustments are handled through Dynamic Panel Data (DPD) modeling. The dynamics are captured by including lagged dependent among the explanatory variables. The DPD modeling approach is well suited particularly when issues such as autocorrelation (which is caused by the inclusion of a lagged dependent variable as one of the regressors), correlated specific effects (which is peculiar with heterogeneity among the cross sectional units) and orthogonality are obvious. Other models considered above, may not produce consistent and unbiased estimates. So, DPD modeling is capable of handling these problems.

From equation (4.50) a DPD model can be specified as:

$$Y_{it} = \alpha + \gamma Y_{it-1} + \sum_{K=1}^{J} \beta_K X_{Kit} + \varepsilon_{it} \qquad (4.55)$$

The inclusion of Y_{it-1} among the right-hand-side variables makes the model dynamic. From the equation, ε_{it} could further be disaggregated as the case with equations (4.51) and (4.52). Therefore,

$$\varepsilon_{it} = \mu_i + \nu_{it} \qquad (4.56)$$

or

$$\varepsilon_{it} = \mu_i + \lambda_t + \nu_{it} \qquad (4.57)$$

4.2.6 Estimation Techniques

The study employed the difference GMM and system GMM estimators for analysis. These are well suited, efficient and consistent for dynamic panel modelling and estimation. However, four additional estimation techniques-Ordinary Least Squares (OLS) otherwise referred to as pooled estimator or common constant estimator; Fixed Effects (FE) estimator; Random Effects (RE) estimator; First Difference (FD) estimator-were employed. The results are presented in Appendices B and C.

Explanations provided on the estimators below benefited largely from Baltagi (2005).

Pooled Estimator

Using this estimator implies assuming away the specific effects (time and country specific effects) in the model, meaning that such effects are not important. In other words, the constant term in the model is assumed the same for all the countries. And therefore, μ_i and λ_t in equations (4.56) and (4.57) are removed. While this estimator provides the liberty to determine the conformity of the estimated model to basic assumptions underlying least squares regression (Folawewo, 2011: p.11), it could however present a biased and inconsistent results: i) if the effects characterizing heterogeneity among countries of focus are significant; and ii) owing to the presence of lagged dependent variable among the regressors.

For instance, given a dynamic model of the type specified in Baltagi (2005: p.135).

$$y_{it} = \delta y_{i,t-1} + x'_{it}\beta + u_{it} \quad \text{i = 1, ..., N; t = 1, ..., T} \qquad (4.58)$$

Where δ is a scalar, x'_{it} is *1 X K* and β is *K X 1*, and

$$u_{it} = \mu_i + \nu_{it} \qquad (4.59)$$

With μ_i being the unobservable country-specific effects not contained in the regression model, which is time invariant while ν_{it} is the remaining stochastic disturbance term, which is both country and time variant. $\mu_i \sim IID(0, \sigma_\mu^2)$ and $\nu_{it} \sim IID(0, \sigma_\nu^2)$ independent of each other among themselves.

So equation (4.58) then becomes

$$y_{it} = \delta y_{i,t-1} = x'_{it}\beta + \mu_i + \nu_{it} \tag{4.60}$$

If μ_i is important, then the estimate may be biased. It is obvious from equations (4.58) and (4.59) that y_{it} is a function of μ_i, which without doubt implies $y_{i,t-1}$ as also a function of μ_i. With this, $y_{i,t-1}$ also correlates with ν_{it}, the stochastic disturbance/error term. Thus, making OLS not completely appropriate estimator for a model of this nature, even though, it assists to test for basic assumptions of least squares regression.

Fixed and Random Effects Estimators

The assumption underlying the FE model is that the country or time effects are fixed. This implies for instance that the each country in this case has its constants (i.e factors which are peculiar to it), which must be taken into consideration in the model. One fundamental advantage among others of both FE and RE estimators is that they help to account for heterogeneities among different countries. Furthermore, employing the FE estimator, the within transformation assists to remove the country effect (μ_i). However, "$(y_{i,t-1} - \bar{y}_{i-1})$ where $y_{i-1} = \sum_{t=2}^{T} y_{i,t-1}/(T-1)$ will still be correlated with $(\nu_{it} - \nu_i)$ even if the ν_{it} are not serially correlated. This is because $y_{i,t-1}$ is correlated with $\bar{\nu}_i$ by construction. The latter average contains $\nu_{i,t-1}$ which is obviously correlated with $y_{i,t-1}$" (Baltagi, 2005: p. 135).

It should be noted that employing FE could result in the lost of degrees of freedom by reason of too many parameters occasioned by the use of dummies. RE estimator could solve this problem based on the assumption of randomness of the country-specific effects (μ_i). "In this case $\mu_i \sim IID(0, \sigma_\mu^2)$, $\nu_{it} \sim IID(0, \sigma_\nu^2)$ and the μ_i are independent of the ν_{it}" while "the X_{it} are independent of the μ_i and ν_{it}, for all *i* and *t*" (Baltagi, 2005: p. 14). The RE estimator or what is referred to as the within group estimator uses deviation method to eliminate the unobservable effects. This notwithstanding, the method may also produce biased outcome with dynamic panel.

First Difference Estimator

This technique also overcomes some of the shortcomings of the earlier considered estimators. First differencing the model helps to eliminate country effects, making it easier to "handle correlation between the predetermined explanatory variables and the remainder error" (Baltagi, 2005: p. 136), and producing efficient results. Anderson and Hsiao (1981) as cited in Baltagi (2005) suggest that the model could first be differenced once in order to remove the country effects (μ_i), thereafter $\Delta y_{i,t-2} = (y_{i,t-2} - y_{i,t-3})$ or $y_{i,t-2}$ can be used as instrument for $\Delta y_{i,t-2} = (y_{i,t-1} - y_{i,t-2})$. The wisdom behind this is that the "instruments will not be correlated with $\Delta \nu_{it} = \nu_{i,t} - \nu_{i,t-1}$, as long as the ν_{it} themselves are not serially correlated" (Baltagi, 2005: p. 136).

Difference Generalized Method of Moments (GMM) Estimator

This was developed by Arellano and Bond (1991). It produces an unbiased and more efficient estimates than the earlier estimators considered. The procedure is to first difference the model to eliminate the effects as well as any explanatory variable that is time invariant. Furthermore, the action also assists to deal with the problem of endogeneity in the model. Differencing equation (4.60) gives

$$y_{it} - y_{i,t-1} = \delta(y_{i,t-1} - y_{i,t-2}) + (x'_{it} - x'_{i,t-1})\beta + (\nu_{it} - \nu_{i,t-1}) \quad (4.61)$$

System Generalized Method of Moments (GMM) Estimator

The system GMM was developed by Blundell and Bond (1998). Although difference GMM provides unbiased and efficient estimates and also helps to solve most of the problems peculiar to dynamic panel, system GMM appears to produce better estimates than difference GMM. The reason for this is based on the instruments employed by both estimators. While difference GMM uses lagged values as instruments, system GMM employs both lagged and level variables as instruments, which helps to increase efficiency of the estimate. The procedure is to instrument variables in levels with appropriate lags of their own first differences, with the assumption that the differences are not correlated with the unobserved country effects (Salisu, 2013).

CHAPTER FIVE

PRESENTATION AND ANALYSIS OF RESULTS

1.0 Introduction

The heart of this chapter is essentially the presentation, analysis and interpretation of results, which are guided principally by the objectives stated in chapter one of the study. This assists a great deal in the determination of how HIV/AIDS epidemic has affected human capital development and economic growth in West Africa.

Four measures of HIV/AIDS variables were employed in the study. They include: HIV incidence, prevalence, number of people living with HIV/AIDS per thousand population, and AIDS deaths per thousand population. One fundamental justification for using four HIV/AIDS measures is to provide alternative results for the purpose of comparison. Moreover, employing just a measure of HIV/AIDS may produce a biased result, particularly since there are arguments in the literature that HIV prevalence data could be overestimated due to selection bias, given that they are more often than not based on samples taken from pregnant women at antenatal clinics (see Salomon and Murray, 2001; Boerma, Ghys and Walker, 2003; and Canning, 2006). Moreover, the four measures are not the same. While HIV prevalence takes into consideration the state of the disease in the previous years, incidence of the disease concerns with the present state of the pandemic. Furthermore, the only available prevalence data covers the productive age group, which comprises persons of ages 15-49 years. Number of people living with the epidemic includes all age groups (from age zero and above). Finally AIDS-related deaths cover all AIDS mortalities.

5.1. Empirical Analysis

This sub-section contains summary/ descriptive statistics of all the variables employed for analysis in the study. The summary statistics are majorly the means and standard deviations of the variables.

5.1.1 Summary Statistics

Table 5.1 presents summary statistics of the variables employed for analysis in the study. The information contained in the table shows that on average, life expectancy in West Africa between 1990 and 2011 was 50.50 years. It however ranged from 37.19 to 64.22 among countries of the sub-region. The standard deviation stood at 5.4, which implies that the dispersion of life expectancy in the region is not far from its average value. This is an indication that average life expectancy in each of the coutries in the sub-region appears relatively the same. The value is a far cry from what obtains elsewhere North Africa, Europe, America, and in some Asian countries.

Incidence of HIV for the sub-region during the observed period stood at an average of 0.26 and varied between 0.10 and 1.46 values. In the same vein, prevalence of the disease had a mean value of 2.15, which spanned between 0.10 and 7.30. Without doubt, these figures would have implication on different economic activities in the region. The dispersions around the mean values of both incidence and prevalence indicated by their standard deviations are 0.22 and 1.54 respectively. Both number of persons living with the disease as well as deaths associated with it are high in the region. Aveagely, about 0.3 million persons were infected with the disease while around 20,000 persons died from AIDS-related illnesses during the period under consideration. The implication of this is that if adequate and appropriate care is not provided for those already infected with the virus, number of deaths caused by the pandemic will tend to increase in the nearest future.

Percentage of population without access to improved water sources remains high in the sub-region. For the period 1990-2011, approximately 39 percent of West African population on the average lacked access to improved water source within the period of the present study. This however, ranged from 11 to 72 percentage points. This could contribute to the spread of water born diseases. Primary enrolment averaged 80.60, with the lowest rate of 26.13 and the highest average rate being 160.00. Per capita gross domestic product (PPP) was US$1078.43, and ranged between US$480.32 and US$2533.05. Its growth rate however, stood at an average of 3.06 percent.

Malaria remains one of the endemic diseases in West Africa. As shown in the table, confirmed cases between 1990 and 2011 averaged 1.08 million, which hovered between 2,000 and 5.72 million cases. Age dependency as percentage of working-age population on average was 89.54. This appears high for the reason that only 10.46 percent of the entire population would carry the burden of 89.54 percent. Additionally, the average value of human capital index was given as 0.41 with the deviated value from the mean being 0.17. Education and health indices correspondingly averaged 0.38 and 0.54.

Fixed capital, which averaged US$ 2.01 billion, shows a disparity of US$ 3.51 billion. The mean value ranged from US$ 17.3 million to US$ 21.9 billion. Trade openness had the mean of 49.52, and this varies from 12.94 to 93.20. The average labour force during the period under review was 10.4 million, showing a disparity around the mean of 18.8 million with the maximum mean of 87.4 million people. Its growth rate averaged 2.81 with a minimum value of -0.72 and a maximum rate of 6.01. The disparity in this value symbolized by the standard deviation was 0.88 indicating a low dispersion.

Table 5.1. Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Life Expectancy	242	50.5	5.45	37.19	64.22
HIV Incidence	242	0.26	0.22	0.02	1.46
HIV Prevalence	242	2.15	1.54	0.10	7.30
Number of People Living with HIV/AIDS (000 000)	242	0.30	0.66	0.001	3.4
AIDS Deaths (000 000)	242	0.02	0.04	0.0001	0.22
Population Without Access to Improved Water Source (%)	242	38.56	13.86	11.00	72.00
Primary School Enrolment	242	80.60	28.40	26.13	160.00
GDP Per Capita((PPP, US$)	242	1078.43	387.66	480.32	2533.05
GDP Per Capita Growth (PPP)	242	3.06	4.58	-33.54	20.36
Malaria Cases Confirmed (000 000)	242	1.08	1.08	0.002	5.72
Dependency Population (000 000)	242	9.10	16.30	0.47	75.10
Dependency Ratio	242	89.54	6.56	73.31	102.17
Human Capital Index	242	0.41	0.17	0.18	2.64
Fixed Capital ($'000 000)	242	2010	3510	17.3	21900
Trade Openness	242	49.52	16.99	12.94	93.20
Labour Force (000 000)	242	10.40	18.80	0.49	87.40
Labour Force Growth	242	2.81	0.88	-0.72	6.01

Source: Author's Computation

5.1.2 Results of Econometric Analysis

This sub-section presents results of dynamic panel analysis for both human capital and growth models. As indicated earlier, four variant HIV/AIDS variables were employed for the analysis. These were HIV incidence, HIV prevalence, number of people living with HIV/AIDS and AIDS deaths. Similarly, three human capital measures were also used. These include: average life expectancy at birth, primary school enrolment rate and human capital index. The human capital index essentially combines both health and education indices, which also has other different measures. It was developed by the author following the methodology normally utilized by the UNDP to produce HDI.

The growth rate of per capita Gross Domestic Product (purchasing power parity) was employed as a measure of economic growth. This is the standard in cross-country growth literature, and no better measure is yet to be developed. Three dynamic panel estimation techniques (First Difference, Difference GMM and System GMM) were used in addition to Ordinary Least Squares (OLS)/pooled/common constant; Fixed Effects (FE); and Random Effects (RE) estimators. The results of OLS, FE and RE are presented in *Appendix* B, since they are much more suited for static panel data.

Tables 5.2 to 5.9 below present summary results of empirical estimation of how the HIV/AIDS epidemic influences human capital and economic growth in West Africa; with each of them containing solely the four HIV/AIDS measures. While the first three tables contain results relating to the impact of the disease on human capital, which addresses the first objective of the study, the remaining five display results that have to do with the influence of the pandemic on economic growth (this addresses the second objective of the study). Results of the entire analyses are shown in *Appendix C*.

Impact of HIV/AIDS on Human Capital Development in West Africa

The summary of results showing how HIV/AIDS affects human capital development activities in West Africa are presented in **Tables** 5.2 to 5.4 with each of the tables displaying results using different human capital measures. **Table** 5.2 employed life expectancy at birth as a measure of human capital; however, **Tables** 5.3 and 5.4 used primary school enrolment and human capital index respectively. Detailed findings are presented in *Appendices* C-1 to C-12.

Table 5.2. Impact of HIV/AIDS on Human Capital

Dependent Variable = Log of Life Expectancy (lnLep)

Regressors	FD	DIFF-GMM	SYS- GMM
HIVI	-0.002	-0.007***	-0.019**
	(0.314)	(0.000)	(0.025)
HIVPR	-0.001**	-0.006***	-0.005***
	(0.027)	(0.004)	(0.029)
HIVP	-0.0002**	-0.001**	-0.0002
	(0.028)	(0.030)	(0.684)
AIDSD	-0.001	-0.016**	-0.013*
	(0.197)	(0.012)	(0.088)

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.

Source: Author's Computation.

Table 5.2 presents findings relating to how the HIV/AIDS pandemic affects human capital development in West Africa, using life expectancy as a measure of human capital with the four HIV/AIDS measures earlier identified. Apparently, the disease has negative and significant impact on life expectancy in the sub-region as evident in the table, irrespective of the HIV/AIDS measure and estimation technique employed for analysis. The negative impact is consistent with the *a priori* expectation. A cursory glance at the table shows that asides results produced by first difference estimator, a negatively significant influence of HIV incidence on life expectancy was returned by the remaining two estimators; with the magnitude being 0.7 and 1.9 percentage points for difference GMM and system GMM respectively. HIV prevalence and number of people living with the disease also returned negative and statistically significant coefficients, with the exception of SYS-GMM estimator's result whose coefficient for number PLWHA was statistically insignificant. Similarly, AIDS deaths imparted negatively on life expectancy as obvious from the table, the coefficients of difference GMM and system GMM estimators being statistically significant at 5 percent and 10 percent significant levels in that order.

Focusing specifically on the magnitude of the coefficients, it is observed that between 0.7 percent and 1.9 percent significant declines were occasioned by HIV incidence in human capital in West Africa. The system GMM result showed a 1.9 percent reduction in human capital due to a percentage decline in HIV incidence. With respect to prevalence and number of PLWHA, their various coefficients were rightly signed and statistically significant, indicating negative influence of the pandemic on human capital; however, the magnitudes were slightly lower than what was found for incidence. For example between 0.1 percent and 0.6 percent declines in human capital were caused by HIV prevalence in the region within the period under consideration while approximately 0.02 percent to 0.1 percent negative and significant influences on life expectancy were occasioned by number of persons living with the disease. Moreover, AIDS-related deaths reduced life expectancy significantly by 1.6 percent and 1.3 percent in the region from 1990 to 2011.

The control variables, such as primary school enrolment, malaria cases, and dependency ratio were rightly signed to a larger extent. These are presented in *Appendices* C-1 to C-4. Primary school enrolment has positive impact on life expectancy substantially, with the exception of few negative coefficients. It is also observed that seven out of the twelve coefficients were statistically significant. However, the magnitude of all the coefficients appeared very low. For instance, in the model where HIV incidence was employed, results of the first difference and system GMM estimations showed about 0.004 percent and 0.02 percent significant increases respectively in life expectancy due to a percentage rise in enrolment. Difference GMM result was however not significant. The same pattern emerged in the remaining three models that employed HIV prevalence, number of persons living with the disease and AIDS-related deaths.

Malaria exerted negative influence on life expectancy. This notwithstanding, only two coefficients (produced by difference GMM estimation) were statistically significant. Consequently, nearly all the coefficients appeared very low. Age dependency produced mixed outcomes in terms of signs and statistical significance. While some of the specifications returned negative and significant coefficients, others were not.

Findings of the remaining control variables revealed that per capita GDP returned the expected positive sign in most cases. However, only four out of the 12 coefficients were marginally significant, implying that the level of income in the region appears not to have imparted significantly on the average life expectancy. Population without access to improved water source associated negatively with life expectancy. About 42 percent of the coefficients remain statistically significant. Nonetheless, most of them were low; with the maximum being -0.001; indicating that a unit increase in the percentage of population lacking access to improved water source would lead to about 0.1 percent reduction in life expectancy in West Africa. This result underscores the importance of good and hygienic water for human survival.

Finally, lagged life expectancy shows positive and highly significant relationship with the current value. Between 0.76 percent and 0.95 percent increase in life expectancy resulted from a percentage rise in the previous value. The implication of this is that an improved life expectancy could lead to a better life span in the future.

Results of Diagnostic Tests

For difference and system GMM estimations, the probabilities of Wald Chi-square tests were highly significant. This implies joint significance of the variables employed in the study. The Hansen Chi-square Statistic, which tests for over-identifying restrictions, was insignificance, implying that the instruments used were valid and truly exogenous. The hypothesis of no autocorrelation was not rejected as evident in the values of the probabilities of both AR(1) and AR(2). The results are presented in *Appendix* C.

In addition to using life expectancy as a measure of human capital, primary school enrolment was also employed, with the results presented in **Table** 5.3. It is evident from the findings that although HIV/AIDS exerted negative pressure on primary school enrolment in West Africa, the influence was not statistically significant. All the estimations, using the four HIV/AIDS variables confirm this outcome.

Other variables, whose results are presented in *Appendices* C-5 to C-8 revealed that the lag value of enrolment possessed the expected positive sign, with its impact on current enrolment rate being significant. Percentage of population lacking access to improved water source related negatively with primary enrolment, with 50 percent of the various estimation outcomes being statistically significant. Malaria, life expectancy and dependency population produced mixed results. While some were rightly signed under some specifications, others were not. However, a good number of them remained statistically insignificant.

Regarding post estimation tests, the joint significance of the model (all the explanatory variables) was confirmed by the significance of the probabilities of Chi-squares of Wald tests while both the Hansen and the autocorrelation tests failed to reject the null hypothesis of valid instruments as well as no autocorrelation respectively.

Table 5.3. Impact of HIV/AIDS on Human Capital

Dependent Variable = Primary School Enrolment Rate

Regressors	FD	DIFF-GMM	SYS- GMM
HIVI	0.555 (0.961)	-5.057 (0.248)	-4.892 (0.606)
HIVPR	2.251 (0.396)	-1.112 (0.274)	-0.669 (0.680)
HIVP	0.413 (0.415)	-0.435 (0.105)	-0.057 (0.882)
AIDSD	5.179 (0.255)	-2.200 (0.585)	-0.023 (0.996)

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.

Source: Author's Computation.

The use of human capital index, an index containing both health and education indices did not produce substantially different results from what was reported when school enrolment was employed. Although most of the coefficients were negative, only AIDS deaths have marginally significant impact on human capital index, given results of difference and system GMM estimators as shown in **Table** 5.4 above. Apparently, the insiginificance influence of the disease on education index must have influenced the outcome of the analyses.

For the remaining variables, previous value of human capital index produced mixed outcomes. While some were positive and significant, others remained negative and either significant or insignificant. A peep into *Appendices* C-9 to C-12 shows that lagged human capital index under system GMM remained positive all through, with 3, out of the 4 coefficients being significant. Malaria also returned mixed signs. However, difference and system estimation produced negative and statistically significant relationship between the disease and human capital index.

With respect to post estimation, results obtained were consistent with the previous ones reported above.

In conclusion, the overwhelming evidence suggests that HIV/AIDS has negative impact on human capital. However, the effect appears more pronounced and statistically significant with life expectancy (a measure of human capital) irrespective of the HIV/AIDS measures employed. The influence of the pandemic on primary school enrolment was negative but insignificant. With respect to human capital index, while most of the coefficients were negative, only AIDS deaths produced marginally significant impact while others remained insignificant. The conclusion drawn from this is that, in West Africa, HIV/AIDS appears to reduce life exctancy, a health capital measure than education capital.

Table 5.4. Impact of HIV/AIDS on Human Capital

Dependent Variable = Human Capital Index

Regressors	FD	DIFF-GMM	SYS- GMM
HIVI	0.131 (0.734)	0.136 (0.126)	-0.027 (0.733)
HIVPR	-0.034 (0.708)	-0.051 (0.366)	-0.002 (0.899)
HIVP	0.0002 (0.991)	-0.006 (0.817)	-0.003 (0.353)
AIDSD	-0.038 (0.800)	-0.058* (0.085)	-0.076* (0.082)

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.

Source: Author's Computation.

Impact of HIV/AIDS on Economic Growth in West Africa

Two forms of findings are reported in this section. Firstly, the shock of the disease on economic growth was established directly through the inclusion of HIV/AIDS measure as one of the explanatory variables in the growth model. This is basically to capture the epidemiological environment that affects economic growth. On the other hand, the second scenario saw HIV/AIDS impact on growth determined through its effects on human capital, using interactive variable methodology. While **Tables** 5.5 and 5.6 presents summary results of the first scenario, with the full findings display in *Appendices* C-13 to C-20, **Tables** 5.7 to 5.9 present summary findings of the second scenario and the full results shown in *Appendices* C-21 to C-32. Furthermore, results presented in **Table** 5.5 incorporated life expectancy and primary enrolment, representing human capital measures among the explanatory variables while the findings shown in **Table** 5.6 included only human capital index (a form of human capital measure) as one of the independent variables.

Evidence that emerged from the findings is that, the disease imparted negatively on growth in West Africa when its measure appears as one of the explanatory variables, particularly with system GMM estimation. This is obvious in **Table** 5.5. Incidence of the pandemic produced negative coefficients all through. However, only the result produced by the system GMM estimation was statistically significant. Showing that a unit increase in HIV incidence led to a 7.65 units decline in economic growth in the sub-region during the period under consideration. Similarly, prevalence of the pandemic going by the system GMM analysis reduced growth significantly by 1.00 unit. The number of persons living with the virus in West Africa had a marginally significant negative impact on growth when system GMM was employed as estimator. With respect to AIDS deaths, the negative impact was not significant. In conclusion, asides the results produced through the use of system GMM, all others results were insignificant coefficients.

Outcomes of the analyses involving other control variables appear in *Appendices* C-13 to C-16. They revealed negative influence of lagged per capita GDP growth on its current value. However, only the coefficents returned by the first difference estimation were statistically significant, others were not. The relationship between fixed capital and economic growth remained positive and highly significant across all specifications. Averagely, between 0.03 and 0.07 percentage points increases in growth emerged from a percentage rise in fixed/physical capital. The positive and significant impact of fixed capital on economic growth produced by all specifications suggest that fixed capital formation is very important for growth in the sub-region of West Africa.

Primary enrolment associates positively and significantly with economic growth in the sub-region across nearly (92 percent of) all specifications. However, only 36 percent of these coefficients were statistically significant at 5 percent significance level; the remaining were marginally significant at 10 percent level of significance. Trade openness also relates positively with the level of growth in the sub-region, with 67 percent of the 12 coefficents being statistically significant. About 0.11 unit increase in growth occurred from a unit rise in trade openness. The influence of dependent population on growth in West Africa remains negative but only 2 out of the 12 coefficients were significant.

Post Estimation Test Results

The Wald Chi-square tests for all the estimations were highly significant; indicating joint significance of the entire model. In the same vein, Hansen Chi-square Statistic was insignificant, implying that the instruments used in the analysis were valid. Moreover, autocorrelation test failed to reject the null hypothesis of no autocorrelation, which is evident by the values of the probabilities of both AR(1) and AR(2). As expected, while the AR(1) result was significant, that of AR(2) produced an insignificant result.

Table 5.5. Direct Impact of HIV/AIDS on Economic Growth (Using Life Expectancy and Enrolment Rate as part of the explanatory variables)

Dependent Variable = Growth Rate of Per Capita GDP (Purchasing Power Parity)

Regressors	FD	DIFF-GMM	SYS- GMM
HIVI	-10.713 (0.299)	-4.24 (0.500)	-7.645*** (0.006)
HIVPR	0.491 (0.839)	-0.026 (0.985)	-1.004** (0.033)
HIVP	0.156 (0.734)	0.083 (0.734)	-0.168* (0.061)
AIDSD	3.937 (0.335)	1.302 (0.648)	-1.38 (0.179)

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.

Source: Author's Computation

Evidences displayed in **Table** 5. 6 show clearly that using human capital index as one of the explanatory variables in the growth model did not alter the results substantially, particularly as it relates to the sign of coefficients. The only slight difference was observed in the magnitude of the coefficients and statistical significance. The coefficients of HIV/AIDS variables in models that employed life expectancy and enrolment variables were slightly higher than those in models which used human capital index. One similarity observed in the two scenarios was the statistical significance of only 3 coefficients in each of the former and latter cases. The coefficents were those of incidence, prevalence and PLWHA, which all emerged from system GMM analysis.

Results of the other explanatory variables appeared in *Appendices* C-17 to C-20. From the analyses, coefficients of lagged per capita income growth as produced by first difference estimator were significant and negatively signed. Others had positive and insignificant influence on the current level of per capita GDP. The contribution of fixed capital to the growth of the economies of the sub-region remained overwhelmingly positive and highly significant. Labour force growth generated a positive and insignificant influence on economic growth. Human capital index was rightly signed, showing direct relationship between its value and per capita income growth, with results obtained from FD, DIFF-GMM and SYS-GMM being highly significant. In the same vein, trade openness related positively with growth rate of per capita income, with 67 percent of the coefficients being statistically significant. Dependent population has negative influence on the level of growth of the economies of the region. This notwithstanding, only 42 percent of the coefficients were significant.

Post estimation results obtained were not different from those reported under previous results. The Wald Chi-square and F-statistics for all the estimations were highly significant; Hansen Chi-square Statistic was insignificant, while the AR tests did not reject the null hypothesis of no autocorrelation.

Table 5.6. Direct Impact of HIV/AIDS on Economic Growth (Using Human Capital Index as one of the Explanatory Variables)

Dependent Variable = Growth Rate of Per Capita GDP (Purchasing Power Parity)

Regressors	FD	DIFF-GMM	SYS- GMM
HIVI	-10.47 (0.304)	-4.224 (0.400)	-6.507** (0.012)
HIVPR	0.493 (0.833)	-1.109 (0.791)	-0.850** (0.033)
HIVP	0.133 (0.763)	-0.438 (0.565)	-0.140** (0.048)
AIDSD	3.606 (0.343)	-5.243 (0.457)	-1.269 (0.124)

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.

Source: Author's Computation.

Impact of HIV/AIDS on Economic Growth through Human Capital

Besides the results presented above, the study further tried to determine how the disease affects growth through its impact on human capital. Three human capital variables were interacted with the four HIV/AIDS variables. The human capital measures were: life expectancy at birth, primary school enrolment rate and human capital index. The results are presented in **Tables** 5.7 to 5.9 below. While **Table** 5.7 contains findings on the influence of the disease on economic growth through its influence on life expectancy, **Tables** 5.8 and 5.9 show findings of how the pandemic affects economic growth through enrolment and human capital index respectively.

The effect of HIV/AIDS on growth through its impact on life expectancy overwhelmingly remained negative. Nevertheless, only the findings produced by system GMM were significant, as can be seen in **Table** 5.7 above. About 0.15 unit statistically significant decline in per capita income growth resulted from a unit increase in the interaction of life expectancy with HIV incidence. This value however reduced to approximately 0.02 unit when HIV prevalence was interacted with life expectancy. Furthermore, when number of persons living with the disease was introduced, the coefficient fell to about 0.004. Finally, about 0.03 unit marginally significant decline in growth was recorded due to a unit rise in AIDS-related deaths, in West Africa.

Concerning the control variables in the models, their results are presented in *Appendices* C-21 to C-24. Physical/fixed capital continued to maintain positive and significant relationship with the level of growth in West Africa irrespective of the technique of estimation employed. Approximately, between 0.02 percent and 0.07 percent upsurges in per capita income growth arose from a percentage rise in fixed capital. It is however observed that the coefficents returned by the system GMM estimation are the leasts compared with that of first difference and difference GMM.

Enrolment also retained positive influence on per capita income growth, with about 58 percent of the coefficients remaining statistically significant. Nonetheless, only 17 percent of these coefficents were significant at 5 percent level of significance. Others were marginally significant. Impact of trade openness on growth remained positive and about 67 percent significant. Approximately 0.11 unit significant rise in economic growth arose from a unit increase in trade openness. Dependence population generally exerted negative pressure on growth as conspicuous in the tables. Nonetheless, only 2 out of the 12 coefficients were statistically significant.

On the subject of post estimation tests, as manifested in the F-Statistics, Wald Chi-Square Statistics, Hansen, and AR (1 and 2), their outcomes were consistent with the previous ones reported. The models were jointly significant, instruments used remained truly exogenous and there was no autocorrelation.

Table 5. 7. The Impact of HIV/AIDS on Economic Growth Through Life Expectancy

Dependent Variable = Growth Rate of Per Capita GDP (Purchasing Power Parity)

Regressors	FD	DIFF-GMM	SYS- GMM
HIVI*LEP	-0.197 (0.322)	-0.076 (0.528)	-0.145*** (0.006)
HIVPR*LEP	0.006 (0.897)	-0.003 (0.880)	-0.021** (0.012)
HIVP*LEP	0.002 (0.810)	-0.023 (0.352)	-0.004** (0.021)
AIDSD*LEP	0.055 (0.473)	-0.204 (0.363)	-0.030* (0.084)

Note: ***, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.

Source: Author's Computation.

Table 5.8 contains outcome of analysis involving the interaction of HIV/AIDS variables with primary school enrolment. Apparently, the results differ significantly from what was reported when life expectancy was employed. As observed from the table, even though, most of the coefficients remained negative, only one was highly significant while one showed marginal significance. The import of this is that, in West Africa, HIV/AIDS affects economic growth negatively and substantially through its influence on life expectancy, a measure human capital in the area of health rather than through life expectancy, which measures human capital in the aspect of education.

Regarding other variables whose results are reported in *Appendices* C-25 to C-28, fixed capital, labour force growth and trade openness exert positive impacts on per capita income growth, with more coefficients of fixed capital being statistically significant than the other two variables.

Post estimation results obtained were not different from those reported earlier. The Wald Chi-square and F-statistics for all the estimations were highly significant; Hansen Chi-square Statistic was insignificant, while the AR tests failed to reject the null hypothesis of no autocorrelation.

Table 5.8. The Impact of HIV/AIDS on Economic Growth through Primary School Enrolment

Dependent Variable = Growth Rate of Per Capita GDP (Purchasing Power Parity)

Regressors	FD	DIFF-GMM	SYS- GMM
HIVI*ENR	-0.033 (0.777)	-0.075 (0.739)	-0.046 (0.167)
HIVPR*ENR	0.017 (0.381)	-0.01 (0.730)	-0.006 (0.274)
HIVP*ENR	0.003 (0.359)	-0.0001 (0.980)	-0.004** (0.029)
AIDSD*ENR	0.044 (0.254)	-0.01 (0.880)	-0.058* (0.084)

Note: ***, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.

Source: Author's Computation.

The final variable interacted with HIV/AIDS variables was human capital index. Obviously, the information contained in **Table** 5.9 below reaffirmed the negative influence of HIV/AIDS on growth, through its impact on human capital index, with 4 (results of system GMM) out of the 12 coefficients being highly significant.

In addition, from *Appendices* C-29 to C-32, the coefficients of fixed capital, labour force growth and trade openness retained their positive signs, which is consistent with *a priori* expectation. Moreover, appreciable number of the coefficients were statistically significant, particularly those of fixed capital. Dependent population maintained its negative influence on growth, with few of the coefficients being significant. Results of post estimation tests are consistent with the earlier ones reported.

Table 5.9. The Impact of HIV/AIDS on Economic Growth through Human Capital Index

Dependent Variable = Growth Rate of Per Capita GDP (Purchasing Power Parity)

Regressors	FD	DIFF-GMM	SYS- GMM
HIVI*HCI	0.825 (0.963)	-7.924 (0.959)	-12.616*** (0.002)
HIVPR*HCI	0.313 (0.940)	-2.97 (0.802)	-2.145*** (0.009)
HIVP*HCI	0.232 (0.757)	-1.043 (0.632)	-0.326** (0.020)
AIDSD*HCI	4.758 (0.556)	-11.718 (0.542)	-3.569** (0.044)

Note: ***, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.

Source: Author's Computation.

Summary Results of Difference and System GMM Estimations

Due to the advantages of difference and system GMM estimation techniques over first difference estimator with respect to their efficiency, summary results of analyses involving both techniques in the determination of how HIV/AIDS affects human capital and economic growth are presented in **Tables** 5.10 to 5.12 below.

It is clear from **Tables** 5.10 that the negative and significant impact of HIV/AIDS in West Africa occurs on life expectancy than enrolment and human capital index. This is a clear indication that HIV/AIDS significantly depresses human capital in the area of health rather than human capital in the area of education.

Table 5.10. Impact of HIV/AIDS on Human Capital- Summary Results of Difference and System GMM Estimations

	Log of Life Expectancy		Enrolment		Human Capital Index	
Regressors	DIFF-GMM	SYS- GMM	DIFF-GMM	SYS- GMM	DIFF-GMM	SYS- GMM
HIVI	-0.007***	-0.019**	-5.057	-4.892	0.136	-0.027
	(0.000)	(0.025)	(0.248)	(0.606)	(0.126)	(0.733)
HIVPR	-0.006***	-0.005***	-1.112	-0.669	-0.05	-0.002
	(0.004)	(0.029)	(0.274)	(0.680)	(0.366)	(0.899)
HIVP	-0.001**	-0.0002	-0.435	-0.057	-0.006	-0.003
	(0.030)	(0.684)	(0.105)	(0.882)	(0.817)	(0.353)
AIDSD	-0.016**	-0.013*	-2.200	-0.023	-0.058	-0.076*
	(0.012)	(0.088)	(0.585)	(0.996)	(0.085)	(0.082)

Note: ***, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.

Source: Author's Computation.

Results presented in **Tables** 5.11 and 5.12 showed clearly that the impact of the disease on growth is pronounced through its effect on life expectancy rather than its effects on other human capital measures. Secondly, most of the significant results are associated with system GMM, which underscores the efficiency of the estimator in dynamic panel data modeling and analysis.

Table 5.11. Impact of HIV/AIDS on Economic Growth- Summary Results of Difference and System GMM Estimations

	Per Capita GDP Growth with Log of Life Expectancy and Enrolment Variables		Per Capita GDP Growth with Human Capital Index	
Regressors	DIFF-GMM	SYS- GMM	DIFF-GMM	SYS- GMM
HIVI	-4.24	-7.645***	-4.224	-6.507**
	(0.500)	(0.006)	(0.400)	(0.012)
HIVPR	-0.026	1.004**	-1.109	-0.850**
	(0.985)	(0.033)	(0.791)	(0.033)
HIVP	0.083	-0.168*	-0.438	-0.140**
	(0.734)	(0.061)	(0.565)	(0.048)
AIDSD	1.302	-1.38	-5.243	-1.269
	(0.648)	(0.179)	(0.457)	(0.124)

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively.

Source: Author's Computation.

Table 5.12. Impact of HIV/AIDS on Economic Growth- Summary Results of Difference and System GMM Estimations

Dependent Variable = Per Capita GDP Growth

	Through Life Expectancy		Through Enrolment		Through Human Capital Index	
Regressors	DIFF-GMM	SYS-GMM	DIFF-GMM	SYS-GMM	DIFF-GMM	SYS-GMM
HIVI	-0.076	-0.145***	-0.075	-0.046	-7.924	-12.616***
	(0.528)	(0.006)	(0.739)	(0.167)	(0.959)	(0.002)
HIVPR	-0.003	-0.021**	-0.01	-0.006	-2.97	-2.145***
	(0.880)	(0.012)	(0.730)	(0.274)	(0.802)	(0.009)
HIVP	-0.023	-0.004**	-0.0001	-0.004**	-1.043	-0.326**
	(0.352)	(0.021)	(0.980)	(0.029)	(0.632)	(0.020)
AIDSD	-0.204	-0.030*	-0.01	-0.058*	-11.718	-3.569**
	(0.363)	(0.084)	(0.880)	(0.084)	(0.542)	(0.044)

Note: ***, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.

Source: Author's Computation.

5.2 DISCUSSION OF RESULTS

This section discusses results of various analyses performed in the thesis. The discussions are based strictly on the outcomes of difference GMM and system GMM estimations. The motivation for these centres on the superiority of both estimation techniques to the other four employed in the present study. Difference and System GMM estimators are capable of solving endogeneity problem thereby producing unbiased and more efficient estimates. However, system GMM is capable of generating more and better efficient results than difference GMM, even though both appear to produce efficient outcomes. The reason for this is found in the type of instruments employed by the estimators. While difference GMM uses lagged values as instruments, system GMM employs both lagged and level variables. These contribute to improved efficiency of the estimates produced by the system GMM technique of estimation.

5.2.1 HIV/AIDS and Human Capital Development in West Africa

The results presented in **Tables** 5.2 to 5.4 basically tackled the first objective of this study, which investigates how HIV/AIDS affects human capital development in West Africa. Generally, the findings suggest that the disease significantly reduces human capital development in the sub-region. However, the magnitude and the level of statistical significance depend not only on estimation technique and HIV/AIDS measures used but also on the measure of human capital employed. About 0.70 percent and 1.90 percent significant reductions in life expectancy were occasioned by a percentage increase in the level of HIV incidence in the region, going by the outcomes of difference and system GMM estimations respectively. Similarly, between 0.50 and 0.60 percentage points significant declines occurred in life expectancy, using HIV prevalence. Additionally, number of PLWHA in West Africa depressed life expectancy significantly by 0.10 percent while AIDS deaths reduced it significantly by 1.30 percent going by outcome of difference GMM. The result returned by system GMM was 1.60 percent significant decline at 10 percent level of signifcance. This outcome is consistent with the *a priori* expectation and available evidence in the literature.

Even though not many studies have looked at the human capital implication of HIV/AIDS at macro level, the few available ones have reported negative impact of the pandemic on human capital. Prominent among such studies include: McDonald and Roberts (2006), Bhargava and Docquier (2008), Gardner and Lee (2010); Fortson (2011), and Ferreira, Pessoa and Dos Santos (2011).

McDonald and Roberts (2006) employed short-falls in life expectancy and infant mortality as human capital measures. They however, reported results containing infant mortality. Their study focused on the entire world, then developing countries, OECD, Asia, Africa, and Latin America and Caribbean; with the findings showing substantial positive effect of HIV/AIDS prevalence on infant mortality, particularly in Africa. According to this study, around 0.024 percent, 0.019 percent, 0.024 percent and 0.112 percent increases in infant mortality occurred as a result of a percentage rise in HIV prevalence for the world, developing countries, Africa, and Latin America and Caribbean respectively. Few of the reservations about their findings include: the use of only HIV prevalence data, which cover those in age bracket 15-49 whereas, the human capital proxy used focuses exclusively on infants (which was acknowledged by the authors who suggest that infant mortality variable is more closely related to HIV prevalence among women than the general population). The result obtained for Latin America and Caribbean for which significant 0.112 percent decline in human capital was returned further cast doubt on the applicability of infant mortality for their study. The result appears unrealistic for region having less than 1 percent prevalence compare to the 0.024 percentage reduction reported for Africa, which has the highest prevalence of above 5 percent. In addition, the data point used ended in 1999, which in no doubt has left out the current state of the disease in the study areas.

Gardner and Lee (2010) also used short-fall in life expectancy as human capital measure in their study, which was based on static panel data modeling approach. The authors found that HIV/AIDS prevalence reduced human capital formation significantly in 38 countries of Asia, Eastern Europe and Latin America. Their study documented a 0.20 percent decline in human capital as a result of a percentage increase in HIV prevalence. The static panel estimation approach employed by these authors could have influenced the result, since the use of fixed effect estimator could not solve the problem associated with correlated specific effects (which is peculiar with heterogeneity among the cross sectional units). The authors claimed that the Breusch-Pagan test was conducted and it was discovered that the error terms in the two equations used were correlated, and this informed the choice of fixed-effects estimator. However, the authors failed let us know why they settled for the fixed effects rather than the random effects estimator.

Bhargava and Docquier (2008) also found that HIV prevalence has increased the number of medical personnel migrating from SSA to OECD countries. Their study documents approximately 0.079 percent, 0.082 percent, 0.071 percent and 0.107 percent surge in brain drain due to a percentage increase in HIV prevalence in the results of four different specifications analyzed. Although their study did not focus specifically on human capital but the fact that it looked at the loss of medical personnel to advanced countries due to the scourge of the HIV/AIDS disease could make this study classified under human capital impact of the pandemic.

Furthermore, the use of primary school enrolment as a measure of human capital produced negative influence on the epidemic; nonetheless, the coefficients were not statistically significant as shown in **Table** 5.3. This is not unconnected with the lower burden of HIV/AIDS (manifested in incidence, prevalence and number of morbidity and mortality associated with the disease) relative to what obtains in Southern and East African countries. The import of this is that HIV/AIDS is capable of reducing school enrolment; however, it does not pose much threat to enrolment in schools in the West African sub-region, particularly at primary school level, as the case with Southern and East African countries hardest hit by the menace of the disease.

The above contrasts with results obtained elsewhere, especially as it relates to statistical significance. For instance, Fortson (2011) reported a larger decline in school enrolment and completion in fifteen SSA countries in areas with higher levels of HIV than areas with low rate of the disease. Similarly, Ferreira, Pessoa and Dos Santos (2011) found a 40 percent significant reduction in schooling for five Southern African countries, namely: Botswana, Zimbabwe, Lesotho, Swaziland and South Africa. This is higher than the maximum and insignificant reduction of about 5.06, 2.25, 0.057 and 5.18 in enrolment caused by HIV incidence, prevalence, PLWHA and AIDS-related deaths respectively in the present study. This notwithstanding, the 40 percent reduction in schooling reported by the authors, should be understood in the light of the burden of the disease in the Southern African sub-region, which has the highest prevalence globally. In actual fact, as at 2009, HIV prevalence among PAG according to UNAIDS (2010) stood at 24.8 percent, 23.6 percent, 17.8 percent, 25.9 percent and 14.3 percent in Botswana, Lesotho, South Africa, Swaziland and Zimbabwe respectively. These findings further confirm that in spite of the UNAIDS (2010, 2011, and 2013a) and WHO, UNAIDS and UNICEF (2011) reports suggesting that the disease has stabilized and begun to reverse, its effect on human capital development is still negative and substantial, even in West Africa.

The findings of the present thesis as they relate to the relationship between the disease and enrolment notwithstanding, there is the need to put in place measures to prevent significant negative impact of the pandemic on education outcomes, since all the coefficients reported remained negative.

Finally, the findings using human capital index presented in **Table** 5.4 did not alter substantially the outcome when human capital in the area of education was used, except that marginal significant declines were found to have occurred on human capital index due to AIDS deaths.

From the foregoing, it is evident that the HIV/AIDS disease overwhelmingly reduced life expectancy significantly (human capital in the area of health) compare to its influence on school enrolment (a form of human capital in the area of education). This suggests that the trend witnessed in some Southern and East African countries with respect to the burden of the disease on human capital activities is beginning to emerge in West Africa; although, not in the same magnitude as in those countries.

Additionally, in comparison with findings of some of the studies cited earlier, it can be concluded that the influence of the disease on life expectancy (human capital in the area of health) in particular is not infinitesimal in West Africa. Therefore, the disease could spring a surprise in this part of the world; especially with the current discovery of a new and aggressive HIV strain in Guinea-Bissau, which has the capacity to develop and progress faster and rapidly into a full-blown AIDS within five years than the parent strains (see Palm *et al*, 2014). This then suggests that HIV/AIDS appears as a threat to human capital development activities in West Africa in the area of health, which portend a serious danger for the sub-region already battling with the problem of low rate of human capital formation.

Coefficients of control variables showed lagged life expectancy having positive and highly significant association with its current value; indicating that previous average life expectancy has fundamental role to play on current level of human capital. This is further proof that life expectancy variable is very relevant for human capital formation in West Africa. Any improvement in this variable will not only enhance individuals' contributions to economic prosperity but also to life-time earnings within the economy, which eventually could boost further human capital development activities. Therefore, any policy aimed at improving life expectancy in the sub-region should be encouraged knowing fully well that this has the tendency to enhance the level of human capital development.

Primary enrolment in general had positive impact on life expectancy in the region; meaning that education could boost life span due to ssociated chains of benefits in the area of health, earnings, social status, and so on. However, in the present study, not all the coefficients were statistically significant, and those which did, have very low magnitudes. These findings were not unexpected. West Africa is one of the regions with low literary rate in the world. As a matter of fact, the sub-region appears to rank lowest globally compared to other regions in developing and developed economies.

Statistics provided by the CIA World Factbook (2013a) on literacy rates across the globe show virtually all West African countries at the lowest ebb. For instance, Burkina Faso ranked last, having 21.8 percent. Other countries in the region, such as Niger, Mali, Sierra Leone, Senegal, Guinea, Benin, The Gambia, Guinea Bissau, Cote d'Ivoire, Mauritania, Liberia, Togo, Nigeria, Ghana and Cape Verde, all have their literacy rates in 2012 put at 28.7 percent, 31.1 percent, 31.1 percent, 35.1 percent, 39.3 percent, 41 percent, 42.4 percent, 50 percent, 54.2 percent, 56.2 percent, 58 percent, 60.8 percent, 60.9 percent, 61.3 percent, 67.3 percent and 84.3 percent respectively. Only Cape Verde among the sixteen West African countries attained 84.3 percent literacy rate while none of the remaining fifteen countries has been able to reach 68 percent. Countries in other regions of the world, such as Finland, Greenland and Luxembourg attained 100 percent literacy rate while about 158 other countries including some African countries like Angola, Rwanda, Egypt, Tunisia, Malawi, Cameroon, Botswana, South Africa, Kenya, etc recorded between 70 percent and 99.99 percent literacy rates. Even Lesotho and Zimbabwe, which are in Southern Africa (the sub-region with the highest burden of HIV/AIDS globally), had 89.6 percent and 90.7 percent literacy respectively.

Access to potable water has been one of the major problems in some West African countries. From the findings in the present study, coefficients of the population without access to improved water source were negatively significant in nearly all analyses involving difference and system GMM estimation techniques. This is an indication that life expectancy may be reduced as a result of water borne diseases.

Per capita GDP associated positively with human capital. Nonetheless, the magnitude of the coefficient remained very low, implying that not much of income growth affects level of human capital development in the sub-region. In fact, majority of the specifications showed insignificant coefficients. The majority of West African countries invest little on policies and programmes that improve human capital activities. The percentage of budget devoted to funding education has been very low in the sub-region. Most West African universities are not found among the top universities in the world.

Modern health facilities are lacking while the few available ones which are obsolete are outweighed by bloated population in West Africa. Most common diseases are treated abroad and those who cannot afford this are left to their fate. Out of pocket health expenditures are common among the population, and because of low level of income coupled with high level of poverty, a good number of West African population cannot afford health care services. This is one of the reasons for very high mortality in the area.

5.2.2 HIV/AIDS and Economic Growth in West Africa

The overwhelming evidence suggests that HIV/AIDS has negative impact on the level of growth in West Africa. However, not all the coefficients were statistically significant enough to pose serious challenges to economic growth. As displayed in **Table** 5.11, which showed the results of estimation where HIV/AIDS variables were incorporated directly into the growth model; only outcome of system GMM estimations appeared statistically significant considering the coefficients of HIV incidence, prevalence and number of PLWHA in the sub-region while AIDS-related deaths did not pose any significant challenge to economic growth.

In addition, when the influence of the disease on per capita income growth was determined through human capital variables, none of the coefficients produced by difference GMM estimation was significant; only results of system GMM estimation were statistically significant, and this occurred in those models that contained life expectancy and human capital index. On economic growth through school enrolment, it was observed that only number of PLWHA affects growth significantly while AIDS deaths showed a marginally significant result.

A broad observation about the results is that the magnitude of the impact of HIV/AIDS was lower when its effect on growth was established through human capital than the case when its variable appears directly in the growth model. The only exception occurred with human capital index where the magnitudes of the coefficients were observed to be slightly higher than the previous ones. It is apparent from this that life expectancy index may have influenced this outcome, since the impact of education variables in the previous results has been overwhelmingly insignificant. In summary, HIV/AIDS appears to influence negatively the level of growth in West Africa. Nevertheless, the impact emerges more when life expectancy (human capital in the area of health) was introduced either into the direct model or interactive model.

The findings reported in the present thesis on the impact of the HIV/AIDS disease on economic growth in West Africa are consistent with outcomes of some previous studies carried out in other parts of Africa and beyond. Some of the cross-country studies which have established negative impact of the disease on economic growth include: Over (1992), Bonnel (2000), Haacker (2002), McDonald and Roberts (2006), Gardner and Lee (2010), and Ferreira, Pessoa and Dos Santos (2011). Bonnel (2000) attributed his findings to erosion of some crucial growth determinants such as social capital, domestic savings and human capital caused by HIV/AIDS while others saw the high prevalence of the disease as the factor responsible for its negative impact on economic growth.

Apart from the negative influence of HIV/AIDS predicted on growth, other studies also reported insignificant or marginally significant impact of the disease on economic growth elsewhere. In a study by Kirigia, Sambo, Okorosobo and Mwabu (2002) in the WHO Africa region, it was found that both HIV/AIDS morbidity and AIDS deaths produced insignificant effect on economic growth of Africa. Papageorgiou and Stoytcheva (2008) found a negative but marginally significant impact of HIV on cross-country income levels for a panel of 89 countries over a 15 year period, 1986-2000. Additionally, Bloom and Mahal (1997) in their study on 51 countries discovered that the income impact of HIV/AIDS was insignificant. Mahal (2004) and Werker, Ahuja and Wendell (2006) also found a no effect of the disease on economic growth. Some of these findings may not be unexpected since a few of the studies employed data points that covered the early stage of the disease. Moreover, the HIV/AIDS measure used as well as estimation technique could have influenced the findings as well.

In spite of the two strands of findings given above, it is interesting to note that other studies have found positive impact of the pandemic on per capita income. Two prominent among of such studies include: Young (2005) and Bureau for Economic Research (BER) (2006). Young (2005) who carried out a study on South Africa and reported among others that the AIDS-related deaths enhance future per capita consumption possibilities of "the South African economy" (Young, 2005: p. 423); BER (2006) also reported 0.28 to 0.43 percent higher real per capita GDP growth when compared to the period without AIDS. Although these results may not be unconnected with the prevalence variable employed, the study area, period covered and technique of estimations adopted, population decline caused by AIDS-related deaths has also been explained as one other factor contributing to direct relationship between HIV/AIDS and level of income per capita. Also, most of African labour force are engaged in the informal sector, majority of, whose activities are not captured in the GDP.

With respect to other variables of the model, enrolment and fixed capital significantly increased economic growth in the West Africa. This suggests that the level of income in the sub-region can be improved through rigorous investment in education and physical capital. The only caveat observed regarding physical capital is that most West African countries import this resource from advanced economies, which may pose serious challenge for the sub-region. Exchange rates in the sub-region continued to dwindle, which implies that greater proportion of her income will no doubt be lost not only to the importation of capital equipment but also to their maintenance, since a good number of them are maintained by expatriates. The only solution could be found in effort to look inward and develop some of the imported equipment locally.

Trade openness generally enhanced growth in West Africa as shown by the results. However, most of the coefficients were statistically insignificant. The import of this is that trade policies canvassed for developing countries appear not to be yielding desirable results in West Africa. The reason for this may not be far to seek. A large number of the countries that constitute the sub-region are net exporters, and as such it looks as if trade has not achieved any significant progress in this part of the world. Another reason for this outcome could be explained by the dependency of countries that make up the sub-region on advanced societies not only for capital equipment but also for consumption commodities. As a matter of fact, all kinds of foreign goods are found in this part of the world, and the culture currently appeared to be geared towards consumption of foreign produced goods due to several reasons such as demonstration effect, better quality, etc. In addition, it can be said that unlike some Asian economies, the opening of trade in most African countries has not really benefited their economies as expected due to the unindustrialised state of these economies. Furthermore, prices of the primary products they export are very low compared to the capital and industrial commodities brought into the countries that constitute the sub-region.

Labour force influenced growth positively but insignificantly. This is a paradox or better put, an irony because labour in West Africa is abundant and cheap. This notwithstanding, greater proportion of the sub-region's labour force is not skilled and therefore engaged in the informal agriculture, other informal sectors as well as shadow economy, whose greater percentage of earnings are not captured in the GDP. Furthermore, Nigeria, which accounts for over 50 percent of the size of the entire sub-region, depends heavily on the oil sector, which is extremely capital-intensive and engaged very low proportion of the labour force.

It is insightful also to note that lagged per capita GDP returns negative sign in a good number of the estimations, meaning that an indirect relationship exists between economic growth and level of previous income per capita. The coefficients however, were not significant in most cases. This relationship may not be unconnected with the low level of income in this part of the world. Besides, greater percentage of the sub-region's income is spent on foreign produced commodities. In addition, it appears incomes of the majority of African countries are not geared towards growth related activities, rather on consumption goods, most of which are imported. Currently, most West African economies are flooded with all kinds of products from China. This has been one of the reasons their recurrent expenditure continues to outweigh their capital expenditure every year. Some studies have also reported negative and even significant relationship of previous per capita income on its current value. For instance, Knight, Loayza and Villanueva (1993) who tested the neoclassical theory of economic growth, using a panel data approach, discovered that lagged per capita income for all developed and developing countries affects per capita income negatively and significantly in their estimation. Similarly, Bond, Hoeffler and Temple (2001) reported a similar result in their work. Others who found negative and significant association of per capita GDP and lagged per capita income include: Mbaku and Kimenyi (1997) and Masanjala (2003). It is necessary to state that the results of these studies were based on the test of income convergence among nations of the world as predicted by the Solow model.

It is evident from the findings presented in the present study that the macroeconomic implication of HIV/AIDS in the area of human capital and economic growth is negative. This implies that the disease is capable of not only eroding human capital development but also has the capability of depressing growth in West Africa. However, the threat on human capital, especially in the aspect of health is dominant and significant while the negative impact on growth is engendered by the pressure of the disease on life expectancy. This outcome is not in the best interest of the sub-region, which depends largely on primary sector for survival and has majority of its labour force engaged in agriculture at the informal level. In addition, level of poverty in the sub-region remains very high while human capital development activities are still low compared to other regions of the world. Therefore, the negative impact of HIV/AIDS, a disease that weakens the immune system of its victims could further worsen human capital development in the sub-region, thereby depressing investment in physical capital as well as economic growth and development.

The conclusion that emerged from the overall findings of this thesis is that HIV/AIDS has negative impact on human capital and economic growth in West Africa. However, the threat on human capital is more pronounced on life expectancy than on other human capital measures employed in the study. In the same vein, the declining effect of the pandemic on economic growth appears to have been influenced by its effect on life expectancy, than other human capital variables. This suggests that policies aimed at combating the menace of the disease that improve life expectancy will in no doubt reduce its effect on human capital and economic growth in West Africa.

CHAPTER SIX

SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.1 Summary of Findings

The wide spread of HIV/AIDS disease in African countries since its cases were reported in the early 1980s has continued to be a subject of concern. The multifaceted nature of its effects on society calls for deliberate and concerted efforts to explore all possible areas of its impact on society. It is against this backdrop that the present thesis attempts to explore how the pandemic affects human capital development activities and economic growth in the West African sub-region. To accomplish this, four measures of HIV/AIDS were adopted. These include: incidence, prevalence, number of people living with the disease and AIDS deaths. The study covers the period 1990-2011, with focus on eleven countries-Benin Republic, Burkina Faso, Côte d'Ivoire, The Gambia, Ghana, Guinea, Guinea-Bissau, Mali, Nigeria, Sierra Leone and Togo.

In achieving the specific objectives of the study, two models were estimated (human capital and economic growth models), which were estimated using two dynamic panel estimation techiques- Difference Generalized Method of Moments (GMM), and System Generalized Method of Moments (GMM) estimators-in addition to First Difference (FD), a dynamic panel estimator and three static panel estimators, which were: pooled/OLS, Fixed Effects (FE), and Random Effects (RE). The findings from analyses involving First Difference (FD), Difference Generalized Method of Moments (GMM), and System Generalized Method of Moments (GMM) estimation techniques were reported while the outcome of the other three are presented in *Appendices* B and C. Furthermore, three human capital measures were also employed in the analyses; which were: life expectancy at birth, primary school enrolment rate and human capital index. The human capital index was developed by the author using life expectancy and education indices, following the methodology used by the United Nations Development

Programme (UNDP) for human development index (HDI). Finally, growth rate of per capita income was adopted as a measure for economic growth.

In summary, findings of the thesis revealed that HIV/AIDS in West Africa is beginning to have pronounced adverse effects on human capital development, regardless of the HIV/AIDS measures employed. However, a critical examination of evidences from the various analyses suggest that the negative and significant impact of the disease in the sub-region, is more pronounced on average life expectancy (human capital in the aspect of health) than any other human capital measures. This is consistent with findings of some studies such as Batini, Callen and McKibbin (2006), Haacker (2010), Anderson (2010) and UNDP (2013), which reported that HIV/AIDS has contributed not only to reduction in average life expectancy in most affected regions but has also widen the gap between what obtains in sub-Saharan Africa and the global average value. Apart from its influence on life expectancy, the result also confirmed negative effect of the disease on school enrolment; nevertheless, the impact was not significant. When human capital index was also employed, not many of the negative coefficients were.

With respect to how the disease affects economic growth, two forms of analyses were conducted. Firstly, influence of the disease on economic growth was determined directly by including HIV/AIDS variables as one of the regressors on one hand, and secondly by analyzing its impact on growth through human capital, using interactive variable methodology. Results of the first scenario showed negative effect of the disease on growth, with 3 out of the 4 coefficients of the outcome of system GMM estimation being statistically significant (one was marginally significant at 10 percent significance level) while none was significant for difference GMM. When human capital index was substituted for life expectancy and school enrolment, 3 coefficients from system GMM analysis were significant. Difference GMM results remained negative but insignificant.

Equally, when HIV/AIDS impact on growth was determined through human capital, it was found that coefficients from difference GMM estimation were negative all through; notwithstanding, all were statistically insignificant. With respect to the results generated from analyses involving system GMM, HIV incidence, prevalence and number of persons living with the disease reduced significantly the level of growth through life expectancy while AIDS-related deaths influenced growth negatively with marginal significance through life expectancy. On school enrolment, HIV/AIDS has negative impact; however, coefficients of all the variables except number of PLWHA were statistically insignificant. Even at that the coefficient of PLWHA was very low in magnitude while AIDS deaths returned very marginal significant negative coefficient.

Finally, the influence of the disease on economic growth through human capital index was negative and statistically significant, using system GMM estimator while difference GMM produced insignificant but negative coefficients.

Regarding diagnostic/post estimation tests, the Wald statistic was significant, which implies joint significance of the variables employed in the model. The Hansen Chi-square Statistic was insignificant, meaning that the instruments used in the analysis were valid and truly exogenous. The null hypothesis of no autocorrelation was not rejected based on the results of AR(1) and AR(2). While AR(1) was significant (as expected due to the presence of lagged dependent variable among the regressors), AR(2) was not statistically significant. The results are presented in *Appendix* C.

6.2 Conclusion

The conclusion drawn from the present study is that HIV/AIDS disease has contributed significantly to declining human capital development in West Africa, with the overwhelming evidence supporting greater negative impact on life expectancy. Thus, the disease threatens economic growth in West Africa through life expectancy.

6.3 Recommendations

The recommendation that emerged from the findings of the present study is that there is the need for effective control of the spread of HIV/AIDS epidemic in the West African countries. To do this, two critical policy areas of intervention are suggested, particularly as the disease is yet to get cure. These are in the aspects of treatment of infected persons and prevention of the disease from further spread.

Firstly, the study discovered a significant negative impact of HIV/AIDS on life expectancy (human capital measure relating to health). In order to lengthen the life span of the people already living with the disease and make them contribute meaningfully to economic prosperity of their nations and globally as well, efforts should be made to provide proper treatment for all infected persons in West Africa. This has not been achieved. According to UNAIDS (2013c), merely one out of every three HIV/AIDS infected persons, who need ART is covered globally while just 21 percent of infected persons in West and Central Africa got treatment as at 2012/2013. Additionally, in West and Central Africa, barely 23 percent of pregnant women who need antiretroviral treatment for the purpose of preventing MTCT of HIV were cared for (USAID, 2011a). Moreover, the need for infected persons to live healthy life style should be stressed.

In the area of prevention, which appears the best approach to combating this pandemic, it is apt as a matter of urgency to better spread information on the negative consequences of the disease through different media. Furthermore, since many infected persons in this part of the world are always afraid to declare their HIV/AIDS status, there could be collaboration with employers of labour, authorities of various educational institutions as well as religious leaders to educate people on the danger of the pandemic and the need to assess voluntary counseling and testing services. Additionally, information about the disease should be included as an important aspect of sex education in the various schools in the sub-region and make sure it is properly taught.

When these policies are implemented, the impact HIV/AIDS on economic growth will also decline.

6.4 Limitations and Suggestions for Further Research

The robust findings reported in this thesis notwithstanding, certain limitations are observed. For instance the methodology employed could have influenced the outcome of the study; therefore, a different methodology could be adopted to further look at the same objective or extend it to different sectors in West Africa. Endogenous growth or regional CGE models may be employed. Heterogeneous panel technique can also be adopted for similar study. In addition, an enhanced human capital measure may as well be developed to incorporate training for a better and comprehensive view of the influence of the disease on human capital. Finally, further study may take into consideration effect of intervention policies such as introduction of antiretroviral therapy for treating HIV/AIDS persons on macroeconomic outcomes.

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Appendix A

Derivation of the Solow Growth Model

This *Appendix* benefits from MRW (1992), and McDonald and Roberts (2006)

A type of Cobb Douglas production function is specified as

$$Y = K^{\alpha} (AL)^{1-\alpha} \tag{1}$$

Where:

Y= Output;

K = Physical Capital;

L= Labour; and

A = Knowledge or Technology.

Augmenting equation (1) with human capital variables *H* and *E*, and re-specifying it in panel data form gives

$$Y_{it} = K_{it}{}^{\alpha} E_{it}{}^{\beta} H_{it}{}^{\theta} \left(A_{it} L_{it}\right)^{1-\alpha-\beta-\theta} \tag{2}$$

Where *E* and *H* are education and health capital stocks respectively. α, β and θ are correspondingly the elasticities of output regarding physical capital, education capital and health capital. These values are constants and they are determined by available technology. The subscripts *i* and *t* represent country and time in that order. The Solow model assumes that saving and investment decisions are exogenous likewise factor accumulation and technological growths are exogenous. In this model time affects output only through *K*, *L* and *A*. Technology is labour-augmenting, implying *AL* as effective labour. Land and natural resources are not considered among factors of production.

The model also assumes constant returns to scale in its argument. On the basis of this, if equation (2) is multiplied by a scalar, ϕ, the effect on output will remain the same. Put in another way, α + β + θ = 1. This assumption therefore can be demonstrated as

$$Y_{it} = \{\phi A_{it} L_{it}\}^{1-\alpha-\beta} \{\phi K_{it}\}^{\alpha} \{\phi E_{it}\}^{\beta} \{\phi H_{it}\}^{\theta} \tag{3}$$

From equation (3),

$$Y_{it} = \phi^{1-\alpha-\beta-\theta} \{A_{it} L_{it}\}^{1-\alpha-\beta-\theta} \phi^{\alpha} \{K_{it}\}^{\alpha} \phi^{\beta} \{E_{it}\}^{\beta} \phi^{\theta} \{H_{it}\}^{\theta}$$

This implies

$$Y_{it} = \phi[\{A_{it}L_{it}\}^{1-\alpha-\beta-\theta}\{K_{it}\}^{\alpha}\{E_{it}\}^{\beta}\{H_{it}\}^{\theta}] \tag{4}$$

Setting $\phi = 1/A_{it}L_{it}$ gives the intensive form of equation (4), and therefore,

$$Y_{it} = \frac{1}{A_{it}L_{it}}[\{A_{it}L_{it}\}^{1-\alpha-\beta-\theta}\{K_{it}\}^{\alpha}\{E_{it}\}^{\beta}\{H_{it}\}^{\theta}] \tag{5}$$

Where $(A_{it}L_{it})$ is defined as the effective labour unit in country *i* at time *t*

This is equivalent to

$$Y_{it} = \left(\frac{A_{it}L_{it}}{A_{it}L_{it}}\right)^{1-\alpha-\beta}\left(\frac{K_{it}}{A_{it}L_{it}}\right)^{\alpha}\left(\frac{E_{it}}{A_{it}L_{it}}\right)^{\beta}\left(\frac{H_{it}}{A_{it}L_{it}}\right)^{\theta} \tag{6}$$

Equation (6) now becomes

$$y_{it} = k_{it}^{\alpha}e_{it}^{\beta}h_{it}^{\theta} \tag{7}$$

Equation (7) is the intensive form of equation (2).

Where:

k_{it} = physical capital per unit of effective labour in country *i* at time *t*.

e_{it} = education capital per unit of effective labour in country *i* at time *t*.

h_{it} = health capital per unit of effective labour in country *i* at time *t*.

Considering evolution of labour force, technologies, physical capital and health capital, if labour force grows at country specific constant rate of n_i technological advancement at period specific constant rate of φ_t and physical capital stock with health capital stock depreciating at the same constant rate of δ, then the variables shall evolve as:

$\dot{L}$ (t) = n $L(t)$, which implies that $\dot{L}(t)/L(t) = n$

The above is the rate of change of the log of L given as:

$$\frac{d\ln L(t)}{dt} = (t)\frac{d\ln L}{dL(t)}\frac{dL(t)}{dt} = n \tag{8}$$

In the same vein, the growth of technology is given as: $\dot{A}(t) = \varphi A(t)$ which implies $\dot{A}(t)/L(t) = \varphi$ and this is $\frac{d\ln A(t)}{dt} = \frac{d\ln A(t)}{dA(t)}\frac{dA(t)}{dt} = \varphi$ (9)

The constant depreciation rate, δ of physical, education and health capital stocks can be shown as:

$$K_{it} = \left(I_{it-1}\right)_K + (1-\delta)K_{it-1} \tag{10}$$

$$E_{it} = \left(I_{it-1}\right)_E + (1-\delta)E_{it-1} \tag{11}$$

$$H_{it} = \left(I_{it-1}\right)_H + (1-\delta)H_{it-1} \tag{12}$$

Equations (10) to (12) indicate that the three capital stocks are subject to depreciation. Therefore, investment must be undertaken in the three inputs to keep them intact at least or cause them to grow. That is, investment expenditure must be distributed among the three. Since investment and savings are equal (amount saved is invested) based on the neo-classical assumption, then savings in the economy could be specified as:

$$s_{it} = \left(s_{it}\right)_K + \left(s_{it}\right)_E + \left(s_{it}\right)_H \tag{13}$$

The proportion of income devoted to investment (s_{it}) by country i at time t distributed among the three capital stocks will be given as:

$$I_{it}/Y_{it} = \left[\left(I_{it}\right)_K + \left(I_{it}\right)_E + \left(I_{it}\right)_H\right]/Y_{it} \tag{14}$$

The growth rates of the three capital stocks per unit of effective labour can now be specified as:

$$\dot{\hat{k}}_{it} = \left(s_{it}\right)_K \hat{y}_{it} - \left(n_i + \varphi_t + \delta\right)\hat{k}_{it} \tag{15}$$

$$\dot{\hat{e}}_{it} = \left(s_{it}\right)_E \hat{y}_{it} - \left(n_i + \varphi_t + \delta\right)\hat{e}_{it} \tag{16}$$

$$\dot{\hat{h}}_{it} = \left(s_{it}\right)_H \hat{y}_{it} - \left(n_i + \varphi_t + \delta\right)\hat{h}_{it} \tag{17}$$

In other words, equations (15), (16) and (17) give the dynamic equations for physical capital per unit of effective labour, education capital per unit of effective labour and health capital per unit of effective labour respectively. Where $(s_{it})_K$ is the proportion of income invested in physical capital by county i at time t, $(s_{it})_E$, the proportion of income invested in education capital by county i at time $_t$ $(s_{it})_H$ the proportion of income invested in health capital by county i at time $_t$ and δ is the common depreciation rate.

To determine the steady state of physical capital stock per unit of effective labour, education capital stock per unit of effective labour and health capital stock per unit of effective labour, equations (15), (16) and (17) respectively can be set equal to zero to have:

$$k^* = \left\{ \frac{(s_i)_K^{1/1-\beta-\theta} (s_i)_E^{\beta} (s_i)_H^{\theta}}{n_i + \varphi_t + \delta} \right\}^{1/1-\alpha-\beta-\theta} \tag{18}$$

$$e^* = \left\{ \frac{(s_i)_K^{\alpha} (s_i)_E^{1/1-\alpha-\theta} (s_i)_H^{\theta}}{n_i + \varphi_t + \delta} \right\}^{1/1-\alpha-\beta-\theta} \tag{19}$$

$$h^* = \left\{ \frac{(s_i)_K^{\alpha} (s_i)_E^{\beta} (s_i)_H^{1/1-\alpha-\beta}}{n_i + \varphi_t + \delta} \right\}^{1/1-\alpha-\beta-\theta} \tag{20}$$

Equations (18) to (20) are the steady states of the variables, meaning that the economy converges to the steady state.

Taking the natural log of the three equations gives:

$$\ln k_i^* = \frac{1}{1-\alpha-\beta-\theta} \left\langle \ln\left\{ (s_i)_K^{1/1-\beta-\theta} (s_i)_E^{\beta} (s_i)_H^{\theta} \right\} - \ln(n_i + \varphi_t + \delta) \right\rangle \tag{21}$$

$$\ln e_i^* = \frac{1}{1-\alpha-\beta-\theta} \left\langle \ln\left\{ (s_i)_K^{\alpha} (s_i)_E^{1/1-\alpha-\theta} (s_i)_H^{\theta} \right\} - \ln(n_i + \varphi_t + \delta) \right\rangle \tag{22}$$

$$\ln h_i^* = \frac{1}{1-\alpha-\beta-\theta} \left\langle \ln\left\{ (s_i)_K^{\alpha} (s_i)_E^{\beta} (s_i)_H^{1/1-\alpha-\beta} \right\} - \ln(n_i + \varphi_t + \delta) \right\rangle \tag{23}$$

It can be seen from equations (21) to (23) that the steady state physical, education and health capital stocks per unit of effective labour relate positively to the saving rate and negatively to the population growth rate.

To determine the steady state output per unit of effectively labour, equations (21), (22) and (23) can be substituted into the intensive form of augmented production functions specified as equation (7). This therefore gives:

$$\ln y_{it}^* = \ln A_{i(0)} + \varphi_t t - \gamma_1 \ln(n_i + \varphi_t + \delta) + \gamma_2 \ln s_{iK} + \gamma_3 \ln s_{iE} + \gamma_4 \ln s_{iH} \tag{24}$$

Where:

$$\gamma_1 = \frac{\alpha+\beta+\theta}{1-\alpha-\beta-\theta}, \quad \gamma_2 = \frac{\alpha}{1-\alpha-\beta-\theta}, \quad \gamma_3 = \frac{\beta}{1-\alpha-\beta-\theta}, \quad \gamma_4 = \frac{\theta}{1-\alpha-\beta-\theta}$$

s_{iK}, s_{iE}, s_{iH} are the proportion of output/income earmarked as investment into physical capital, education capital and health capital respectively. $A_{i(0)}$ is the country-specific initial technological endowment. Following the method used by MRW and MR, the alternative formulation of equation (24) can be derived. This is due to the fact that disaggregated savings data are difficult to come by and this may pose some problems when trying to perform estimation. So, the alternative formulation is given as:

$$\ln y_{it}^{*} = \ln A_{i(0)} + \varphi_t t - \xi_1 \ln(n_i + \varphi_t + \delta) + \xi_1 \ln s_{iK} + \xi_2 \ln s_{iE} + \xi_3 \ln h_{it}^{*} \quad (25)$$

Where:

$$\xi_1 = \frac{\alpha}{1-\alpha}, \quad \xi_2 = \frac{\beta}{1-\alpha}, \quad \xi_3 = \frac{\theta}{1-\alpha}$$

h_{it}^{*} is a steady state level quantity of health capital per unit of effective labour. Availability of data will determine which of the equations (24) and (25) to estimate. Equation (24) uses the rates of the accumulation of education and health capitals. Whereas, equation (25) uses the levels of both education and health capitals.

A better version of the two equations can be determined taking into consideration the conditional convergence predicted by the Solow model. According to this model, countries converge to their country-specific steady-state position due to the different levels of saving rate with regards to physical and human capital accumulation. Furthermore, "the Solow model makes quantitative predictions about the speed of convergence to the steady state" (MRW, 1992). From equation (24), y_{it}* is the steady-state level of income per unit of effective labour and y_{it} the actual value at time t. It can be shown that y_{it} approaches y_{it}* around the balanced growth path (bgp). Based on this, the speed of convergence is given as:

$$\frac{d \ln y_{it}}{dt} = \ell \langle \ln y_{it}^{*} - \ln y_{it} \rangle \quad (26)$$

Given that $\ell = \langle (1-\alpha-\beta-\theta)(n+\varphi+\delta) \rangle$

The implication of equation (26) is that exponentially, ln y_{it} converges to ln y_{it}*. This means that

$$\ln y_{it} = (1-e^{-\ell t}) \ln(y_{it}^{*}) + e^{-\ell t} \ln(y_{i0}), \quad (27)$$

Where y_{i0} is the initial level of income per effective labour. When lny_{i0} is subtracted from both sides of equation (27), we have:

$$\ln y_{it} - \ln(y_{i0}) = \left(1 - e^{-\ell t}\right)\ln\left(y^*_{it}\right) - (1 - e^{-\ell t})\ln(y_{i0}), \tag{28}$$

Equation (28) indicates that countries (such as most African countries) with lower levels of initial income in comparison with their steady-state levels, would tend to have higher growth rates. Substituting equation (24) for $y_{it}*$ in equation (28) yields:

$$\ln y^*_{it} - \ln y^*_{i0} = \psi \ln A_{i0} - \psi \ln y^*_{i0} + \lambda_1 \ln\left(n_i + \varphi_t + \delta\right) + \lambda_2 \ln s_{iK} + \lambda_3 \ln s_{iE} + \lambda_4 \ln h_{it}^* + \eta_t + \nu_{it} \tag{29}$$

Where:

$\psi = 1 - e^{\ell t}$, $\lambda_1 = -\frac{\psi\alpha}{1-\alpha}$, $\lambda_2 = \frac{\psi\alpha}{1-\alpha}$, $\lambda_3 = \frac{\psi\beta}{1-\alpha}$, $\lambda_4 = \frac{\psi\theta}{1-\alpha}$, $\eta_t = \varphi_t t$ and ν_{it} is the stochastic term.

Finally, equation (29) becomes:

$$C^*_{it} - C^*_{i0} = -\psi C^*_{i0} + \lambda_1 \ln\left(n_i + \varphi_t + \delta\right) + \lambda_2 \ln s_{iK} + \lambda_3 \ln s_{iE} + \lambda_4 \ln h_{it}^* + \eta_t + \mu_i + \nu_{it} \tag{30}$$

Where: $C_{it} = \ln y_{it}*$ and $C_{i0} = \ln y_{i0}*$ and $\mu_i = \psi ln A_{i0}$

Equation (30) now becomes:

$$C^*_{it} = \lambda_0 C^*_{i0} + \lambda_1 z^1_{it} + \lambda_2 z^2_{it} + \lambda_3 z^3_{it} + \lambda_4 z^4_{it} + \eta_t + \mu_i + \nu_{it} \tag{31}$$

Where:

$C^*_{it} = \ln y^*_{it}$, $C^*_{i0} = \ln y^*_{i0}$, $\lambda_0 = (1-\psi)$, $\psi = 1 - e^{\ell t}$, $\lambda_1 = -\frac{\psi\alpha}{1-\alpha}$, $\lambda_2 = \frac{\psi\alpha}{1-\alpha}$, $\lambda_3 = \frac{\psi\beta}{1-\alpha}$, $\lambda_4 = \frac{\psi\theta}{1-\alpha}$, $z^1_{it} = \ln\left(n_i + \varphi_t + \delta\right)$, $z^2_{it} = \ln s_{iK}$, $z^3_{it} = \ln s_{iE}$ or $\ln e^*_{it}$, $z^4_{it} = \ln s_{iH}$ or $\ln h_{it}^*$ $\eta_t = \varphi_t t$, $\mu_i = \psi \ln A_{i0}$ and ν_{it} = stochastic term.

Equation (31) can be estimated either in levels or in terms of growth in output per capital.

Appendix B

Summary Results of Pooled/OLS, Fixed Effects (FE) and Random Effects (RE) Estimation Techniques

Although the estimated models were specified in dynamic panel data form, the author in addition to using dynamic panel data estimators-first difference, difference GMM and system GMM-, employed three additional panel estimation techniques {Pooled/OLS, Fixed Effects (FE) and Random Effects (RE) estimators} in order to compare results.

Decision Between/Among Models or Estimators

When using the three estimators- Pooled/OLS, FE and RE- indicated above, it is necessary to conduct some tests to decide the most suitable among the three. The Hausman, and Breusch and Pagan Lagrangian multiplier (LM) tests were carried out for this purpose.

Decision Between Fixed Effects and Random Effects Estimators: Hausman Test

The Hausman test is employed to decide between the FE and RE technique. The null hypothesis is that the model or estimator is random; whereas the alternative hypothesis is that the FE is preferred. This implies that the null hypothesis argues that the unique error terms (individual or in the case of this study, country characteristics) do not correlate with the explanatory variables while the alternative hypothesis suggests that they in actual fact correlate. We fail to reject the null hypothesis if the probability of the chi-square value of the Hausman test result is not significant, which is a preference for the RE. However, if the result of the Hausman test is significant, then the FE estimator is preferred. The 5 percent (or 0.050) level of significance was used in this study.

Decision Between Pooled/OLS and Random Effects Estimators: The Breusch and Pagan Lagrangian multiplier (LM) Test

The LM test is used to decide between pooled and RE estimators. This test has the null hypothesis indicating that no panel effects exist. This means that there are no variations across entities/individuals/countries. The alternative hypothesis however, submits that there exist significant differences across entities. The decision rule is that if the Chi-square statistic is significant, then the null hypothesis is rejected, which is a preference for the RE modeling; however, if the chi-square statistic is insignificant, then we fail to reject the null hypothesis, meaning that pooled estimator is okay. This suggests that there is no evidence of differences among the units. As indicated earlier, the 5 percent (or 0.050) level of significance was used in the present study.

***Appendix* B-1.** Impact of HIV/AIDS on Human Capital

Dependent Variable = Log of Life Expectancy (lnLep)

Regressors	OLS	FE	RE
HIVI	-0.014*** (0.000)	-0.010*** (0.000)	-0.012*** (0.000)
HIVPR	-0.002*** (0.000)	-0.001* (0.064)	-0.001*** (0.000)
HIVP	-0.0003*** (0.000)	-0.0001 (0.183)	-0.0002*** (0.001)
AIDSD	-0.002*** (0.001)	0.001 (0.496)	-0.001 (0.400)

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.
Source: Author's Computation.

The results presented in *Appendix* B-1 above show clearly that the HIV/AIDS disease is a threat to life expectancy in the West African sub-region. All the coefficients are negative, with 75 percent of them being statistically significant. For instance, a percentage increase in HIV incidence reduced life expectancy significantly by 1.4, 1.0 and 1.2 percentage points based on results of OLS, FE and RE estimations respectively. However, both Hausman test, and Breusch and Pagan Lagrangian multiplier (LM) test, which are presented in *Appendix* C-1 support RE estimation technique. With this, it is obvious that incidence of the pandemic depresses life expectancy by 1.2 percent. The Wald Chi-square statistic was highly significant, implying that the variables employed in the model are jointly significant. The R-Squared of the model was 0.993; an indication of a good fit of the model.

Furthermore, HIV prevalence has negative impact on life expectancy as presented in the *Appendix.* With a percentage rise in prevalence, the level of life expectancy in the sub-region declined by 0.2 percent, 0.1 percent and 0.1 percent according to the results returned by the Pooled/OLS, FE and RE estimators in that order. Nonetheless, Hausman test supported the FE estimation technique. The F-Statistic was highly significant, which is an indication of joint significant of the model. The R-Squared stood at 0.993.

Number of persons living with HIV/AIDS in West Africa also affects average life expectancy negatively and significantly. However, the magnitude of the coefficients remained very low while the coefficient of FE estimation technique was insignificant. The Hausman test also favoured the FE technique while the R-Squared was 0.992. The F-Statistic was also significant.

Deaths caused by AIDS reduced life expectancy going by the results of OLS and RE estimation. However, only the coefficient returned by OLS was statistically significant. The Breusch and Pagan Lagrangian multiplier (LM) test backed the RE estimator. The Wald statistic was significant while the R-Squared stood at 0.992.

Results of all the control variables as well as the diagnostic tests are presented in *Appendices* C-1 to C-4.

***Appendix* B-2.** Impact of HIV/AIDS on Human Capital
Dependent Variable = Primary School Enrolment Rate

Regressors	OLS	FE	RE
HIVI	-1.438 (0.470)	-2.456 (0.412)	-1.438 (0.469)
HIVPR	-0.179 (0.546)	-0.354 (0.522)	-0.179 (0.546)
HIVP	-0.021 (0.694)	-0.050 (0.626)	-0.021 (0.694)
AIDSD	-0.285 (0.667)	-0.581 (0.611)	-0.285 (0.667)

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.
Source: Author’s Computation.

Appendix B-2 shows results of how the HIV/AIDS epidemic affects primary school enrolment in West Africa. Evidently, the disease exerts negative pressure on primary school enrolment in the sub-region regardless of the estimation technique adopted; nevertheless, none of the coefficients was statistically significant.

With respect to diagnostic tests, the models were jointly significant as shown by the probabilities of Wald and F-Statistic tests while both the RE technique of estimation was mostly preferred.

***Appendix* B-3.** Impact of HIV/AIDS on Human Capital

Dependent Variable = Human Capital Index

Regressors	OLS	FE	RE
HIVI	0.062 (0.271)	-0.034 (0.652)	0.062 (0.269)
HIVPR	0.002 (0.852)	-0.014 (0.348)	0.002 (0.852)
HIVP	0.001 (0.658)	-0.002 (0.402)	0.001 (0.657)
AIDSD	-0.006 (0.751)	-0.023 (0.455)	-0.006 (0.751)

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.
Source: Author's Computation.

The findings showing impact of the disease on human capital index were not different from what was reported on its influence on primary enrolment. All the coefficients were statistically insignificant. The diagnostic tests conducted showed preference for FE by three models that employed prevalence, number of people that live with the virus and AIDS-related deaths while model that employed incidence supported RE. The F-Statistic and the Wald tests were jointly significant.

In conclusion, the overwhelming evidence suggests that HIV/AIDS has negative impact on human capital. However, the effect appears more pronounced and statistically significant with life expectancy (a measure of human capital) irrespective of the HIV/AIDS measures employed. The influence of the pandemic on primary school enrolment and human capital index was insignificant.

Impact of HIV/AIDS on Economic Growth in West Africa

In determining how HIV/AIDS affects economic growth in West Africa, attempt was made to model the variable as one of the regressors on the first hand while on the other hand, the influence of the pandemic on economic growth was determined through its impact on human capital using interactive variable methodology. The results are presented below. *Appendices* B-4 and B-5 show summary results of the first case with the full findings displayed in *Appendices* C-13 to C-20 while the summary outcomes of the second case are shown in *Appendices* B-6 to B-8. The full results are however presented in *Appendices* C-21 to C-32.

Appendix B-4. Direct Impact of HIV/AIDS on Economic Growth (Using Life Expectancy and Enrolment Rate as part of the explanatory variables)

Dependent Variable = Growth Rate of Per Capita GDP (Purchasing Power Parity)

Regressors	OLS	FE	RE
HIVI	-5.403*** (0.002)	-4.953* (0.057)	-5.403*** (0.001)
HIVPR	-0.611** (0.015)	0.312 (0.475)	-0.611** (0.014)
HIVP	-0.098** (0.031)	0.086 (0.284)	-0.098** (0.030)
AIDSD	-0.682 (0.208)	1.776** (0.036)	-0.682 (0.207)

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.
Source: Author's Computation.

Apparently, the information contained in *Appendix* B-4 revealed that the HIV/AIDS disease has negative influence on economic growth in West Africa, with coefficients of incidence, prevalence and number of persons living with the disease significant for OLS and RE. Result of FE estimation was marginally significant for incidence of the disease. Regarding AIDS deaths only coefficient produced by FE was significant at 5 percent significant level. The relationship however was positive. The diagnostic tests supported FE estimator for the models that employed HIV incidence, number of persons living with the disease and AIDS-related deaths while the RE technique was preferred in the model that used prevalence of HIV. The positive and significant influence of AIDS deaths on growth appear consistent with the findings of Young (2005) in South Africa, where AIDS-related deaths increased output level. The F-Statistic and Wald tests were all highly significant.

***Appendix* B-5**. Direct Impact of HIV/AIDS on Economic Growth (Using Human Capital Index)

Dependent Variable = Growth Rate of Per Capita GDP (Purchasing Power Parity)

Regressors	OLS	FE	RE
HIVI	-4.332*** (0.009)	-3.491 (0.176)	-4.332*** (0.008)
HIVPR	-0.502** (0.042)	0.493 (0.257)	-0.502** (0.041)
HIVP	-0.080* (0.073)	0.111 (0.165)	-0.080* (0.071)
AIDSD	-0.624 (0.254)	1.824** (0.031)	-0.624 (0.252)

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.
Source: Author's Computation.

The negative impact of the disease continues to emerge from the results of the different specifications estimated. Evidences displayed in *Appendix* B-5 above show clearly that using human capital index as one of the explanatory variables in the growth model did not alter the results substantially, particularly as it relates to the sign of coefficients. The only slight difference was observed in the magnitude of the coefficients and statistical significance. It is observed that the coefficients of HIV/AIDS variables in models that employed life expectancy and enrolment variables were slightly higher than those in models which used human capital index. From the table, 6 of the 8 coefficients of HIV/AIDS measures which arose from the outcomes of OLS and RE estimations were statistically significant while only AIDS deaths had its coefficient being significant for the FE estimation. However, the coefficient was positive. Hausman test results supported RE where HIV incidence and prevalence were employed while FE was preferred in models that used number of people living with the disease and AIDS deaths. Going by these outcomes, it is clear that HIV incidence and prevalence reduced economic growth by 4.33 and 0.50 units respectively. Number of people living with the pandemic does not pose significant threat to growth in the West African region; whereas, AIDS-related deaths increased growth significantly by 1.82 units. This results is also consistent with

Young (2005) earlier mentioned. Wald and F-Statistics confirmed the joint significance of the models.

Impact of HIV/AIDS on Economic Growth through Human Capital

Besides growth estimation results presented above, the study further tried to determine how the dreaded HIV/AIDS disease affects economic growth through its impact on human capital, using interactive variable methodology. Three human capital variables were interacted with the four HIV/AIDS variables. The human capital measures were: life expectancy at birth, primary school enrolment rate and human capital index, which was derived from the combination of both health and education indices. The results are presented in *Appendices* B-6 to B-8 below. While *Appendix* B-6 contains findings on the influence of the disease on economic growth through its influence on life expectancy, *Appendices* B-7 and B-8 show findings of how the pandemic affects economic growth through enrolment and human capital index respectively. The complete results are presented in *Appendices* C-21 to C-32.

Appendix B-6. Impact of HIV/AIDS on Economic Growth through Life Expectancy
Dependent Variable = Growth Rate of Per Capita GDP (Purchasing Power Parity)

Regressors	OLS	FE	RE
HIVI*LEP	-0.098*** (0.003)	-0.094* (0.057)	-0.098*** (0.002)
HIVPR*LEP	-0.013** (0.011)	0.006 (0.504)	-0.013** (0.011)
HIVP*LEP	-0.002** (0.022)	0.002 (0.303)	-0.002** (0.021)
AIDSD*LEP	-0.015 (0.155)	0.035** (0.035)	-0.015 (0.154)

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.
Source: Author's Computation.

Evidences presented in *Appendix* B-6 above indicate that HIV/AIDS depresses economic growth substantially through life expectancy, going by the high significance of 8 out of the 12 coefficients. However, the Hausman test results supported outcomes of the FE estimation technique, with just one of the coefficients being significant at 5 percent level of significance. Incidence of the disease declined growth marginally through life expectancy at 10 percent significance level. Deaths occasioned by the pandemic returned positive and significant coefficient. Prevalence and number of persons living with the virus do not pose any significant threat to economic growth. F-Statistic was generally significant.

Appendix B-7. Impact of HIV/AIDS on Economic Growth through Primary School Enrolment

Dependent Variable = Growth Rate of Per Capita GDP (Purchasing Power Parity)

Regressors	OLS	FE	RE
HIVI*ENR	-0.031* (0.091)	-0.016 (0.624)	-0.031* (0.090)
HIVPR*ENR	-0.004 (0.179)	0.008 (0.102)	-0.004 (0.178)
HIVP*ENR	-0.0005 (0.271)	0.002* (0.075)	-0.0005 (0.270)
AIDSD*ENR	-0.006 (0.355)	0.024** (0.018)	-0.006 (0.354)

Note: ***, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.
Source: Author's Computation.

The information presented in *Appendix* B-7 above suggests that HIV/AIDS epidemic does not exact any noteworthy negative influence on economic growth in West Africa through primary enrolment. As a matter of fact, the Hausman test results showed preference for the FE estimation technique in models that employed HIV incidence, prevalence, and AIDS deaths. The results of these estimators were not significant except the coefficient of AIDS deaths, which was positive and statistically significant at 5 percent level of significance. This appears consistent with the previous findings as well as that of Young (2005). Furthermore, the Hausman test also showed preference for the estimator when number of people living with the virus was used; however, the coefficient was statistically insignificant. With respect to the F-Statistic and Wald test, the outcomes were all highly significant.

Appendix B-8 below contained outcome of the analysis involving how HIV/AIDS affects economic growth through human capital index. The results reaffirmed the negative influence of the pandemic on growth. HIV incidence, prevalence and number of persons living with the disease reduced economic growth substantially through human capital index by 9.87, 1.39 and 0.21 units respectively, going by the RE estimation results, supported by the Hausman test. AIDS-deaths however, do not pose any significant threat to growth.

***Appendix* B-8.** Impact of HIV/AIDS on Economic Growth through Human Capital Index

Dependent Variable = Growth Rate of Per Capita GDP (Purchasing Power Parity)

Regressors	OLS	FE	RE
HIVI*HCI	-9.874*** (0.008)	-9.366 (0.113)	-9.874*** (0.007)
HIVPR*HCI	-1.394** (0.018)	0.712 (0.507)	-1.394** (0.017)
HIVP*HCI	-0.213** (0.039)	0.177 (0.356)	-0.212** (0.038)
AIDSD*HCI	-1.993 (0.136)	3.751* (0.067)	-1.993 (0.134)

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.
Source: Author's Computation.

In summary, the impact of HIV/AIDS on human capital and economic growth using OLS, FE and RE estimation techniques appears negative. However, not all the coefficients were statistically significant. Major negative and significant effect of the disease on human capital and economic growth was established through life expectancy. Its effects on human capital and growth through school enrolment and human capital index were statistically insignificant in most cases.

Limitation of OLS, FE and RE

It should be noted that these results should be accepted with some caution. The findings may be biased given the dynamic nature of the estimated models. OLS, FE and RE estimators are mostly suited for static panel as against dynamic panel. However, the findings provide better information for the comparison of results. The findings reported in the main body of the study, which employed FD, Difference GMM and system GMM (dynamic panel estimators) are no doubt superior to those reported in *Appendix* B.

Appendix C

Overall Results of Panel Data Econometric Analysis

***Appendix* C-1.** Impact of HIV/AIDS on Human Capital, Using HIV Incidence

Dependent Variable = Life Expectancy at Birth (lnLEP)

Regressors	OLS	FE	RE	FD	DIFF-GMM	SYS- GMM
lnLEP(-1)	0.988*** (0.000)	0.981*** (0.000)	0.989*** (0.000)	0.954*** (0.000)	0.925*** (0.000)	0.860*** (0.000)
HIVI	-0.014*** (0.000)	-0.010*** (0.000)	-0.012*** (0.000)	-0.002 (0.314)	-0.007*** (0.000)	-0.019** (0.025)
lnMAL	-0.001** (0.032)	-0.001** (0.010)	-0.001** (0.011)	-0.00003 (0.762)	-0.0003 (0.150)	0.001 (0.401)
lnDEP	0.002*** (0.000)	0.006 (0.380)	0.002*** (0.001)	-0.051*** (0.000)	-0.027* (0.053)	0.006 (0.182)
WTA	-0.0001* (0.084)	0.00004 (0.681)	-0.0001 (0.282)	0.00003 (0.718)	-0.001** (0.023)	-0.0002 (0.794)
ENR	0.0001*** (0.000)	0.0001*** (0.000)	0.0001*** (0.000)	0.00004*** (0.001)	0.0001 (0.498)	0.0002** (0.013)
lnPCGDP	0.0002 (0.797)	0.001 (0.203)	0.0006 (0.461)	-0.0001 (0.847)	0.001* (0.051)	0.004 (0.561)
Constants	0.041 (0.013)	-0.004 (0.961)	0.033 (0.179)	0.002	NA	0.42 (0.238)
R-Sq	0.9985	0.9931	0.993	0.9645		
F-Stat	21346.42 (0.000)	4372.35 (0.000)		821.92 (0.000)		
Wald-Stat.			69637.25 (0.000)		16323.96 (0.000)	8714 (0.000)
Hausman Stat.			13.39 (0.0631)			
BP-LM- Stat.			6.04 (0.0139)			
AR(1)-(p-value)					(0.061)	(0.076)
AR(2)- (p-value)					(0.075)	(0.149)
Hansen Stat. (p-value)					(0.902	0.989)

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.
BP-LM = Breusch and Pagan Lagrangian multiplier

Source: Author's Computation.

***Appendix* C-2.** Impact of HIV/AIDS on Human Capital, Using HIV Prevalence

Dependent Variable = Life Expectancy at Birth (lnLEP)

Regressors	OLS	FE	RE	FD	DIFF-GMM	SYS- GMM
lnLEP(-1)	0.987*** (0.000)	0.960*** (0.000)	0.987*** (0.000)	0.945*** (0.000)	0.855*** (0.000)	0.793*** (0.000)
HIVPR	-0.002*** (0.000)	-0.001* (0.064)	-0.001*** (0.000)	-0.001** (0.027)	-0.006*** (0.004)	-0.005** (0.029)
lnMAL	-0.0003 (505)	-0.001** (0.032)	-0.001 (0.157)	-0.00003 (0.759)	-0.0004** (0.037)	0.001 (0.580)
lnDEP	0.001*** (0.004)	0.019*** (0.001)	0.002** (0.012)	-0.048*** (0.000)	0.020 (0.310)	0.004 (0.526)
WTA	-0.0001* (0.057)	0.0001 (0.131)	-0.0001 (0.188)	0.00004 (0.623)	-0.001*** (0.002)	-0.001* (0.062)
ENR	0.0001*** (0.000)	0.0001*** (0.000)	0.0001*** (0.000)	0.00003*** (0.001)	-0.0001*** (0.731)	0.0001 (0.414)
lnPCGDP	0.001 (0.444)	0.002* (0.089)	0.001 (0.177)	-0.0001 (0.784)	0.0002 (0.582)	0.010 (0.286)
Constants	0.041** (0.025)	-0.141* (0.069)	0.033 (0.232)	0.002*** (0.000)	NA	0.713* (0.082)
R-Sq	0.9982	0.9925	0.9920	0.9651		
F-Stat	18038.43	4019.35		837.56		
F-Stat (p-value)	0.000	0.000		0.000		
Wald-Stat.			58693.34		9800.38	2232.88
Wald-Stat. (p-value)			0.000		0.000	0.000
Hausman Stat.			173.16			
Hausman (p-value)			0.0000			
BP-LM- Stat.			14.13			
BP-LM- (p-value)			0.0002			
AR(1)-(p-value)					0.058	0.083
AR(2)- (p-value)					0.066	0.085
Hansen Stat. (p-value)					0.950	0.999

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.
BP-LM = Breusch and Pagan Lagrangian multiplier

Source: Author's Computation.

***Appendix* C-3.** Impact of HIV/AIDS on Human Capital, Using Number of People Living with HIV/AIDS

Dependent Variable = Life Expectancy at Birth (lnLEP)

Regressors	OLS	FE	RE	FD	DIFF-GMM	SYS- GMM
lnLEP(-1)	0.988*** (0.000)	0.958*** (0.000)	0.988*** (0.000)	0.944*** (0.000)	0.850*** (0.000)	0.860*** (0.000)
HIVP	-0.0003*** (0.000)	-0.0001 (0.183)	-0.0002*** (0.001)	-0.0002** (0.028)	-0.001** (0.030)	-0.0002 (0.684)
lnMAL	-0.0002 (0.660)	-0.001** (0.036)	-0.001 (0.205)	-0.00003 (0.739)	-0.0003* (0.080)	0.0004 (0.694)
lnDEP	0.001** (0.012)	0.021*** (0.000)	0.001** (0.028)	-0.048*** (0.000)	0.019 (0.315)	0.002 (0.429)
WTA	-0.0001 (0.141)	0.0001 (0.126)	-0.0001 (0.255)	-0.0001 (0.582)	-0.001*** (0.002)	-0.001 (0.121)
ENR	0.0001*** (0.000)	0.0001*** (0.000)	0.0001*** (0.000)	0.00004*** (0.001)	-0.00004 (0.789)	0.0003*** (0.006)
lnPCGDP	0.001 (0.420)	0.002* (0.073)	0.001 (0.137)	-0.0002 (0.717)	0.0002 (0.516)	0.001 (0.886)
Constants	0.035* (0.064)	-0.150* (0.055)	0.031 (0.276)	0.002*** (0.000)	NA	0.525** (0.038)
R-Sq	0.9982	0.9924	0.9919	0.9651		
F-Stat	17552.14	3987.87		837.37		
F-Stat (p-value)	0.000	0.000		0.000		
Wald-Stat.			54660.51		8489.74	12241.64
Wald-Stat. (p-value)			0.0000		0.000	0.000
Hausman Stat.			55.47			
Hausman (p-value)			0.0000			
BP-LM- Stat.			16.25			
BP-LM- (p-value)			0.0001			
AR(1)-(p-value)					0.059	0.087
AR(2)- (p-value)					0.061	0.133
Hansen Stat. (p-value)					0.961	0.982

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.
BP-LM = Breusch and Pagan Lagrangian multiplier

Source: Author's Computation.

***Appendix* C-4.** Impact of HIV/AIDS on Human Capital, Using AIDS Deaths

Dependent Variable = Life Expectancy at Birth (lnLEP)

Regressors	OLS	FE	RE	FD	DIFF-GMM	SYS- GMM
lnLEP(-1)	0.986*** (0.000)	0.957*** (0.000)	0.985*** (0.000)	0.944*** (0.000)	0.760*** (0.000)	0.772*** (0.000)
AIDSD	-0.002*** (0.001)	0.001 (0.496)	-0.001 (0.400)	-0.001 (0.197)	-0.016** (0.012)	-0.013* (0.088)
lnMAL	0.00004 (0.929)	-0.001 (0.053)	-0.0004 (0.390)	-0.00003 (0.741)	-0.0004 (0.004)	0.001 (0.727)
lnDEP	0.001 (0.112)	0.020*** (0.001)	0.001 (0.166)	-0.048*** (0.000)	0.078*** (0.009)	0.006 (0.43)
WTA	-0.0001* (0.093)	0.0001 (0.146)	-0.0001 (0.244)	0.00004 (0.690)	-0.00003 (0.870)	-0.001* (0.070)
ENR	0.0001*** (0.000)	0.0001*** (0.000)	0.0001*** (0.000)	0.00004*** (0.001)	0.0001 (0.533)	0.0001 (0.374)
lnPCGDP	0.0003 (0.761)	0.002* (0.053)	0.001 (0.176)	-0.0001 (0.783)	-0.001 (0.388)	0.009 (0.347)
Constants	0.047** (0.015)	-0.139** (0.079)	0.045 (0.123)	0.002*** (0.000)	NA	0.783** (0.036)
R-Sq	0.9980	0.9924	0.9918	0.9646		
F-Stat	16202.05	3963.13		824.54		
F-Stat (p-value)	0.000	0.000		0.000		
Wald-Stat.			52172.36		3055.33	2991.52
Wald-Stat. (p-value)			0.0000		0.000	0.000
Hausman Stat.			-40.85			
Hausman (p-value)						
BP-LM- Stat.			23.43			
BP-LM- (p-value)			0.0001			
AR(1)-(p-value)					0.069	0.054
AR(2)- (p-value)					0.072	0.076
Hansen Stat. (p-value)					0.989	0.974

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.
BP-LM = Breusch and Pagan Lagrangian multiplier

Source: Author's Computation.

***Appendix* C-5.** Impact of HIV/AIDS on Human Capital, Using HIV Incidence

Dependent Variable = Primary School Enrolment (ENR)

Regressors	OLS	FE	RE	FD	DIFF-GMM	SYS- GMM
ENR(-1)	0.979*** (0.000)	0.877*** (0.000)	0.979*** (0.000)	0.138** (0.051)	1.117*** (0.000)	1.086*** (0.000)
HIVI	-1.438 (0.470)	-2.456 (0.412)	-1.438 (0.469)	0.555 (0.961)	-5.057 (0.248)	-4.892 (0.606)
lnLEP	-2.064 (0.713)	39.229* (0.094)	-2.064 (0.713)	227.145** (0.010)	-87.407 (0.384)	-98.517 (0.416)
lnMAL	0.319 (0.572)	0.113 (0.852)	0.319 (0.571)	0.200 (0.701)	0.426 (0.474)	0.550 (0.922)
lnDEP	-0.475 (0.383)	-11.513 (0.201)	-0.475 (0.382)	30.310 (0.533)	-45.496* (0.086)	3.365 (0.598)
WTA	-0.022 (0.693)	-0.308** (0.015)	-0.022 (0.692)	-0.847 (0.106)	-1.233** (0.014)	-0.492 (0.332)
lnPCGDP	-1.533 (0.188)	-2.392* (0.075)	-1.533 (0.187)	-1.403 (0.589)	-1.990 (0.595)	-6.907 (0.485)
Constants	25.321 (0.271)	58.175 (0.628)	25.321 (0.270)	-1.072 (0.355)		384.571 (0.392)
R-Sq	0.9573	0.9277	0.9241	0.0972		
F-Stat	713.37	390.25		3.26		
F-Stat (p-value)	0.000	0.000		0.0026		
Wald-Stat.			4993.61		595.92	1898.63
Wald-Stat. (p-value)			0.0000		0.000	0.000
Hausman Stat.			-6.42			
Hausman (p-value)			NA			
BP-LM- Stat.			2.06			
BP-LM- (p-value)			0.1515			
AR(1)-(p-value)					0.135	0.031
AR(2)- (p-value)					0.513	0.368
Hansen Stat. (p-value)					0.751	0.514

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.
BP-LM = Breusch and Pagan Lagrangian multiplier

Source: Author's Computation.

Appendix C-6. Impact of HIV/AIDS on Human Capital, Using HIV Prevalence

Dependent Variable = Primary School Enrolment (ENR)

Regressors	OLS	FE	RE	FD	DIFF-GMM	SYS- GMM
ENR(-1)	0.978*** (0.000)	0.876*** (0.000)	0.978*** (0.000)	0.135* (0.056)	1.133*** (0.000)	1.106*** (0.000)
HIVPR	-0.179 (0.546)	-0.354 (0.522)	-0.179 (0.546)	2.251 (0.396)	-1.112 (0.274)	-0.669 (0.680)
lnLEP	-2.089 (0.710)	36.003 (0.118)	-2.089 (0.709)	242.947*** (0.006)	-110.025 (0.258)	-112.964 (0.154)
lnMAL	0.374 (0.497)	0.134 (0.825)	0.374 (0.497)	0.206 (0.692)	0.433 (0.483)	-0.498 (0.846)
lnDEP	-0.497 (0.363)	-8.455 (0.288)	-0.497 (0.362)	26.101 (0.591)	-34.598 (0.111)	4.445 (0.386)
WTA	-0.023 (0.675)	-0.284*** (0.021)	-0.023 (0.675)	-0.853 (0.101)	-1.153** (0.011)	-0.571* (0.051)
lnPCGDP	-1.467 (0.212)	-2.329* (0.082)	-1.467 (0.210)	-1.248 (0.631)	-2.266 (0.547)	-5.218 (0.566)
Constants	24.732 (0.285)	23.033 (0.834)	24.732 (0.284)	-1.114 (0.333)		430.257 (0.151)
R-Sq	0.9572	0.9276	0.9242	0.1003		
F-Stat	712.84	389.73		3.38		
F-Stat (p-value)	0.000	0.000		0.0020		
Wald-Stat.			4989.90		754.84	776.75
Wald-Stat. (p-value)			0.0000		0.000	0.000
Hausman Stat.			2.33			
Hausman (p-value)			0.9392			
BP-LM- Stat.			1.83			
BP-LM- (p-value)			0.1758			
AR(1)-(p-value)					0.122	0.039
AR(2)- (p-value)					0.529	0.539
Hansen Stat. (p-value)					0.980	0.669

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.
BP-LM = Breusch and Pagan Lagrangian multiplier

Source: Author’s Computation.

***Appendix* C-7.** Impact of HIV/AIDS on Human Capital, Using Number of Persons Living with HIV/AIDS

Dependent Variable = Primary School Enrolment (ENR)

Regressors	OLS	FE	RE	FD	DIFF-GMM	SYS- GMM
ENR(-1)	0.978*** (0.000)	0.875*** (0.000)	0.978*** (0.000)	0.133* (0.060)	1.113*** (0.000)	1.115*** (0.000)
HIVP	-0.021 (0.694)	-0.050 (0.626)	-0.021 (0.694)	0.413 (0.415)	-0.435 (0.105)	-0.057 (0.882)
lnLEP	-1.984 (0.725)	35.316 (0.124)	-1.984 (0.725)	245.174*** (0.006)	-116.857 (0.216)	-121.189 (0.181)
lnMAL	0.401 (0.465)	0.137 (0.821)	0.401 (0.464)	0.211 (0.684)	0.372 (0.517)	0.472 (0.932)
lnDEP	-0.547 (0.310)	-7.937 (0.317)	-0.547 (0.309)	27.014 (0.577)	-27.663 (0.185)	4.364 (0.517)
WTA	-0.021 (0.706)	-0.282** (0.022)	-0.021 (0.706)	-0.864* (0.097)	-1.125** (0.012)	-0.539** (0.044)
lnPCGDP	-1.490 (0.206)	-2.289* (0.086)	-1.490 (0.205)	-1.164 (0.655)	-1.879 (0.594)	-5.061 (0.578)
Constants	24.648 (0.292)	17.479 (0.873)	24.648 (0.291)	-1.195 (0.303)		447.065 (0.168)
R-Sq	0.9572	0.9275	0.9240	0.1000		
F-Stat	712.14	389.39		3.37		
F-Stat (p-value)	0.000	0.000		0.0020		
Wald-Stat.			4985.00		608.20	1298.13
Wald-Stat. (p-value)			0.0000		0.000	0.000
Hausman Stat.			-13.29			
Hausman (p-value)			NA			
BP-LM- Stat.			1.91			
BP-LM- (p-value)			0.1668			
AR(1)-(p-value)					0.128	0.037
AR(2)- (p-value)					0.545	0.349
Hansen Stat. (p-value)					0.991	0.158

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.
BP-LM = Breusch and Pagan Lagrangian multiplier

Source: Author's Computation.

***Appendix* C-8.** Impact of HIV/AIDS on Human Capital, Using AIDS Deaths

Dependent Variable = Primary School Enrolment (ENR)

Regressors	OLS	FE	RE	FD	DIFF-GMM	SYS- GMM
ENR(-1)	0.977*** (0.000)	0.874* (0.060)	0.977*** (0.000)	0.131* (0.064)	1.282*** (0.000)	1.137*** (0.000)
AIDSD	-0.285 (0.667)	-0.581 (0.611)	-0.285 (0.667)	5.179 (0.255)	-2.200 (0.585)	-0.023 (0.996)
lnLEP	-1.999 (0.723)	34.115 (0.14)	-1.999 (0.722)	265.129*** (0.004)	-166.186 (0.121)	-121.621* (0.064)
lnMAL	0.409 (0.453)	0.139 (0.819)	0.409 (0.453)	0.228 (0.661)	-0.033 (0.95)	-0.822 (0.764)
lnDEP	-0.555 (0.294)	-7.146 (0.378)	-0.555 (0.292)	21.919 (0.653)	-31.311 (0.257)	5.141 (0.378)
WTA	-0.022 (0.686)	-0.279** (0.024)	-0.022 (0.685)	-0.818 (0.116)	-1.131** (0.030)	-0.541** (0.020)
lnPCGDP	-1.507 (0.199)	-2.323* (0.083)	-1.507 (0.197)	-1.011 (0.698)	-2.450 (0.566)	-4.774 (0.608)
Constants	24.948 (0.282)	10.245 (0.926)	24.948 (0.281)	-1.145 (0.32)		450.186* (0.061)
R-Sq	0.9572	0.9275	0.9241	0.1027		
F-Stat	712.25	389.43		3.47		
F-Stat (p-value)	0.000	0.000		0.0015		
Wald-Stat.			4985.72		642.24	798.48
Wald-Stat. (p-value)			0.0000		0.000	0.000
Hausman Stat.			2.73			
Hausman (p-value)			0.9090			
BP-LM- Stat.			1.83			
BP-LM- (p-value)			0.1756			
AR(1)-(p-value)					0.069	0.042
AR(2)- (p-value)					0.527	0.523
Hansen Stat. (p-value)					0.289	0.480

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.
BP-LM = Breusch and Pagan Lagrangian multiplier

Source: Author's Computation.

***Appendix* C-9.** Impact of HIV/AIDS on Human Capital, Using HIV Incidence

Dependent Variable = Human Capital Index (HCI)

Regressors	OLS	FE	RE	FD	DIFF-GMM	SYS- GMM
HCI(-1)	0.107 (0.108)	-0.074 (0.274)	0.107 (0.106)	-0.501*** (0.000)	0.005 (0.599)	0.029** (0.017)
HIVI	0.062 (0.271)	-0.034 (0.652)	0.062 (0.269)	0.131 (0.734)	0.136 (0.126)	-0.027 (0.733)
lnMAL	0.037** (0.018)	0.024 (0.157)	0.037** (0.017)	0.001 (0.975)	-0.009** (0.040)	-0.013** (0.020)
lnDEP	-0.013 (0.375)	0.015 (0.937)	-0.013 (0.374)	-0.106 (0.946)	0.410* (0.052)	0.068 (0.112)
WTA	0.001 (0.610)	0.001 (0.878)	0.001 (0.610)	-0.010 (0.588)	0.005 (0.320)	-0.003 (0.489)
lnPCGDP	0.018 (0.59)	-0.011 (0.766)	0.018 (0.590)	0.040 (0.658)	-0.029 (0.428)	-0.059 (0.718)
Constants	-0.077 (0.745)	-0.042 (0.988)	-0.077 (0.745)	-0.001 (0.973)		0.016 (0.980)
R-Sq	0.0680	0.0190	0.0020	0.2497		
F-Stat	2.72	0.69		11.82		
F-Stat (p-value)	0.0143	0.6581		0.0000		
Wald-Stat.			16.33		87.59	280.17
Wald-Stat. (p-value)			0.0121		0.000	0.000
Hausman Stat.			-232.95			
Hausman (p-value)			NA			
BP-LM- Stat.			16.08			
BP-LM- (p-value)			0.0001			
AR(1)-(p-value)					0.306	0.300
AR(2)- (p-value)					0.304	0.250
Hansen Stat. (p-value)					0.323	0.184

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.
BP-LM = Breusch and Pagan Lagrangian multiplier

Source: Author’s Computation.

***Appendix* C-10.** Impact of HIV/AIDS on Human Capital, Using HIV Prevalence

Dependent Variable = Human Capital Index (HCI)

Regressors	OLS	FE	RE	FD	DIFF-GMM	SYS- GMM
HCI(-1)	0.113* (0.091)	-0.076 (0.263)	0.113* (0.089)	-0.501*** (0.000)	-0.012 (0.387)	0.032** (0.049)
HIVPR	0.002 (0.852)	-0.014 (0.348)	0.002 (0.852)	-0.034 (0.708)	-0.051 (0.366)	-0.002 (0.899)
lnMAL	0.033** (0.032)	0.023 (0.163)	0.033** (0.031)	0.0003 (0.988)	-0.016*** (0.000)	-0.009* (0.053)
lnDEP	-0.009 (0.564)	0.047 (0.784)	-0.009 (0.564)	-0.105 (0.947)	0.123 (0.520)	0.021 (0.683)
WTA	0.001 (0.638)	0.001 (0.805)	0.001 (0.637)	-0.010 (0.567)	-0.001 (0.891)	-0.001 (0.517)
lnPCGDP	0.019 (0.571)	-0.012 (0.734)	0.019 (0.571)	0.035 (0.701)	0.0001 (0.997)	0.016 (0.673)
Constants	-0.086 (0.721)	-0.514 (0.845)	-0.086 (0.72)	-0.002 (0.955)		0.146 (0.79)
R-Sq	0.0630	0.0221	0.0024	0.2498		
F-Stat	2.51	0.81		11.82		
F-Stat (p-value)	0.0226	0.5665		0.0000		
Wald-Stat.			15.07		219.06	44.30
Wald-Stat. (p-value)			0.0197		0.000	0.000
Hausman Stat.			120.12			
Hausman (p-value)			0.0000			
BP-LM- Stat.			19.09			
BP-LM- (p-value)			0.0000			
AR(1)-(p-value)					0.321	0.303
AR(2)- (p-value)					0.548	0.246
Hansen Stat. (p-value)					0.620	0.992

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.
BP-LM = Breusch and Pagan Lagrangian multiplier

Source: Author's Computation.

***Appendix* C-11.** Impact of HIV/AIDS on Human Capital, Using Number of People Living with HIV/AIDS

Dependent Variable = Human Capital Index (HCI)

Regressors	OLS	FE	RE	FD	DIFF-GMM	SYS- GMM
HCI(-1)	0.112* (0.093)	-0.075 (0.266)	0.112* (0.092)	-0.501*** (0.000)	-0.015 (0.379)	0.038* (0.068)
HIVP	0.001 (0.658)	-0.002 (0.402)	0.001 (0.657)	0.0002 (0.991)	-0.006 (0.817)	-0.003 (0.353
lnMAL	0.033** (0.029)	0.023 (0.162)	0.033** (0.028)	0.0004 (0.983)	-0.013*** (0.001)	-0.015*** (0.000)
lnDEP	-0.010 (0.514)	0.058 (0.738)	-0.010 (0.513)	-0.126 (0.936)	-0.128 (0.615)	0.089 (0.180)
WTA	0.001 (0.630)	0.001 (0.783)	0.001 (0.630)	-0.011 (0.563)	-0.003 (0.402)	-0.002 (0.267)
lnPCGDP	0.017 (0.610)	-0.011 (0.756)	0.017 (0.609)	0.038 (0.674)	0.069 (0.288)	0.003 (0.943)
Constants	-0.070 (0.772)	-0.686 (0.795)	-0.070 (0.772)	-0.003 (0.951)		-0.637 (0.473)
R-Sq	0.0637	0.0213	0.0023	0.2493		
F-Stat	2.54	0.77		11.79		
F-Stat (p-value)	0.0212	0.5905		0.0000		
Wald-Stat.			15.24		192.86	162.61
Wald-Stat. (p-value)			0.0185		0.000	0.000
Hausman Stat.			121.31			
Hausman (p-value)			0.0000			
BP-LM- Stat.			18.70			
BP-LM- (p-value)			0.0000			
AR(1)-(p-value)					0.327	0.298
AR(2)- (p-value)					0.576	0.177
Hansen Stat. (p-value)					0.324	0.624

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.
BP-LM = Breusch and Pagan Lagrangian multiplier

Source: Author's Computation.

***Appendix* C-12.** Impact of HIV/AIDS on Human Capital, Using HIV Incidence

Dependent Variable = Human Capital Index (HCI)

Regressors	OLS	FE	RE	FD	DIFF-GMM	SYS- GMM
HCI(-1)	0.112* (0.091)	-0.075 (0.272)	0.112* (0.090)	-0.501*** (0.000)	-0.013 (0.441)	0.034 (0.122)
AIDSD	-0.006 (0.751)	-0.023 (0.455)	-0.006 (0.751)	-0.038 (0.800)	-0.058* (0.085)	-0.076* (0.082)
lnMAL	0.032** (0.036)	0.024 (0.155)	0.032** (0.035)	0.0002 (0.993)	-0.013*** (0.000)	-0.010 (0.533)
lnDEP	-0.007 (0.661)	0.069 (0.696)	-0.007 (0.660)	-0.114 (0.942)	0.091 (0.492)	0.145* (0.076)
WTA	0.001 (0.687)	0.001 (0.732)	0.001 (0.686)	-0.011 (0.557)	-0.002 (0.523)	-0.005* (0.055)
lnPCGDP	0.021 (0.525)	-0.012 (0.727)	0.021 (0.524)	0.034 (0.708)	-0.013 (0.565)	-0.101 (0.296)
Constants	-0.109 (0.648)	-0.865 (0.746)	-0.109 (0.648)	-0.002 (0.952)		-0.797 (0.363)
R-Sq	0.0633	0.0206	0.0028	0.2496		
F-Stat	2.52	0.75		11.81		
F-Stat (p-value)	0.0220	0.6099		0.0000		
Wald-Stat.			15.14		137.30	20.26
Wald-Stat. (p-value)			0.0192		0.000	0.002
Hausman Stat.			106.42			
Hausman (p-value)			0.0000			
BP-LM- Stat.			19.34			
BP-LM- (p-value)			0.0000			
AR(1)-(p-value)					0.328	0.303
AR(2)- (p-value)					0.610	0.464
Hansen Stat. (p-value)					0.592	0.257

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.
BP-LM = Breusch and Pagan Lagrangian multiplier

Source: Author's Computation.

***Appendix* C-13**. Impact of HIV/AIDS on Economic Growth, Using HIV Incidence

Dependent Variable = Per Capita Income Growth (PCGDP g)

Regressors	OLS	FE	RE	FD	DIFF-GMM	SYS- GMM
PCGDP g(-1)	-0.059 (0.383)	-0.103 (0.127)	-0.059 (0.382)	-0.451*** (0.000)	-0.040 (0.759)	-0.003 (0.981)
HIVI	-5.403*** (0.002)	-4.953* (0.057)	-5.403*** (0.001)	-10.713 (0.299)	-4.240 (0.500)	-7.645*** (0.006)
lnMAL	0.408 (0.335)	0.648 (0.152)	0.408 (0.334)	0.604 (0.203)	0.365 (0.914)	-0.291 (0.909)
lnFC	1.653*** (0.006)	2.757*** (0.000)	1.653*** (0.005)	5.833*** (0.000)	6.343*** (0.002)	3.106*** (0.000)
LBFg	0.995** (0.012)	0.525 (0.248)	1.000** (0.011)	0.496 (0.691)	-0.416 (0.663)	0.965 (0.145)
lnLEP	-6.368 (0.145)	-3.883 (0.822)	-6.368 (0.143)	22.928 (0.771)	2.237 (0.952)	-11.170 (0.37)
ENR	0.025* (0.052)	0.078*** (0.010)	0.025* (0.051)	0.110* (0.079)	0.112** (0.039)	0.039** (0.035)
OPE	0.002 (0.945)	0.039 (0.191)	0.002 (0.945)	0.106** (0.010)	0.106** (0.011)	0.025 (0.421)
lnDEP	-1.098 (0.111)	-12.760** (0.021)	-1.098 (0.110)	-39.662 (0.367)	-30.040* (0.08)	-2.255 (0.28)
Constants	2.238 (0.881)	138.879** (0.030)	2.238 (0.881)	0.022 (0.982)		16.592 (0.67)
R-Sq	0.1244	0.1431	0.1032	0.3606		
F-Stat	3.49	3.92		13.16		
F-Stat (p-value)	0.0005	0.0001		0.0000		
Wald-Stat.			31.39		675.36	176.91
Wald-Stat. (p-value)			0.0003		0.000	0.000
Hausman Stat.			162.75			
Hausman (p-value)			0.0000			
BP-LM- Stat.			0.00			
BP-LM- (p-value)			0.9496			
AR(1)-(p-value)					0.028	0.028
AR(2)- (p-value)					0.322	0.557
Hansen Stat. (p-value)					0.932	0.922

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.
BP-LM = Breusch and Pagan Lagrangian multiplier

Source: Author's Computation.

***Appendix* C-14.** Impact of HIV/AIDS on Economic Growth, Using HIV Prevalence

Dependent Variable = Per Capita Income Growth (PCGDP g)

Regressors	OLS	FE	RE	FD	DIFF-GMM	SYS- GMM
PCGDP g(-1)	-0.033	-0.083	-0.033	-0.447***	-0.037	0.001
	(0.622)	(0.217)	(0.621)	(0.000)	(0.782)	(0.995)
	-0.611**	0.312	-0.611**	0.491	-0.026	-1.004**
HIVPR	(0.015)	(0.475)	(0.014)	(0.839)	(0.985)	(0.033)
	0.601	0.692	0.601	0.628	1.066	-0.254
lnMAL	(0.151)	(0.129)	(0.149)	(0.187)	(0.405)	(0.922)
	1.533**	2.012***	1.533**	5.855***	6.510***	3.107***
lnFC	(0.012)	(0.006)	(0.011)	(0.000)	(0.000)	(0.000)
	0.716*	0.199	0.716*	0.208	-0.477	0.564
LBFg	(0.063)	(0.645)	(0.061)	(0.866)	(0.520)	(0.428)
	-4.496	-5.933	-4.496	16.084	0.531	-7.849
lnLEP	(0.298)	(0.733)	(0.297)	(0.842)	(0.989)	(0.566)
	0.021*	0.067**	0.021*	0.111*	0.108*	0.039*
ENR	(0.092)	(0.028)	(0.091)	(0.078)	(0.094)	(0.092)
OPE	0.005	0.060**	0.005	0.110***	0.108**	0.029
	(0.811)	(0.04)	(0.811)	(0.008)	(0.013)	(0.383)
lnDEP	-1.098	-8.486	-1.098	-38.082	-31.524**	-2.201
	(0.117)	(0.100)	(0.115)	(0.390)	(0.010)	(0.325)
Constants	-4.510	95.380		0.095		3.432
	(0.764)	(0.119)	-4.510	(0.923)		(0.935)
R-Sq	0.1086	0.1304	0.0784	0.3575		
F-Stat	2.99	3.52		12.98		
F-Stat (p-value)	0.0022	0.0004		0.0000		
Wald-Stat.			26.93		481.48	215.79
Wald-Stat. (p-value)			0.0014		0.000	0.000
Hausman Stat.			13.17			
Hausman (p-value)			0.1549			
BP-LM- Stat.			0.23			
BP-LM- (p-value)			0.6346			
AR(1)-(p-value)					0.032	0.028
AR(2)- (p-value)					0.330	0.575
Hansen Stat. (p-value)					0.852	0.876

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.
BP-LM = Breusch and Pagan Lagrangian multiplier

Source: Author’s Computation.

***Appendix* C-15.** Impact of HIV/AIDS on Economic Growth, Using Number of Persons Living with HIV/AIDS

Dependent Variable = Per Capita Income Growth (PCGDP g)

Regressors	OLS	FE	RE	FD	DIFF-GMM	SYS- GMM
PCGDP g(-1)	-0.028 (0.676)	-0.084 (0.211)	-0.028 (0.675)	-0.447*** (0.000)	-0.043 (0.736)	-0.003 (0.979)
HIVP	-0.098** (0.031)	0.086 (0.284)	-0.098** (0.030)	0.156 (0.734)	0.083 (0.734)	-0.168* (0.061)
lnMAL	0.621 (0.139)	0.707 (0.121)	0.621 (0.137)	0.629 (0.185)	-0.075 (0.982)	-0.316 (0.901)
LnFC	1.358** (0.022)	1.970*** (0.006)	1.358** (0.021)	5.848*** (0.000)	6.323*** (0.003)	2.902*** (0.001)
LBFg	0.698* (0.070)	0.192 (0.654)	0.698* (0.069)	0.204 (0.868)	-0.446 (0.559)	0.519 (0.455)
lnLEP	-3.809 (0.377)	-5.007 (0.774)	-3.809 (0.376)	19.529 (0.810)	0.917 (0.981)	-6.491 (0.636)
ENR	0.021 (0.101)	0.066** (0.03)	0.021 (0.100)	0.110* (0.08)	0.110** (0.031)	0.038* (0.098)
OPE	0.007 (0.751)	0.060** (0.038)	0.007 (0.750)	0.109*** (0.008)	0.106*** (0.010)	0.032 (0.359)
lnDEP	-0.984 (0.157)	-8.948* (0.082)	-0.984 (0.156)	-38.344 (0.385)	-26.598 (0.210)	-2.019 (0.374)
Constants	-5.790 (0.701)	99.164 (0.103)	-5.790 (0.701)	0.064 (0.949)		0.162 (0.997)
R-Sq	0.1035	0.1330	0.0772	0.3577		
F-Stat	2.83	3.60		12.99		
F-Stat (p-value)	0.0036	0.0003		0.0000		
Wald-Stat.			25.50		547.98	190.35
Wald-Stat. (p-value)			0.0025		0.000	0.000
Hausman Stat.			21.36			
Hausman (p-value)			0.0112			
BP-LM- Stat.			0.08			
BP-LM- (p-value)			0.7804			
AR(1)-(p-value)					0.026	0.029
AR(2)- (p-value)					0.368	0.551
Hansen Stat. (p-value)					0.928	0.994

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.
BP-LM = Breusch and Pagan Lagrangian multiplier

Source: Author's Computation.

***Appendix* C-16.** Impact of HIV/AIDS on Economic Growth, Using AIDS Deaths

Dependent Variable = Per Capita Income Growth (PCGDP g)

Regressors	OLS	FE	RE	FD	DIFF-GMM	SYS- GMM
PCGDP g(-1)	-0.013 (0.850)	-0.096 (0.152)	-0.013 (0.850)	-0.448*** (0.000)	-0.044 (0.709)	-0.004 (0.978)
AIDSD	-0.682 (0.208)	1.776** (0.036)	-0.682 (0.207)	3.937 (0.335)	1.302 (0.648)	-1.380 (0.179)
lnMAL	0.697* (0.098)	0.751* (0.097)	0.697* (0.096)	0.648 (0.173)	-0.751 (0.796)	-0.410 (0.874)
LnFC	1.134* (0.052)	2.012*** (0.003)	1.134* (0.051)	5.938*** (0.000)	6.264*** (0.004)	2.661** (0.019)
LBFg	0.655* (0.091)	0.276 (0.516)	0.655* (0.090)	0.241 (0.844)	-0.565 (0.532)	0.417 (0.581)
lnLEP	-3.304 (0.446)	-1.105 (0.949)	-3.304 (0.445)	41.389 (0.622)	7.473 (0.868)	-4.962 (0.7)
ENR	0.016 (0.208)	0.05** (0.031)	0.016 (0.206)	0.106* (0.093)	0.099** (0.024)	0.032 (0.137)
OPE	0.002 (0.949)	0.057** (0.047)	0.002 (0.949)	0.107*** (0.009)	0.105*** (0.009)	0.025 (0.468)
lnDEP	-0.906 (0.196)	-10.460** (0.043)	-0.906 (0.195)	-43.874 (0.324)	-23.683 (0.307)	-1.860 (0.448)
Constants	-5.240 (0.731)	104.913* (0.083)	-5.240 (0.730)	0.046 (0.963)		-1.712 (0.969)
R-Sq	0.0910	0.1464	0.0702	0.3602		
F-Stat	2.46	4.02		13.13		
F-Stat (p-value)	0.0110	0.0001		0.0000		
Wald-Stat.			22.12		1510	238.75
Wald-Stat. (p-value)			0.0085		0.000	0.000
Hausman Stat.			26.27			
Hausman (p-value)			0.0018			
BP-LM- Stat.			0.00			
BP-LM- (p-value)			0.9832			
AR(1)-(p-value)					0.021	0.031
AR(2)- (p-value)					0.474	0.588
Hansen Stat. (p-value)					0.761	0.888

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.
BP-LM = Breusch and Pagan Lagrangian multiplier

Source: Author's Computation.

***Appendix* C-17.** Impact of HIV/AIDS on Economic Growth, Using Human Capital Index and HIV Incidence

Dependent Variable = Per Capita Income Growth (PCGDP g)

Regressors	OLS	FE	RE	FD	DIFF-GMM	SYS- GMM
PCGDP g(-1)	-0.035 (0.62)	-0.070 (0.321)	-0.035 (0.62)	-0.415*** (0.000)	0.073 (0.348)	0.041 (0.574)
HIVI	-4.332*** (0.009)	-3.491 (0.176)	-4.332*** (0.008)	-10.470 (0.304)	-4.224 (0.400)	-6.507** (0.012)
lnMAL	0.368 (0.312)	0.718 (0.118)	0.368 (0.311)	0.673 (0.156)	1.247 (0.344)	-0.527 (0.712)
LnFC	0.925* (0.058)	2.268*** (0.002)	0.925* (0.056)	6.194*** (0.000)	7.588*** (0.000)	2.248*** (0.000)
LBFg	0.879** (0.016)	1.050** (0.017)	0.879** (0.015)	1.089 (0.369)	0.415 (0.725)	0.851 (0.221)
HCI	1.280 (0.494)	1.333 (0.508)	1.280 (0.494)	3.159* (0.062)	7.857*** (0.000)	4.743*** (0.000)
OPE	0.002 (0.916)	0.035 (0.255)	0.002 (0.916)	0.096** (0.019)	0.089** (0.024)	0.018 (0.511)
lnDEP	-0.435 (0.428)	-3.603 (0.263)	-0.435 (0.427)	-26.068 (0.523)	-25.229*** (0.000)	-1.409 (0.149)
Constants	-15.993 (0.000)	-2.160 (0.958)	-15.993 (0.000)	0.095 (0.922)		-17.920 (0.000)
R-Sq	0.1065	0.1095	0.0835	0.3605		
F-Stat	3.31	3.26		14.87		
F-Stat (p-value)	0.0014	0.0016		0.0000		
Wald-Stat.			26.47		117735.79	481.51
Wald-Stat. (p-value)			0.0009		0.000	0.000
Hausman Stat.			11.06			
Hausman (p-value)			0.1984			
BP-LM- Stat.			0.19			
BP-LM- (p-value)			0.6655			
AR(1)-(p-value)					0.046	0.033
AR(2)- (p-value)					0.363	0.682
Hansen Stat. (p-value)					0.827	0.924

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.
BP-LM = Breusch and Pagan Lagrangian multiplier

Source: Author’s Computation.

Appendix C-18. Impact of HIV/AIDS on Economic Growth, Using Human Capital Index and HIV Prevalence

Dependent Variable = Per Capita Income Growth (PCGDP g)

Regressors	OLS	FE	RE	FD	DIFF-GMM	SYS- GMM
PCGDP g(-1)	-0.018 (0.793)	-0.060 (0.399)	-0.018 (0.792)	-0.412*** (0.000)	0.082 (0.335)	0.043 (0.569)
HIVPR	-0.502** (0.042)	0.493 (0.257)	-0.502** (0.041)	0.493 (0.833)	-1.109 (0.791)	-0.850** (0.033)
lnMAL	0.587* (0.094)	0.754 (0.102)	0.587* (0.093)	0.695 (0.144)	1.255 (0.346)	-0.291 (0.836)
LnFC	0.950* (0.061)	1.629** (0.016)	0.950* (0.06)	6.205*** (0.000)	7.613*** (0.000)	2.378*** (0.000)
LBFg	0.682* (0.055)	0.700* (0.079)	0.682* (0.054)	0.786 (0.508)	0.445 (0.670)	0.585 (0.41)
HCI	0.754 (0.690)	1.245 (0.537)	0.754 (0.690)	3.145* (0.064)	7.940*** (0.000)	4.366*** (0.000)
OPE	0.008 (0.718)	0.054* (0.068)	0.008 (0.717)	0.100** (0.015)	0.087** (0.034)	0.026 (0.409)
lnDEP	-0.592 (0.29)	-1.930 (0.518)	-0.592 (0.289)	-25.788 (0.529)	-23.616*** (0.000)	-1.634* (0.096)
Constants	-16.641 (0.000)	-16.960 (0.661)	-16.641 (0.000)	0.154 (0.875)		-19.653 (0.000)
R-Sq	0.0955	0.1072	0.0620	0.3574		
F-Stat	2.93	3.18		14.67		
F-Stat (p-value)	0.0040	0.0020		0.0000		
Wald-Stat.			23.44		6642.62	625.55
Wald-Stat. (p-value)			0.0028		0.000	0.000
Hausman Stat.			14.80			
Hausman (p-value)			0.0631			
BP-LM- Stat.			0.56			
BP-LM- (p-value)			0.4541			
AR(1)-(p-value)					0.041	0.033
AR(2)- (p-value)					0.372	0.695
Hansen Stat. (p-value)					0.780	0.982

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.
BP-LM = Breusch and Pagan Lagrangian multiplier

Source: Author’s Computation.

***Appendix* C-19.** Impact of HIV/AIDS on Economic Growth, Using Human Capital Index and Number of Persons Living with HIV/AIDS

Dependent Variable = Per Capita Income Growth (PCGDP g)

Regressors	OLS	FE	RE	FD	DIFF-GMM	SYS- GMM
PCGDP g(-1)	-0.013 (0.854)	-0.060 (0.391)	-0.013 (0.853)	-0.412*** (0.000)	0.091 (0.290)	0.041 (0.592)
HIVP	-0.080* (0.073)	0.111 (0.165)	-0.080* (0.071)	0.133 (0.763)	-0.438 (0.565)	-0.140** (0.048)
lnMAL	0.627* (0.073)	0.768* (0.095)	0.627* (0.072)	0.697 (0.143)	1.264 (0.349)	-0.212 (0.878)
LnFC	0.840* (0.091)	1.632** (0.014)	0.840* (0.089)	6.203*** (0.000)	7.616*** (0.000)	2.235*** (0.001)
LBFg	0.687* (0.054)	0.704* (0.075)	0.687* (0.053)	0.793 (0.503)	0.521 (0.630)	0.591 (0.403)
HCI	0.821 (0.665)	1.253 (0.533)	0.821 (0.664)	3.135* (0.065)	8.088*** (0.000)	4.344*** (0.000)
OPE	0.010 (0.655)	0.053* (0.070)	0.010 (0.655)	0.099** (0.016)	0.087** (0.030)	0.030 (0.377)
lnDEP	-0.551 (0.324)	-2.381 (0.427)	-0.551 (0.323)	-25.436 (0.534)	-21.940*** (0.000)	-1.601 (0.115)
Constants	-15.817 (0.001)	-10.630 (0.785)	-15.817 (0.001)	0.133 (0.892)		-18.602 (0.000)
R-Sq	0.0917	0.1099	0.0613	0.3576		
F-Stat	2.80	3.27		14.68		
F-Stat (p-value)	0.0056	0.0015		0.0000		
Wald-Stat.			22.42		11531.53	731.54
Wald-Stat. (p-value)			0.0042		0.000	0.000
Hausman Stat.			16.19			
Hausman (p-value)			0.0398			
BP-LM- Stat.			0.36			
BP-LM- (p-value)			0.5480			
AR(1)-(p-value)					0.043	0.034
AR(2)- (p-value)					0.406	0.666
Hansen Stat. (p-value)					0.547	0.698

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.
BP-LM = Breusch and Pagan Lagrangian multiplier

Source: Author's Computation.

***Appendix* C-20.** Impact of HIV/AIDS on Economic Growth, Using Human Capital Index and AIDS Deaths

Dependent Variable = Per Capita Income Growth (PCGDP g)

Regressors	OLS	FE	RE	FD	DIFF-GMM	SYS- GMM
PCGDP g(-1)	-0.002 (0.975)	-0.070 (0.319)	-0.002 (0.975)	-0.412*** (0.000)	0.113 (0.286)	0.041 (0.592)
AIDSD	-0.624 (0.254)	1.824** (0.031)	-0.624 (0.252)	3.606 (0.343)	-5.243 (0.457)	-1.269 (0.124)
lnMAL	0.665* (0.058)	0.806* (0.078)	0.665* (0.056)	0.715 (0.132)	1.255 (0.343)	-0.285 (0.842)
LnFC	0.750 (0.135)	1.766*** (0.006)	0.750 (0.134)	6.323*** (0.000)	7.501*** (0.000)	2.180*** (0.006)
LBFg	0.643* (0.073)	0.832** (0.033)	0.643* (0.071)	0.882 (0.456)	0.429 (0.696)	0.514 (0.462)
HCI	0.804 (0.674)	1.356 (0.498)	0.804 (0.673)	3.193* (0.060)	8.209*** (0.000)	4.241*** (0.000)
OPE	0.004 (0.866)	0.048* (0.094)	0.004 (0.866)	0.097** (0.017)	0.087*** (0.031)	0.0238 (0.455)
lnDEP	-0.547 (0.336)	-2.857 (0.340)	-0.547 (0.335)	-26.996 (0.509)	-22.721*** (0.000)	-1.598 (0.151)
Constants	-14.600 (0.001)	-7.034 (0.856)	-14.600 (0.001)	0.155 (0.874)		-16.607 (0.000)
R-Sq	0.0838	0.1213	0.0573	0.3600		
F-Stat	2.54	3.66		14.84		
F-Stat (p-value)	0.0115	0.0005		0.0000		
Wald-Stat.			20.32		9865.62	311.62
Wald-Stat. (p-value)			0.0092		0.000	0.000
Hausman Stat.			21.65			
Hausman (p-value)			0.0056			
BP-LM- Stat.			0.12			
BP-LM- (p-value)			0.7289			
AR(1)-(p-value)					0.052	0.036
AR(2)- (p-value)					0.483	0.703
Hansen Stat. (p-value)					0.402	0.696

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.
BP-LM = Breusch and Pagan Lagrangian multiplier

Source: Author's Computation.

***Appendix* C-21.** Impact of HIV/AIDS on Economic Growth through Life Expectancy, Using HIV Incidence

Dependent Variable = Per Capita Income Growth (PCGDP g)

Regressors	OLS	FE	RE	FD	DIFF-GMM	SYS- GMM
PCGDP g(-1)	-0.062 (0.364)	-0.102 (0.128)	-0.062 (0.363)	-0.450*** (0.000)	-0.034 (0.805)	-0.006 (0.96)
HIVI*LEP	-0.098*** (0.003)	-0.094* (0.057)	-0.098 (0.002)	-0.197 (0.322)	-0.076 (0.528)	-0.145*** (0.006)
lnMAL	0.200 (0.600)	0.657 (0.145)	0.200 (0.599)	0.607 (0.200)	-0.147 (0.963)	-0.938 (0.598)
LnFC	1.288** (0.014)	2.715*** (0.000)	1.288** (0.013)	5.862*** (0.000)	6.440*** (0.003)	2.627*** (0.000)
LBFg	0.779** (0.031)	0.504 (0.262)	0.779** (0.030)	0.533 (0.664)	-0.376 (0.700)	0.607 (0.201)
ENR	0.021* (0.087)	0.073*** (0.004)	0.021* (0.086)	0.114* (0.064)	0.110** (0.033)	0.035 (0.105)
OPE	-0.006 (0.782)	0.039 (0.188)	-0.006 (0.781)	0.106** (0.010)	0.105** (0.010)	0.015 (0.567)
lnDEP	-0.603 (0.271)	-13.111*** (0.004)	-0.603 (0.27)	-34.185 (0.409)	-26.108 (0.135)	-1.372 (0.187)
Constants	-18.854 (0.000)	130.094 (0.033)	-18.854 (0.000)	0.050 (0.960)		-20.447 (0.000)
R-Sq	0.1185	0.1425	0.0927	0.3602		
F-Stat	3.73	4.40		14.85		
F-Stat (p-value)	0.0004	0.0001		0.0000		
Wald-Stat.			29.84		564.65	75.62
Wald-Stat. (p-value)			0.0002		0.000	0.000
Hausman Stat.			31.13			
Hausman (p-value)			0.0001			
BP-LM- Stat.			0.11			
BP-LM- (p-value)			0.7355			
AR(1)-(p-value)					0.025	0.033
AR(2)- (p-value)					0.372	0.735
Hansen Stat. (p-value)					0.691	0.770

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.
BP-LM = Breusch and Pagan Lagrangian multiplier

Source: Author's Computation.

***Appendix* C-22.** Impact of HIV/AIDS on Economic Growth through Life Expectancy, Using HIV Prevalence

Dependent Variable = Per Capita Income Growth (PCGDPg)

Regressors	OLS	FE	RE	FD	DIFF-GMM	SYS- GMM
PCGDPg(-1)	-0.039 (0.558)	-0.084 (0.21)	-0.039 (0.557)	-0.446*** (0.000)	-0.033 (0.805)	-0.0004 (0.997)
HIVPR*LEP	-0.013** (0.011)	0.006 (0.504)	-0.013** (0.011)	0.006 (0.897)	-0.003 (0.880)	-0.021** (0.012)
lnMAL	0.432 (0.239)	0.693 (0.128)	0.432 (0.238)	0.628 (0.185)	-0.404 (0.897)	-0.663 (0.714)
LnFC	1.332** (0.015)	1.927*** (0.005)	1.332** (0.014)	5.878*** (0.000)	6.452*** (0.004)	2.823*** (0.000)
LBFg	0.576 (0.105)	0.199 (0.643)	0.576 (0.104)	0.261 (0.829)	-0.402 (0.612)	0.323 (0.497)
ENR	0.020 (0.113)	0.062** (0.014)	0.020 (0.112)	0.113* (0.065)	0.110** (0.028)	0.036 (0.149)
OPE	0.002 (0.927)	0.059** (0.042)	0.002 (0.927)	0.109*** (0.008)	0.106*** (0.009)	0.025 (0.403)
lnDEP	-0.776 (0.169)	-9.636** (0.025)	-0.776 (0.168)	-35.089 (0.398)	-24.133 (0.202)	-1.647 (0.142)
Constants	-19.889 (0.000)	91.774 (0.114)	-19.890 (0.000)	0.126 (0.897)		-23.279 (0.000)
R-Sq	0.1081	0.1295	0.0755	0.3573		
F-Stat	3.36	3.94		14.66		
F-Stat (p-value)	0.0012	0.0002		0.0000		
Wald-Stat.			26.91		146.34	122.39
Wald-Stat. (p-value)			0.0007		0.000	0.000
Hausman Stat.			19.75			
Hausman (p-value)			0.0113			
BP-LM- Stat.			0.40			
BP-LM- (p-value)			0.5248			
AR(1)-(p-value)					0.024	0.033
AR(2)- (p-value)					0.412	0.705
Hansen Stat. (p-value)					0.704	0.771

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.
BP-LM = Breusch and Pagan Lagrangian multiplier

Source: Author’s Computation.

***Appendix* C-23.** Impact of HIV/AIDS on Economic Growth through Life Expectancy, Using Number of Persons Living with HIV/AIDS

Dependent Variable = Per Capita Income Growth (PCGDPg)

Regressors	OLS	FE	RE	FD	DIFF-GMM	SYS- GMM
PCGDPg(-1)	-0.034 (0.616)	-0.085 (0.205)	-0.034 (0.615)	-0.446*** (0.000)	-0.009 (0.953)	-0.004 (0.976)
HIVP*LEP	-0.002** (0.022)	0.002 (0.303)	-0.002** (0.021)	0.002 (0.810)	-0.023 (0.352)	-0.004** (0.021)
lnMAL	0.480 (0.189)	0.709 (0.119)	0.480 (0.188)	0.629 (0.185)	1.073 (0.423)	-0.599 (0.739)
LnFC	1.193** (0.025)	1.888*** (0.005)	1.193** (0.024)	5.875*** (0.000)	6.553*** (0.000)	2.659*** (0.000)
LBFg	0.580 (0.104)	0.194 (0.651)	0.580 (0.102)	0.263 (0.827)	-0.250 (0.760)	0.326 (0.492)
ENR	0.020 (0.116)	0.062** (0.013)	0.020 (0.114)	0.113* (0.065)	0.141* (0.090)	0.037 (0.152)
OPE	0.005 (0.817)	0.059** (0.04)	0.005 (0.817)	0.109*** (0.008)	0.105** (0.017)	0.030 (0.361)
lnDEP	-0.717 (0.203)	-10.028** (0.019)	-0.717 (0.201)	-34.872 (0.401)	-26.437* (0.055)	-1.591 (0.169)
Constants	-18.891 (0.000)	97.935* (0.092)	-18.891 (0.000)	0.106 (0.914)		-22.088 (0.000)
R-Sq	0.1034	0.1320	0.0749	0.3574		
F-Stat	3.20	4.03		14.67		
F-Stat (p-value)	0.0018	0.0002		0.0000		
Wald-Stat.			25.61		102.34	112.85
Wald-Stat. (p-value)			0.0012		0.000	0.000
Hausman Stat.			22.78			
Hausman (p-value)			0.0037			
BP-LM- Stat.			0.19			
BP-LM- (p-value)			0.6643			
AR(1)-(p-value)					0.030	0.034
AR(2)- (p-value)					0.407	0.653
Hansen Stat. (p-value)					0.716	0.762

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.
BP-LM = Breusch and Pagan Lagrangian multiplier

Source: Author's Computation.

***Appendix* C-24.** Impact of HIV/AIDS on Economic Growth through Life Expectancy, Using AIDS Deaths

Dependent Variable = Per Capita Income Growth (PCGDPg)

Regressors	OLS	FE	RE	FD	DIFF-GMM	SYS- GMM
PCGDPg(-1)	-0.017 (0.796)	-0.096 (0.150)	-0.017 (0.796)	-0.447*** (0.000)	0.024 (0.890)	0.006 (0.959)
AIDSD*LEP	-0.015 (0.155)	0.035** (0.035)	-0.015 (0.154)	0.055 (0.473)	-0.204 (0.363)	-0.030* (0.084)
lnMAL	0.561 (0.126)	0.755* (0.095)	0.561 (0.125)	0.641 (0.176)	1.050 (0.418)	-0.271 (0.890)
LnFC	0.985* (0.063)	1.975*** (0.002)	0.985* (0.061)	5.954*** (0.000)	6.328*** (0.000)	2.368*** (0.003)
LBFg	0.547 (0.128)	0.276 (0.516)	0.547 (0.127)	0.332 (0.783)	-0.569 (0.532)	0.292 (0.566)
ENR	0.014 (0.239)	0.065*** (0.009)	0.014 (0.237)	0.113* (0.066)	0.148 (0.107)	0.026 (0.280)
OPE	-0.001 (0.961)	0.056* (0.051)	-0.001 (0.961)	0.108*** (0.009)	0.106** (0.017)	0.024 (0.436)
lnDEP	-0.649 (0.257)	-11.068** (0.010)	-0.649 (0.255)	-35.923 (0.387)	-31.220** (0.017)	-1.650 (0.212)
Constants	-16.591 (0.001)	110.475 (0.057)	-16.591 (0.000)	0.119 (0.903)		-19.278 (0.000)
R-Sq	0.0902	0.1459	0.0658	0.3588		
F-Stat	2.75	4.53		14.76		
F-Stat (p-value)	0.0065	0.0000		0.0000		
Wald-Stat.			22.02		50.56	101.02
Wald-Stat. (p-value)			0.0049		0.000	0.000
Hausman Stat.			26.83			
Hausman (p-value)			0.0008			
BP-LM- Stat.			0.03			
BP-LM- (p-value)			0.8531			
AR(1)-(p-value)					0.045	0.036
AR(2)- (p-value)					0.654	0.681
Hansen Stat. (p-value)					0.217	0.636

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.
BP-LM = Breusch and Pagan Lagrangian multiplier

Source: Author's Computation.

***Appendix* C-25.** Impact of HIV/AIDS on Economic Growth through Primary School Enrolment, Using HIV Incidence

Dependent Variable = Per Capita Income Growth (PCGDPg)

Regressors	OLS	FE	RE	FD	DIFF-GMM	SYS- GMM
PCGDPg(-1)	-0.018 (0.790)	-0.080 (0.242)	-0.018 (0.789)	-0.455*** (0.000)	-0.007 (0.959)	-0.022 (0.854)
HIVI*ENR	-0.031* (0.091)	-0.016 (0.624)	-0.031* (0.090)	-0.033 (0.777)	-0.075 (0.739)	-0.046 (0.167)
lnMAL	0.771* (0.061)	0.732 (0.111)	0.771* (0.059)	0.628 (0.189)	1.127 (0.398)	-0.362 (0.864)
LnFC	0.728 (0.163)	1.787*** (0.009)	0.730 (0.162)	5.617*** (0.000)	6.242*** (0.000)	1.943** (0.048)
LBFg	0.890** (0.025)	0.707 (0.116)	0.890** (0.024)	0.643 (0.611)	0.236 (0.789)	0.747 (0.352)
lnLEP	-2.905 (0.496)	17.839 (0.238)	-2.905 (0.496)	41.423 (0.594)	31.015 (0.293)	-3.133 (0.782)
OPE	0.015 (0.495)	0.046 (0.129)	0.015 (0.494)	0.103** (0.013)	0.094** (0.036)	0.039 (0.178)
lnDEP	-0.628 (0.360)	-7.156 (0.177)	-0.628 (0.359)	-28.789 (0.514)	-29.188** (0.004)	-1.319 (0.527)
Constants	-3.746 (0.804)	-8.124 (0.838)	-3.746 (0.804)	-0.014 (0.989)		-2.334 (0.946)
R-Sq	0.0903	0.1063	0.0706	0.3478		
F-Stat	2.76	3.15		14.07		
F-Stat (p-value)	0.0064	0.0021		0.0000		
Wald-Stat.			22.04		89.76	62.76
Wald-Stat. (p-value)			0.0048		0.000	0.000
Hausman Stat.			38.72			
Hausman (p-value)			0.0000			
BP-LM- Stat.			0.01			
BP-LM- (p-value)			0.9035			
AR(1)-(p-value)					0.039	0.031
AR(2)- (p-value)					0.368	0.482
Hansen Stat. (p-value)					0.540	0.827

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.
BP-LM = Breusch and Pagan Lagrangian multiplier

Source: Author's Computation.

***Appendix* C-26.** Impact of HIV/AIDS on Economic Growth through Primary School Enrolment, Using HIV Prevalence

Dependent Variable = Per Capita Income Growth (PCGDPg)

Regressors	OLS	FE	RE	FD	DIFF-GMM	SYS- GMM
PCGDPg(-1)	-0.009 (0.892)	-0.081 (0.229)	-0.009 (0.892)	-0.453*** (0.000)	-0.003 (0.980)	-0.019 (0.878)
HIVPR*ENR	-0.004 (0.179)	0.008 (0.102)	-0.004 (0.178)	0.017 (0.381)	-0.010 (0.730)	-0.006 (0.274)
lnMAL	0.844** (0.040)	0.741 (0.105)	0.844** (0.039)	0.635 (0.183)	1.143 (0.390)	-0.078 (0.972)
LnFC	0.744 (0.156)	1.534** (0.022)	0.744 (0.155)	5.692*** (0.000)	6.2989*** (0.000)	1.992* (0.061)
LBFg	0.763** (0.049)	0.454 (0.268)	0.763** (0.048)	0.408 (0.739)	0.186 (0.826)	0.608 (0.454)
lnLEP	-2.307 (0.589)	13.587 (0.353)	-2.307 (0.589)	44.718 (0.564)	21.976 (0.510)	-3.151 (0.806)
OPE	0.017 (0.477)	0.056* (0.053)	0.017 (0.476)	0.106** (0.011)	0.092** (0.027)	0.043 (0.190)
lnDEP	-0.686 (0.319)	-7.593 (0.139)	-0.686 (0.317)	-33.958 (0.443)	-24.370** (0.050)	-1.535 (0.490)
Constants	-6.270 (0.679)	18.519 (0.667)	-6.270 (0.679)	-0.011 (0.991)		-3.580 (0.927)
R-Sq	0.0860	0.1165	0.0587	0.3500		
F-Stat	2.61	3.50		14.20		
F-Stat (p-value)	0.0095	0.0008		0.0000		
Wald-Stat.			20.89		74.40	263.61
Wald-Stat. (p-value)			0.0074		0.000	0.000
Hausman Stat.			17.48			
Hausman (p-value)			0.0255			
BP-LM- Stat.			0.14			
BP-LM- (p-value)			0.7046			
AR(1)-(p-value)					0.038	0.032
AR(2)- (p-value)					0.385	0.449
Hansen Stat. (p-value)					0.844	0.782

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.
BP-LM = Breusch and Pagan Lagrangian multiplier

Source: Author's Computation.

***Appendix* C-27.** Impact of HIV/AIDS on Economic Growth through Primary School Enrolment, Using Number of Persons Living with HIV/AIDS

Dependent Variable = Per Capita Income Growth (PCGDPg)

Regressors	OLS	FE	RE	FD	DIFF-GMM	SYS- GMM
PCGDPg(-1)	-0.007 (0.919)	-0.082 (0.221)	-0.007 (0.919)	-0.453*** (0.000)	-0.013 (0.924)	-0.023 (0.857)
HIVP*ENR	-0.0005 (0.271)	0.002* (0.075)	-0.0005 (0.270)	0.003 (0.359)	-0.0001 (0.980)	-0.004** (0.029)
lnMAL	0.844** (0.040)	0.754* (0.099)	0.844** (0.039)	0.636 (0.182)	1.109 (0.404)	0.582 (0.776)
LnFC	0.684 (0.191)	1.552** (0.020)	0.684 (0.190)	5.688*** (0.000)	6.247*** (0.000)	1.903** (0.015)
LBFg	0.750* (0.053)	0.466 (0.252)	0.750* (0.052)	0.432 (0.724)	0.003 (0.996)	0.793 (0.446)
lnLEP	-2.073 (0.630)	15.222 (0.296)	-2.073 (0.629)	45.475 (0.558)	26.892 (0.427)	-0.508 (0.964)
OPE	0.016 (0.516)	0.054* (0.063)	0.016 (0.516)	0.104** (0.012)	0.097** (0.025)	0.114* (0.095)
lnDEP	-0.650 (0.345)	-8.654* (0.098)	-0.650 (0.344)	-32.694 (0.459)	-27.734** (0.049)	-1.647 (0.337)
Constants	-6.562 (0.667)	27.656 (0.536)	-6.562 (0.666)	-0.069 (0.945)		-19.223 (0.533)
R-Sq	0.0836	0.1187	0.0600	0.3502		
F-Stat	2.53	3.57		14.21		
F-Stat (p-value)	0.0118	0.0007		0.0000		
Wald-Stat.			20.24		80.15	543.20
Wald-Stat. (p-value)			0.0095		0.000	0.000
Hausman Stat.			7.76			
Hausman (p-value)			0.3543			
BP-LM- Stat.			0.04			
BP-LM- (p-value)			0.8334			
AR(1)-(p-value)					0.037	0.032
AR(2)- (p-value)					0.352	0.468
Hansen Stat. (p-value)					0.644	0.999

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.
BP-LM = Breusch and Pagan Lagrangian multiplier

Source: Author’s Computation.

***Appendix* C-28**. Impact of HIV/AIDS on Economic Growth through Primary School Enrolment, Using HIV AIDS Deaths

Dependent Variable = Per Capita Income Growth (PCGDPg)

Regressors	OLS	FE	RE	FD	DIFF-GMM	SYS- GMM
PCGDPg(-1)	-0.004 (0.954)	-0.093 (0.166)	-0.004 (0.954)	-0.454*** (0.000)	-0.014 (0.925)	0.001 (0.992)
AIDSD*ENR	-0.006 (0.355)	0.024** (0.018)	-0.006 (0.354)	0.044 (0.254)	-0.010 (0.880)	-0.058* (0.084)
lnMAL	0.846** (0.040)	0.773* (0.089)	0.846** (0.038)	0.649 (0.173)	1.085 (0.413)	-0.271 (0.905)
LnFC	0.718 (0.171)	1.636** (0.013)	0.718 (0.170)	5.787*** (0.000)	6.271*** (0.000)	2.101*** (0.002)
LBFg	0.717* (0.064)	0.575 (0.148)	0.717* (0.063)	0.524 (0.666)	0.061 (0.945)	0.317 (0.724)
lnLEP	-2.070 (0.631)	19.774 (0.175)	-2.070 (0.630)	58.349 (0.460)	23.120 (0.603)	3.994 (0.688)
OPE	0.013 (0.587)	0.050* (0.083)	0.013 (0.587)	0.103** (0.012)	0.095** (0.017)	0.090 (0.191)
lnDEP	-0.693 (0.315)	-10.357* (0.051)	-0.693 (0.314)	-36.632 (0.409)	-25.719* (0.090)	-1.395 (0.450)
Constants	-6.522 (0.670)	33.538 (0.438)	-6.522 (0.669)	-0.042 (0.966)		-31.748 (0.243)
R-Sq	0.0821	0.1286	0.0579	0.3516		
F-Stat	2.48	3.91		14.30		
F-Stat (p-value)	0.0135	0.0002		0.0000		
Wald-Stat.			19.85		75.78	200.35
Wald-Stat. (p-value)			0.0109		0.000	0.000
Hausman Stat.			25.09			
Hausman (p-value)			0.0015			
BP-LM- Stat.			0.04			
BP-LM- (p-value)			0.8442			
AR(1)-(p-value)					0.044	0.038
AR(2)- (p-value)					0.262	0.734
Hansen Stat. (p-value)					0.993	0.991

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.
BP-LM = Breusch and Pagan Lagrangian multiplier

Source: Author's Computation.

***Appendix* C-29.** Impact of HIV/AIDS on Economic Growth through Human Capital Index, Using HIV Incidence

Dependent Variable = Per Capita Income Growth (PCGDPg)

Regressors	OLS	FE	RE	FD	DIFF-GMM	SYS- GMM
PCGDPg(-1)	-0.050 (0.469)	-0.091 (0.185)	-0.049 (0.468)	-0.453*** (0.000)	-0.020 (0.894)	-0.044 (0.721)
HIVI*HCI	-9.874*** (0.008)	-9.366 (0.113)	-9.874*** (0.007)	0.825 (0.963)	-7.924 (0.959)	-12.616*** (0.002)
lnMAL	0.481 (0.171)	0.737 (0.107)	0.481 (0.169)	0.636 (0.183)	1.099 (0.396)	-0.527 (0.589)
LnFC	0.842* (0.078)	2.333*** (0.001)	0.842* (0.076)	5.692*** (0.000)	6.268*** (0.001)	2.050*** (0.003)
LBFg	0.830** (0.020)	0.997** (0.017)	0.830** (0.019)	0.676 (0.572)	0.129 (0.926)	0.6738 (0.308)
OPE	0.012 (0.543)	0.037 (0.218)	0.012 (0.543)	0.103** (0.012)	0.097** (0.025)	0.0302 (0.282)
lnDEP	-0.399 (0.467)	-3.657 (0.248)	-0.399 (0.466)	-21.736 (0.598)	-20.828* (0.079)	-1.113 (0.278)
Constants	-16.229 (0.000)	-2.158 (0.957)	-16.229 (0.000)	0.098 (0.921)		-16.608 (0.000)
R-Sq	0.1059	0.1109	0.0860	0.3468		
F-Stat	3.77	3.79		16.08		
F-Stat (p-value)	0.0007	0.0007		0.0000		
Wald-Stat.			26.41		68.74	79.98
Wald-Stat. (p-value)			0.0004		0.000	0.000
Hausman Stat.			10.20			
Hausman (p-value)			0.1773			
BP-LM- Stat.			0.06			
BP-LM- (p-value)			0.8051			
AR(1)-(p-value)					0.033	0.038
AR(2)- (p-value)					0.356	0.490
Hansen Stat. (p-value)					0.528	1.000

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.
BP-LM = Breusch and Pagan Lagrangian multiplier

Source: Author’s Computation.

***Appendix* C-30.** Impact of HIV/AIDS on Economic Growth through Human Capital Index, Using HIV Prevalence

Dependent Variable = Per Capita Income Growth (PCGDPg)

Regressors	OLS	FE	RE	FD	DIFF-GMM	SYS- GMM
PCGDPg(-1)	-0.031 (0.648)	-0.070 (0.300)	-0.031 (0.648)	-0.453*** (0.000)	-0.014 (0.924)	-0.016 (0.9)
HIVPR*HCI	-1.394** (0.018)	0.712 (0.507)	-1.394** (0.017)	0.313 (0.940)	-2.970 (0.802)	-2.145*** (0.009)
lnMAL	0.657* (0.055)	0.755 (0.101)	0.657* (0.054)	0.635 (0.183)	1.103 (0.407)	-0.366 (0.794)
LnFC	0.947* (0.056)	1.733** (0.011)	0.947* (0.055)	5.688*** (0.000)	6.247*** (0.000)	2.268*** (0.000)
LBFg	0.675* (0.054)	0.698* (0.073)	0.675* (0.053)	0.681 (0.567)	0.169 (0.845)	0.476 (0.472)
OPE	0.0208 (0.339)	0.052* (0.078)	0.021 (0.338)	0.103** (0.012)	0.094** (0.033)	0.048 (0.172)
lnDEP	-0.603 (0.277)	-2.090 (0.486)	-0.603 (0.276)	-21.804 (0.596)	-18.548** (0.010)	-1.379 (0.203)
Constants	-17.479*** (0.000)	-15.589 (0.690)	-17.479*** (0.000)	0.094 (0.924)		-18.986 (0.000)
R-Sq	0.1001	0.1021	0.0652	0.3468		
F-Stat	3.55	3.46		16.08		
F-Stat (p-value)	0.0012	0.0016		0.0000		
Wald-Stat.			24.82		77.55	278.75
Wald-Stat. (p-value)			0.0008		0.000	0.000
Hausman Stat.			11.77			
Hausman (p-value)			0.1082			
BP-LM- Stat.			0.65			
BP-LM- (p-value)			0.4207			
AR(1)-(p-value)					0.036	0.033
AR(2)- (p-value)					0.348	0.625
Hansen Stat. (p-value)					0.586	0.644

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.
BP-LM = Breusch and Pagan Lagrangian multiplier

Source: Author’s Computation.

***Appendix* C-31.** Impact of HIV/AIDS on Economic Growth through Human Capital Index, Using Number of Persons Living with HIV/AIDS

Dependent Variable = Per Capita Income Growth (PCGDPg)

Regressors	OLS	FE	RE	FD	DIFF-GMM	SYS- GMM
PCGDPg(-1)	-0.024 (0.719)	-0.070 (0.300)	-0.024 (0.719)	-0.451*** (0.000)	-0.013 (0.928)	-0.018 (0.882)
HIVP*HCI	-0.213** (0.039)	0.177 (0.356)	-0.212** (0.038)	0.232 (0.757)	-1.043 (0.632)	-0.326** (0.020)
lnMAL	0.702** (0.041)	0.769* (0.095)	0.702** (0.040)	0.639 (0.180)	1.100 (0.410)	-0.281 (0.841)
LnFC	0.814* (0.093)	1.711** (0.011)	0.814* (0.091)	5.702*** (0.000)	6.177*** ((0.000))	2.094*** (0.002)
LBFg	0.677* (0.055)	0.702* (0.07)	0.677* (0.054)	0.687 (0.563)	0.193 (0.826)	0.481 (0.464)
OPE	0.022 (0.336)	0.051* (0.080)	0.022 (0.335)	0.103** (0.012)	0.095** (0.027)	0.049 (0.164)
lnDEP	-0.560 (0.313)	-2.454 (0.419)	-0.560 (0.312)	-21.996 (0.593)	-15.742* (0.063)	-1.353 (0.233)
Constants	-16.264 (0.000)	-10.050 (0.801)	-16.264 (0.000)	0.0760 (0.938)		-17.351*** (0.001)
R-Sq	0.0945	0.1039	0.0632	0.3471		
F-Stat	3.33	3.53		16.10		
F-Stat (p-value)	0.0022	0.0013		0.0000		
Wald-Stat.			23.28		68.28	323.74
Wald-Stat. (p-value)			0.0015		0.000	0.000
Hausman Stat.			13.67			
Hausman (p-value)			0.0574			
BP-LM- Stat.			0.38			
BP-LM- (p-value)			0.5380			
AR(1)-(p-value)					0.038	0.034
AR(2)- (p-value)					0.365	0.581
Hansen Stat. (p-value)					0.489	0.633

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.
BP-LM = Breusch and Pagan Lagrangian multiplier

Source: Author's Computation.

***Appendix* C-32.** Impact of HIV/AIDS on Economic Growth through Human Capital Index, Using AIDS Deaths

Dependent Variable = Per Capita Income Growth (PCGDPg)

Regressors	OLS	FE	RE	FD	DIFF-GMM	SYS- GMM
PCGDPg(-1)	-0.012 (0.852)	-0.079 (0.242)	-0.012 (0.852)	-0.452*** (0.000)	0.010 (0.952)	-0.012 (0.926)
AIDSD*HCI	-1.993 (0.136)	3.751* (0.067)	-1.993 (0.134)	4.758 (0.556)	-11.718 (0.542)	-3.569** (0.044)
lnMAL	0.722** (0.036)	0.810* (0.077)	0.722** (0.035)	0.646 (0.175)	1.100 (0.406)	-0.347 (0.812)
LnFC	0.782 (0.113)	1.757*** (0.007)	0.782 (0.112)	5.744*** (0.000)	6.155*** (0.000)	2.127*** (0.006)
LBFg	0.622* (0.078)	0.794** (0.039)	0.622* (0.077)	0.732 (0.538)	0.126 (0.895)	0.401 (0.54)
OPE	0.014 (0.537)	0.048* (0.097)	0.014 (0.536)	0.102** (0.013)	0.094** (0.030)	0.043 (0.215)
lnDEP	-0.602 (0.288)	-3.119 (0.305)	-0.602 (0.287)	-22.797 (0.579)	-17.197*** (0.006)	-1.430 (0.235)
Constants	-15.099 (0.001)	-1.976 (0.960)	-15.099 (0.001)	0.086 (0.930)		-15.822 (0.006)
R-Sq	0.0863	0.1143	0.0552	0.3479		
F-Stat	3.01	3.93		16.16		
F-Stat (p-value)	0.0049	0.0005		0.0000		
Wald-Stat.			21.06		65.40	249.35
Wald-Stat. (p-value)			0.0037		0.000	0.000
Hausman Stat.			19.34			
Hausman (p-value)			0.0072			
BP-LM- Stat.			0.28			
BP-LM- (p-value)			0.5996			
AR(1)-(p-value)					0.046	0.036
AR(2)- (p-value)					0.314	0.628
Hansen Stat. (p-value)					0.466	0.641

Note: ****, **,* denote significance at 1%, 5% and 10% levels respectively while probabilities are in parenthesis.
BP-LM = Breusch and Pagan Lagrangian multiplier

Source: Author’s Computation.