ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATES STUDIES

ASSESSING THE ECONOMIC GROWTH IMPACT OF AIDS: *THE ETHIOPIAN CASE*

BY
BRHANU HABTU BERHEA

A thesis presented to the School of Graduate Studies
Addis Ababa University
In partial fulfillment of the requirements for the Degree of
Master of Science in Economics (Economic Policy Analysis)

March 31, 2006
Addis Ababa

Addis Ababa University
School of Graduate Studies

Assessing the Growth Impact of AIDS: The Ethiopian Case

By
Brhanu Habtu Berhea

Approved by the Board of Examiners:

DR. J. MANOHAR RAO
Advisor

Signature

Dr. Issac Paul
Examiner

Signature

Getnet Alemu
Examiner

Signature

Acknowledgments

I wish to acknowledge my appreciation to those who were beside me in finalizing this study.

First, I would like to thank Dr. J Manohar Rao for his advice and invaluable comments.

I would also like to acknowledge African Economic Research Consortium for sponsoring my study at the university.

Lastly, but not least I would like to express my heart felt gratitude to my family and friends for their moral support and encouragement during those years. In this regard, I owe a lot to Eden.

Table of Contents

List of Tables and Figures

Page

Annexes

List of Abbreviations

ADF = Augmented Dickey & Fuller

AIDS = Acquired immune deficiency syndrome

CSA = Central Statistical Authority

EPRDF = Ethiopian peoples revolutionary democratic front

HIV = Human Immunodeficiency Virus

GDP= Gross Domestic Product

GCF = Gross Capital Formation

GDS = Gross Domestic Saving

LAIDS = log of AIDS cases

LGPC = log of GDP per capita

LHAP = log of HIV prevalence

LINV = log of investment to GDP ratio

LLELA = log of life expectancy lost due to AIDS

LNGD = log of ngd (population growth, technological growth and depreciation rate)

MOH = Ministry of Health

MOLSA = Ministry of Labor and Social Affairs

MRW = Mankiew, Romer and Weil model

NBE = National Bank of Ethiopia

NIC = National Intelligence Office of USA

UNAIDS = Joint United Nations Programme on HIV/AIDS

UNECA = United Nations Economic Commissions for Africa

WHO = World Health Organization

Abstract

Several studies have tried to show the extent HIV/AIDS epidemic slows down economic growth of highly infected developing countries.

Ethiopia like those countries has a rising incidence rate and large number of people living with the virus. This paper primarily aims to highlight the impact of this epidemic on GDP per capita of the country and draw some policy implications thereof. The investigation employs extended Solow growth model and uses time series data.

According to the findings, like in many countries investment has affected economic growth of the country positively, while it is indeterminate to that of population growth. More importantly, the finding conveyed that AIDS has imposed its quantifiable adverse impact on GDP per capita of the country since its outbreak.

Given the epidemic's prime impact on labor quality and so of economic growth, and the nature of the country's economy, it indicates a need for an intensive and integrated intervention effort in prevention of the virus expansion especially in rural area where around 85% population lives and the mainstay sector of the economy hinges upon.

1. INTRODUCTION

1.1 BACKGROUND

Due to the heavy impact, it has imposed on the economic, social, cultural, and political arena, HIV/AIDS has become the most burning and debating issue in the global media and other research fields. Currently, beyond demographic and health issue, it has become more of development agenda, as a consequence of destruction it has been recording since it was first identified in 1981 (UNAIDS & WHO, 2005).

To begin with, in the year 2005, 40.3 million people out of which 38 million adults were living with HIV/AIDS globally. Newly infected and death of adults from HIV/AIDS were 4.2 and 2.6 million respectively in the same year. This indicates a rising incidence rate, and despite all efforts and a glimpse of change, piling up of the prevalence rate to horrible and gloomy future (UNAIDS/WHO, 2005).

In Sub Saharan Africa (SSA) about 25.8 million adults and children that constitutes for two third of the total were estimated to be living with HIV/AIDS. In addition, in this region in the year 2005 newly infected and death of both adults and children were estimated to be 3.5 million and 2.4 million respectively (ibid).

Up to the year 2000 alone when Africa had buried three quarters of the more than 20 million people who died world wide of AIDS, 12 million children have been orphaned (UNECA, 2000). In these figures, beyond their mere factual contents, reside far-reaching meaningful economic realities. The adverse influence of such losses can be translated into different sectors and the overall economic performance. For instance in some highly infected countries, life expectancy was projected to fall down to around 30 years which would reverse totally what has so far been gained for decades (Bonnel, 2000). In 2005, the region faces life expectancy fall by about 14 years on average. Similarly, population growth would start to grow negatively

and at zero rate or remain intact in some countries (Espstein, 2004). On average adult mortality has increased due to AIDS' life expectancy cut at birth by half, provided that infant mortality is taken into account (Espstein, 2004). Under normal circumstances mortality for different age cohorts follow the J curve, nevertheless, as a consequence of AIDS the curve switches its shape into humped in the middle of the curve, that is higher mortality rate on the age group of adult age group (ibid).

The pandemic, on top of demographic and health effects just mentioned, erodes the most fundamental factors of economic development such as *social*, physical and human capital with their immediate and long-run adverse repercussions on GDP growth or per capita income. In 1999, the GDP per capita in Africa was 0.4%, which should have been 1.1% per year without AIDS that was 8.6% prevalence rate by then (ibid).

Annual cost of treating an adult AIDS patient for instance in Tanzania and Malawi during 1990's was estimated at Tsh 3,230 and 232 kwacha respectively of each country's currency (Cuddington, 1993; Cuddington & Hancock, 1994). These figures when multiplied by the total number of people living with AIDS claim extremely large financial resource compared to GDP and capital of such countries, which grew at slower rate.

Being in SSA, Ethiopia is one of those countries hardest-hit by the epidemic. The country was ranked third in HIV/AIDS prevalence in Africa next to South Africa and Nigeria, while it was second in adult prevalence rate following South Africa (MOLSA, 2003; Shewit, 2002).

Official documents of the government revealed that 2.2 million people were estimated to live with HIV/AIDS in 2001 out of which 2 million were adults and 200, 000 children. 219,400 of them were full blown AIDS cases (MOH, 2002). Other international organizations did not agree on this number. Instead, they estimated it to be between 3 to 5 million (NIC, 2003). Needless to mention the country have registered a good sign on its prevention, which currently

have leveled off with a total prevalence of 1.5 million people (MOH, 2004). Whichever figure represents the truth, still picking any of the two predictions ensure that the country can be categorized under those highly infected countries. Worst of all, about 91% of the reported AIDS cases are adults falling in the 15 to 49 years old- the most economically and socially productive age cohort.

It is helpful to see the implication on demographic and some economic performance indicators because these figures alone may not convey any concrete meaning.

Over 1.2 million people may have died of AIDS since the beginning of the epidemic (1986) up to the year 2000. In the year 2001 alone, it was estimated that about 160,000 people died of HIV/AIDS and related illnesses (Chima, 2003). Undoubtedly, due to the feature of the epidemic, the country buried the most skilled and experienced labor force, (synonymously accumulated human capital) that are directly reflected in output slow down. Resulting from its heavy toll of human life, life expectancy at birth was 48.8 in 2005 years, which should have been 53.5 years without AIDS. In the same year, population growth would slide down slightly from 2.6% to 2.4% per year (Espstein, 2004). Currently, those dying from the disease, largely adults and breadwinners of most households, have left above 1.2 million orphans implying a need to expand social security expenditure. These factors combined together has expanded social security expenditures with the likely impact on crowding out investment opportunities already undermined by a need to meet treatment cost in HIV or AIDS stages. Few studies that have attempted to derive some effect of the epidemic on the country's economic trajectory have depicted a possibility of significantly slowing down its growth (Bonnel, 2000; Daniel, 2001; Papageorgiou & Stoytcheva, 2004). Broadly speaking, the country has, one-way or the other, begun to harvest the severe burden virtually since late 90's, briefly the epidemic's detrimental growth impact has come to scene.

1.2 STATEMENT OF THE PROBLEM

In addition to factors behind the low performance of many African economies, namely, low level of saving, high population growth, low level of human capital, inward oriented economic policies, deteriorating terms of trade, overvaluation of exchange rate, etc, since recent times AIDS has become one of these economic growth plagues.

Its impact in some highly infected sub Saharan African countries was found to be quiet significant which extremely ranges to reversing economic growth countries' have achieved for decades.(Cuddington, 1993; Cuddington & Hancock, 1994; Bonnel, 2000; MacFaran & Sgherri, 2001; Haacker, 2002; Papageorgiou & Stoytcheva, 2004). Few studies did not agree with such findings rather argued the impact of the pandemic as insignificant, and the low growth recorded being mistakenly attributed to AIDS (Bloom & Mahal, 1995).

Primarily, AIDS destroys human capital and physical capital. In a sense, it erodes labor quality, labor size and capital formation/saving level, which are the most fundamental determinants of development and which have already been at stake/or low stage in SSA as well in Ethiopia.

Given the above human and related losses that arose due to the epidemic, Ethiopia can be classified as one of those hardest-hit countries and victim of its rapid spread. On the other side of the spectrum, the country's economy is known as labor intensive with very low level of saving/capital. Agriculture sector has considerably dominated the aggregate economy by accounting for 85% employment of the population, contributing above 50% to GDP and lion's share of export earnings (MOH, 2002; Shewit, 2002; NBE, 2001/02). The saving level, despite a slight improvement on average it showed (NBE, 2003/04), still is low even in comparison to SSA standards (Seyoum, 1997). The resource mobilized lags behind its investment need to make a progress and escape out of poverty. In short, AIDS has been spreading in a country

already tightened by susceptible economy and very low level of economic development determinants. And yet, albeit the noticeable attention it gets in several countries, commitment to health sector in Ethiopia still lags at embryology stage.

Thus, what is the concrete fact that may lie behind this all figures of the epidemic? Specifically, the research question are, therefore, first to explore the likely effect of AIDS spread since its outbreak on the overall economic performance of the country beyond the first influences it has already imposed; Second, to investigate if the effect of the epidemic has happened to be significant or immaterial.

Obviously there are some indications of negative impact of the disease on the country's GDP growth using simulation methodology (Bonnel, 2000) and GDP per capita applying cross-sectional analysis (Papageorgiou & Stoytcheva, 2004). In this approach, however, time series is opted due to some pitfalls involved with respect to assumptions while employing simulation and that of averaging between countries and periods while using cross sectional analysis.

1.3 OBJECTIVE OF THE STUDY

In general, objective of the study focuses on assessing the real impact of the epidemic on aggregate economic performance of the country. Specifically, it

- assesses whether AIDS affects GDP growth and per capita income and to examine the impact extent using econometric tools;
- examines the immediate effects of AIDS such as labor force size and labor productivity
- explores policy implications and strategies to combat the spread of the epidemic and its related costs

1.4 SIGNIFICANCE

On this special field where barely few studies have been done, the study has its own value added. Studies so far conducted in relation to HIV/AIDS, in addition to being very few in number are mainly focused at household and factory level. This paper targeted at assessing the impact of the virulent disease on the works of the macroeconomy in aggregate using the growth model. Besides, there is a hope that the study may induce and be used as benchmark to other researchers who have the interest on this serious and timely issue to fill the gap in the long run to what so far have been achieved. Against these justifying aims, long-term approach suits best in order to investigate the actual impact of HIV/AIDS, which by its typical nature would inflict its influence after 8-10 years of its inception. What's more, the country, in view of its objective to materialize the Poverty Reduction Strategy Paper (PRSP) and the Millennium Development Goals (MDGs), envisages reducing the existing poverty by 50% by the year 2015. Most studies have already consolidated the proposition that AIDS retards the economic growth of several countries. And as long as HIV/AIDS and poverty have positive association, the pandemic obviously stands against the aforementioned visions. Hence, the study can contribute its share in pinpointing areas of intervention to combat the pandemic and thereby meet the country's as well as UN motto known by MDGs.

1.5 HYPOTHESIS

The main hypothesis to be tested is,

AIDS affects adversely and significantly the level of GDP per capita.

1.6 SCOPE AND LIMITATION OF THE STUDY

Since the main interest of the study lies on drawing some implications of AIDS, the analysis relies on and incorporates only few but fundamental parameters. Above all the study's shortcomings arose in obtaining consistent and reliable data on AIDS cases and treatment costs related to them. We could not get full and systematically documented reports in connection to AIDS cases, which obliges to leave the conclusion open for further and detail study.

1.7 ORGANIZATION OF THE STUDY

The study is organized as follows. Chapter two deals with overview of the macroeconomic performance and HIV/AIDS prevalence and incidence in the country. Chapter three briefly reviews both theoretical and empirical literatures with an emphasis on economic growth and AIDS cases. Chapter four devoted to brief discussion on methodology, model specification, and data set. Both empirical results and respective interpretations are dealt with in chapter five. Finally, chapter six concludes with forwarding policy implications.

2. OVERVIEW OF ETHIOPIAN ECONOMY AND HIV/AIDS

2.1 MACROECONOMIC PERFORMANCE

In the first part of this chapter, discussion focuses on the macroeconomic performance of the country since 1980, i.e. explore the Derge and EPRDF regime. The emphasis rests on major macro variables, among others real GDP growth and real GDP per capita growth, investment and saving trends over the specified period. In addition, sectoral activity with special focus on the contribution to GDP is seen.

2.1.1 PRE 1990/91 MACROECONOMIC TREND ANALYSIS

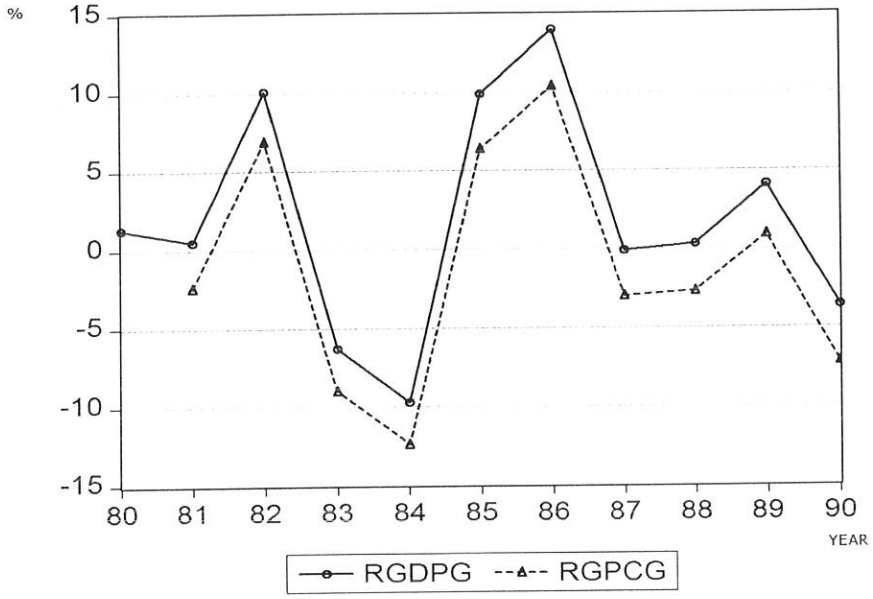
GDP AND GDP PER CAPITA

During this period, spanning over the years 1980/81-1990/91 real GDP grew on average by 1.9% while population growth was at 3% annual average. Owing to this unbalanced growth, real GDP per capita was declining by a yearly average of about 1.2 percentage points (Berhanu & Seid, 1999). Instead of an increasing income and thereby the well-being the country registered very poor macroeconomic activity.

The diagram below witnesses GDP growth had fluctuated from year to year. For ease of analysis we can note three episodes: those are years before and after 1984/85, and at the advent of the regimes downfall.

Before the drought year, despite the prevailed command economy, which had been implemented as a leading policy, the economy performed well. The campaigns decreed and launched during these periods are credited to such worth noting growth (Seyoum, 1997).

Figure 1. Annual Growth Rate of Real GDP and Real GDP Per Capita



Source: NBE various publications

However, drought and famine that occurred in 1984/85 turned upside-down things totally. Real GDP grew by negative 9.7% in this year and reached its bottom ever seen historically. The following years tend to show a slight improvement and boost the GDP growth, which recorded 14% in 1986/87. Generosity of nature implicitly rainfall was warranted behind this success story. Agricultural sector in our country was and is still rain fed which makes it highly susceptible to natural calamities. Thus, the economy waxed and waned following the same wave of the agriculture sector, a sector covering for 53% on average of the total GDP's share (Berhanu & Seid, 1999). The economy undisputedly hinged up on the fate of agricultural sector.

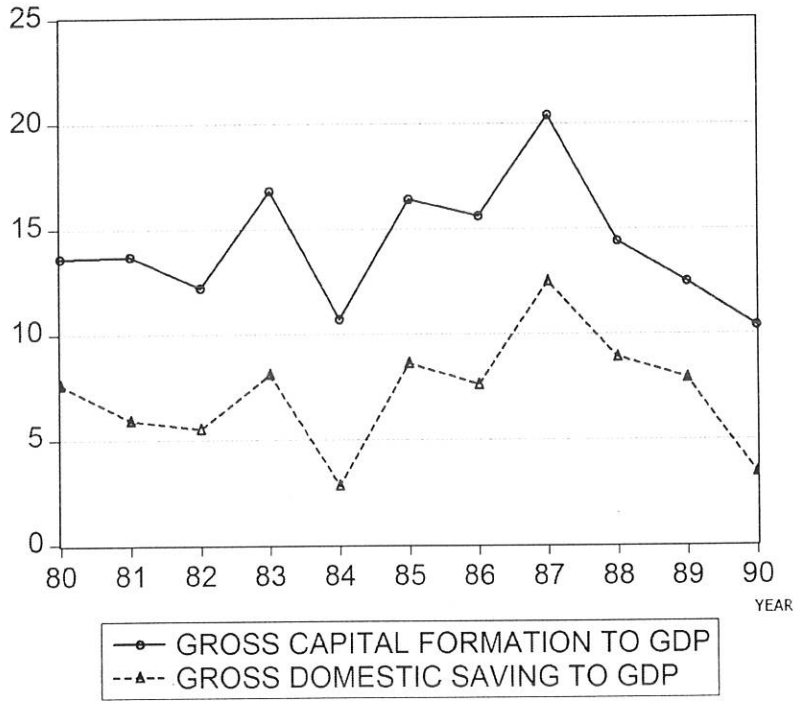
At the end of its period, the economy again did work very poorly during this time mainly due to deepening internal crisis or civil war. For instance, real GDP growth and real GDP per

capita were -4.2% and -7.2% respectively in 1990/91. Broadly speaking, the real economic growth on average in the period under discussion recorded low and ever perpetually declining trend.

TRENDS IN SAVING & INVESTMENT

Saving and investment are one of the fundamental growth determinants and behind fascinating growth performance of many developed and developing countries. With this in mind and as one of our explanatory variables, it is essential to examine their trend.

Figure 2. Annual Percentage of GCF/GDP and GDS/GDP



Source: NBE. various publications

Gross Domestic Saving to GDP ratio fluctuated between the lowest 2.8% in 1984/85 and 3.4% 1990/91 to the highest 12.5% in 1987/88. Compared to its predecessor, in general saving was very low even by any sub Saharan standard. The figure is not surprising, however, because

first intentionally the economic policy was designed to discourage private sector saving and property denying the pivotal role of the sector; next the only source state saving, was awash by an accelerating government consumption expenditure the lion's share being allotted on military expenditure.

Investment trend expressed by gross capital formation to GDP ratio exhibited a gradual increase up to the year 1987/88 with ever-registered 20.4% in its governance. The following years it declined continuously to reach as low as 10.4% at the end of the regimes power, i.e.1990/91. As described above no vital role was given to the private sector investment instead, largely the investment was undertaken by the state. On average investment grew at 14.2% per annum, which was still below the standard for developing countries (Seyoum, 1997).

Due to the above facts, the resource gap- the difference between saving and investment- that is worth discussing, was negative and big absolutely. On average, during periods of Derge under consideration, the resource gap was 7.1% of GDP. Put differently the economy using its domestically mobilized resource was unable to cover the investment projects carried out by then. The last resort at the hand of the government was therefore to seek for other sources such as external source and locally via money creation and domestic bank borrowing.

Nevertheless, these alternative sources possess their own undesired costs. Explicitly, they could increase debt-service ratio, inflation and crowed out the insignificant private investment respectively. Often, these are the manifestations of unhealthy economic performance.

2.1.2 POST 1990/91 MACROECONOMIC TREND ANALYSIS

GDP AND GDP PER CAPITA

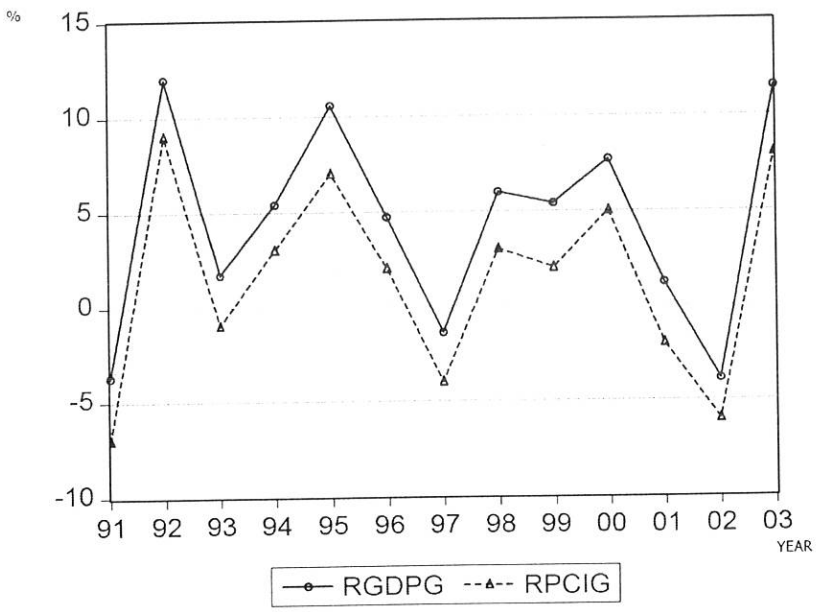
With the coming into power of the incumbent government in 1990/91, New Economic Policy reform, picked as market oriented, was put in place. This direction was believed to rescue the economy, which was at the advent of debacle. It gained immense assistance from the giant advocates of the capitalist system mainly IMF, World Bank as well as bilateral governments. These groups ploughed back the government with enormous donations and loans via structural adjustment programme and other stabilization projects having embraced package of reforms. As a result of these measures, the economy began to revitalize from its historic poor performance and on average has shown promising growth over the ruling party's period. Figure 3 below depicts the real GDP growth for the period 1991/92-2003/04. On average real GDP has grown by 4.7% which is an acclaimed performance in comparison to the preceding period but not as is expected to be since it is short of bailing out the population from abject poverty. Within this achievement, notably, the economy was also moving ups and downs in few exceptional years. When the government commenced its administration, for instance, the growth was negative,-3.7%, that could be attributed to political and other instabilities, and making it subtle to pull out from the previous trough.

Then after, nonetheless, the economy achieved growth for longer period of time until 1996/97. Various researchers stated varying plausible reasons based on their findings for outcome. Generosity of donors that came with the aforementioned programme (Berhanu & Seid, 1999), good whether and appropriate macroeconomic policies with due attention given to agriculture (Seyoum, 1997; Eqaur, 2001; NBE, 2001/02) are among the major ones. Despite the tremendous progress, in 1997/98 the economy fell back again into negative growth mainly due to sharp drop in agricultural output and the Ethio-Eritrean border conflict with its bearings as

implied in uncertainty and looted the country's resource to the war end than productive activities.

Then again, the economy revived and bounced back into positive growth after 1998/99 with the lowest being registered in the year 2002/03. Like the preceding arguments, here too, the agriculture performance which is rain fed determined the success or failure of the economy. Noteworthy is that apart from the above factors, the influence of the global economy such as international fall in price of coffee which contributed to lower growth in 2002/03 has aggravated the decline caused by sever drought that hit the mainstay sector of the economy back then.

Figure 3. Annual Growth of Real GDP (RGDPG) & Real GDP Per Capita (RPCIG)



Source: NBE various publications

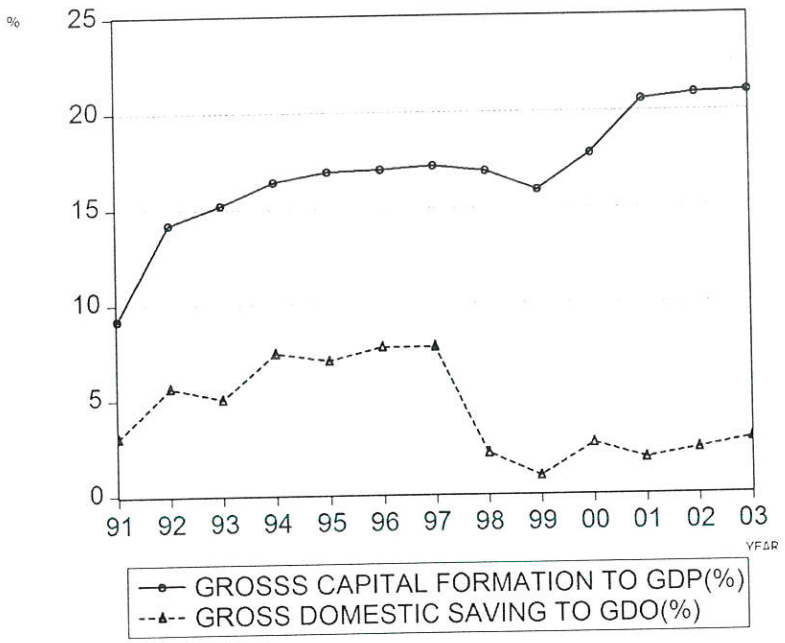
In spite of the difference in magnitude, real GDP per capita followed the same direction of real GDP movements. This fashion would continue provided that the country unless and otherwise has create the capability to harness the population growth. In the review period, the pattern of

population growth was like in the Derge period, around 3% per annum. Concisely, the two macroeconomic variables are victims or vulnerable to the fate of agriculture which has been under the benevolent of nature, i.e. rainfall.

Under the current governance, the structure of the economy has sustained to be dominated by agriculture sector, which constitutes for 85% of the total employment and slightly less than 50% contribution to GDP (NBE, 2001/02), like its predecessors. Despite the gradual decline in its share to below 50% especially after 1998/99, its importance continues to determine overwhelmingly economic growth of the country. Service sector is coping up the share of agriculture. In 2003/04, it even overtakes the lead by contributing 46.6% to GDP, whereas industry, hitherto, remains immaterial with below 11% share.

TREND IN SAVING & INVESTMENT

Figure 4. Annual Percentage of GCF/GDP & GDS/GDP



Source: NBE various publications

As depicted in figure 4, over the review period, in aggregate, gross capital formation to GDP moved upward while gross domestic saving to GDP ratio shows fluctuation. On average, they grow by 4.4% and 16.5% respectively. Saving has grown steadily until the end of 1997/98. But by 1998/99 and 1999/00, it sharply fall down to its lowest point 2.1% and 0.90% respectively. These were the years the country was involved in heightened war with Eritrea over the border conflict, which claim heavy human tolls and other resources. The state consumption outlay has leapt up unprecedently, largely to fortify its defense force. During the two years government consumption expenditure accounted for 18.7% and 23.8% of the total consumption expenditure, which was, 13.9% in the immediate year (1997/98) that eroded the saving level. Certainly, the war hurts the domestic saving immensely even after the end of the crisis on top of poor aggregate economic performance. That is why despite a slight positive relief, the level remains low in comparison to the overall economy and the previous years.

On the other side of the spectrum, gross capital formation or investment has mounted up from 9.2% in 1991/92 to around 22.6% in 2003/04. The graph depicted a gradual improvement in investment until the end of 1997/98 like its counterpart saving. Nevertheless, due to the war, which affected confidence of private investors by creating uncertainty and took away state investment to war front, the factor slid down a little bit to reach 15.9%. It stirred up remarkably to 22.6% above any rate in its entire governance by 2003/04. Factors like loan and donations, debt cancellation, investment, confidence of investors etc are presumed to have played role behind such improvement.

In effect, it seems that the resource gap has widened considerably after the border crisis. This implies the country has met some of its commitments from other sources majorly from external sources. On average, the resource balance has been low by 12% over the last 13 years. It ranges from the lowest -6.2% to the highest -19.8 of GDP in 1991/92 and 2002/03

respectively. The international donors were behind financing the gap at the early periods associated with the programmes and projects launched to stabilize the economy (Berhanu & Seid, 1999). International donation and loans resumed to influx after the war had wound up accompanying different initiatives to reduce poverty. On top of this, nevertheless, the country has succeeded in attracting foreign direct investment (FDI) better than the previous periods. In contrast, still in both cases remains much effort to be exerted against the challenge of making visible change in terms of, basically, reducing poverty. The central bank in its report put this fear concisely: "the magnitude of saving and investment growth remains too low to bring about meaningful changes in the living condition of the people" (NBE, 2001/02:10).

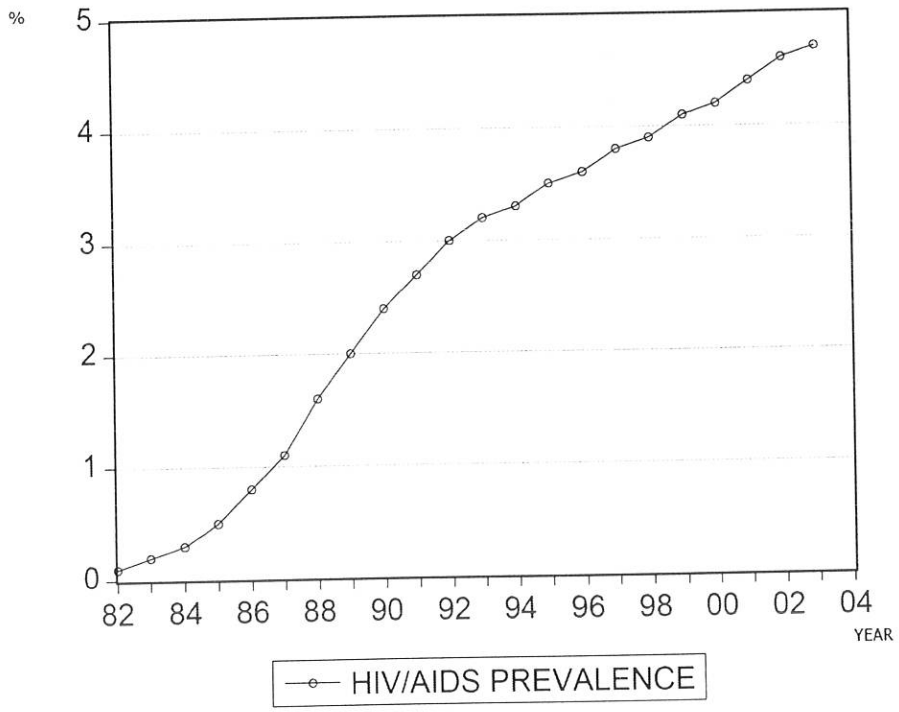
2.2 TREND OF HIV AND AIDS

While looking at the trend of epidemiological prevalence of HIV/AIDS in Ethiopia, the first HIV antibody was detected in 1984 and the first AIDS case was identified in 1986. After 1989, MOH has begun officially sentinel surveillance in Addis Ababa on women of the age group from 15 to 49, which the prevalence was 4.6%. While the coverage expands to other urban centers after 1992/93. After a couple of years interruption, the surveillance resumed including additional urban and rural centers in 1998-2001. However, it is difficult to make a trend analysis thereof, which was not consistent. Therefore, the option is to rely totally on the official forecast made by the MOH on HIV prevalence and incidence since 1982 (MOH, 2004).

As shown in the figure 5, in general the rate has risen rapidly during the late 80's and early 90's. In 1983, the prevalence was 0.2 per cent in urban areas at a national level it was immaterial but in 1984 it reached 0.1 per cent. Over the period 1988 to 1994, the spread jumped from 1 percent to 3 per cent respectively. These were the periods when the virus made its outstanding record of expansion owing to various reasons combined with the acute shortage

of awareness prevailed at that time. Besides, though there was a department as watchdog for the issue, government's intervention was uncoordinated and unsuccessful to curb the spread at its infancy stage. Thus, that the negligence too exacerbated the infection pace.

Figure 5. Annual HIV/AIDS Prevalence Forecast



Source: MOH, 2004

Then after prevalence grew gradually until 2000 and reached 3.9 per cent of the total adult. Even during these periods the intervention was not successful instead the transmission continued to infect people uncurbed because people who are living with the virus did not reveal themselves that arose due to the taboo on the disease and fear of discrimination and stigma.

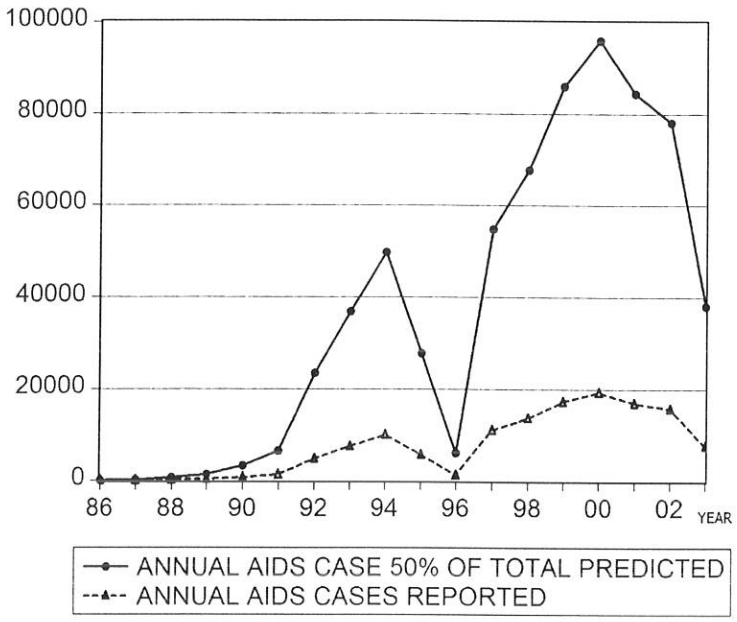
After the year 2000, the prevalence rate leveled off and plateaued at above 4% (MOH, 2004: UNAIDS, 2005). The awareness achieved in the society in general has been responsible for curbing the virus at the stated rate. We can conclude that the intervention by the government and other interested organs has begun to bear fruit.

Next place takes for the discussion on AIDS incidence based on the reported AIDS cases to the Ministry of Health and compiled by UNAIDS and WHO (2002). AIDS is mirror image of the HIV prevalence some years back because apparently people with the virus develops into AIDS stage within less than a decade.

Since the outbreak of the epidemic up to 2003, reported AIDS cases to the MOH had cumulated to 147,314 in number. In 2003 alone, there were 7,614 reported cases. In fact, the real cases are by far larger than the reported figures. For instance, estimated number of full-blown AIDS case by the Ministry in same year was 123,000, which by far exceeds actual report and represents 6% only. Reasons that lie behind the underreport of AIDS cases, among others, are the following

- Most people never seek medical care for AIDS
- Most people with HIV infection may die of other diseases before they are *never* screened for AIDS stage
- Most rural hospitals and district health care facilities may not have the capability to test for HIV infection
- Most private laboratories do not report data

Figure 6. Annual AIDS Cases Reported to MOH



Source: MOH(2004) & UNAIDS/WHO(2002)

Bearing this in mind, however, the analysis follows on reported AIDS cases owing to shortfall on the availability of its forecast. The first AIDS case, two in number, was reported in 1986. The graph exhibits a very steadily cases increase until 1991/92. In the consecutive three years, the AIDS incidence increased rapidly with a slight decline during the following two years perhaps due to underreport. However, the succeeding years depicted that AIDS had surged up at alarming rate, which is the exact reflection of HIV virus trend before the incubation period of AIDS. It can be described this worrisome number as an indication that the country began to harvest the burden for the negligence it heeds to prevention at late 80's and early 90's. The sharp fall reported in 2002/03 might imply the promising and good results of late interventions in curbing the virus. But still remains the gloomy future and threat to come explicitly AIDS-ridden by the time current HIV reaches at its last stage.

3. LITERATURE REVIEW

3.1. THEORETICAL BACKGROUND

Various researches have been conducted to identify determinants of variation in economic growth and per capita income, in general living standards among countries. In this regard, the credit goes to Neoclassical as the founders. Their works relied on saving rate and population growth of countries as fundamental factors that play a vital role behind such differences to being poor and rich (Solow, 1956). The model tries to address the problem standing at two fundamental equations such as production function and capital evolution equations.

Solow depicted the importance of saving rate and population growth on the trend of GDP growth and per capita income. Investment per worker increases capital accumulation per worker overtime, whereas population growth affects capital per worker negatively. The economy must save and make sufficiently new investment to either scale up capital to the existing labor or equip new labor entrants adequately. Capital deepening owing to saving would thus enable the economy to equip capital per worker well and improves per capita income (Jones, 2001), as a result of which saving and output growth correlate positively.

In contrast, population growth by implication raise new investment demand to keep capital per labor constant otherwise dwindling capital stock into lower level of capital per worker. Since as it move up, due to capital widening, capital to labor ratio will be scarcely dispersed among workers (Mankiw et al. 1992; Jones, 2001; Barro & Sala-i-Martin, 2004). Higher population growth forces rate of capital and output per worker ratio to cross at low level. Thus, population growth affects adversely both capital per worker and income per capita. To put the summary supplemented by empirical evidences across different countries,

> "Countries that have high savings or investment rates will tend to be richer, *ceteris paribus*. Such countries accumulate more capital per

> worker, and countries with more capital per worker have more output per worker. Countries that have high population growth rates, in contrast, will tend to be poorer, according to the Solow model. A higher fraction of savings in these economies must go simply to keep the capital-labor ratio constant in the face of a growing population. Thus capital-widening requirement makes capital-deepening more difficult and these economies tend to accumulate less capita per worker" (Jones, 2001:32-33).

The main message of neoclassical growth framework revolves around showing, no matter where countries start/stand and at what speed it adjusts, if having equal saving rate, rate of population growth and technology, finally converges into equal income (Dornbusch et al. 1998). Technological progress determines growth in output and capital per head. Therefore, change in saving rate is powerless to affect growth rates in the long run, which is limited only to making a difference on levels. Nevertheless, for a country in transition period saving rate and population growth determine considerably output growth until reaching steady state.

In Solow model, technology is assumed as exogenous or 'manna from heaven'. On the other hand, in endogenous growth model, Romer (1986) dissatisfied by the works of neoclassical growth model both theoretically and empirically, embodied technology as determined within the system. Endogenous model supposes constant marginal product of capital against the pillars of rudimentary microeconomics i.e. diminishing marginal returns (Dornbusch et al. 1998). Research effect may be both negative and positive by reducing labor that can be involved in output production and more ideas are attributable to the increase productivity of the economy respectively (Jones, 2001). The implication is that the greater saving level a

country may have the better growth its economy will achieve. New ideas created by different agents induced by profit or other interests contribute to the invention and innovation. The magnitude of new ideas produced in turn depend on the labor force proportion allocated on research and development and level of capital invested in this sector (Dornbusch et al. 1998) not only from the perspective of capital accumulation but also from a fraction of saving allocated on R& D.

An increase in population therefore results in number of researchers' accumulation especially those who invest their time on skill acquiring and this would boost finally the economy (Jones, 2002). By implication, it indicates positive association between population growth and output in contrast to the arguments forwarded by the previous models. In fact, though the argument sounds against the above hypothesis, it still works because it is not mere population growth but number of researchers and time invested on acquiring skill. Penultimate, this model argues that technology associated with ideas and knowledge, which have externality once created and increasing returns, happens the sole source of long-run growth (Dornbusch et al. 1998). Economic Growth rate, therefore, grows at technological productivity like neoclassical, notwithstanding the fact that determined inside the model instead of exogenously (Jones & Manuelli, 1994).

Within endogenous growth models, scholars who are not pleased by former findings, tried to find out what really determines output per worker differences across rich and poor countries. Notably Hall & Jones (1999) exert their effort to this end. In particular, they assessed the effect of social infrastructure as the fundamental explanatory factors for long-run economic performance variation seen across countries. They use institutions and government policies introduced in countries as a proxy for social infrastructure. Their outcome consolidated their

hypothesis, i.e. such endogenous factors lie behind the success or failure of economic growth history of different countries.

Another worth noting contribution made on growth model, where the interest of this study heavily relies on, is the one framed by Mankiw, Romer & Weil (1992). MRW model extended Solow's model in order to incorporate human capital, as additional factor to explain why some countries flourished while others impoverished or for the prevailing big living standard variation. They criticized the shortcomings of Solow model in respect to consistency of its empirical results and international living standard differences in practice. Also, they suspected for overestimated effect of saving and population growth on steady state per capital income. The pit fall on the model stems from omitted explanatory variable, which according to this approach, was human capital accumulation.

Accumulation of human capital, approximated by schooling and in some instance time devoted on acquiring skills as determinant of growth, alters both the theoretical knowledge so far prevailed and elicit variation in empirical evidences more profoundly (ibid). In addition to its direct effect on output production, human capital increases the effectiveness of physical capital accumulation. Empirically they found positive and significant effect on top of improving the performance or the magnitude of saving and population growth to a plausible figure otherwise exaggerated by Solow assessment (ibid). Thus, the value added of this augmented model rests on eliciting the substantial effect of investment on education narrowly and human capital accumulation broadly that creates a great difference in the economic growth of various countries.[1]

[1] Because human capital is comprised of health, nutrition, experience on top of educational attainment

Since 1960 economists have began to incorporate health status as part and parcel of human capital, which determined productivity and output significantly (Schultz, 1961; Behrman, 1996; Wheeler, 1980; Bloom et al. 2001; Weil, 2005). These approaches contribute and advance the long lasting growth theory experience that has considered only educational attainment or level as a source of human capital. Hence, numbers of studies then have extended the basic Solow model like MRW in order to encompass health capital as another input of production (Knowles & Owen, 1995; Heshmati, 2001; Bloom et al. 2001; Weil, 2005).

As a component of human capital, health affects output growth positively and significantly often higher than schooling (Behrman, 1996; Wheeler, 1980; Bloom et al. 2001). Healthier people are robust and more productive (Strauss & Thomas, 1998). Put another way, these people, owing to their good health they are strong physically and mentally that contributes to effectiveness of performance at work (Weil, 2005), work hard, work more hours, and use their cognitive skills properly. Ill health, on the contrary, undermines these stated facts thereby diminish workers productivity and efficiency.

Moreover, poor health affects a country's or household's economy by diverting saving and investment into caring that would have been deployed at alternative uses otherwise in addition to its immediate effect on earnings and productivity. In the final analysis, depending on its degree, namely good or poor health status, health capital affects productivity of labor and potential output performance either positively or negatively.

Distinct approach from Solow and other extended models came into scene by concerned researchers on the intergenerational impact of the pandemic. This study used Overlapping generations (OLG) model (Bell et al., 2004) to assess its repercussions in the long run –

beyond the prime victim of the disease. Most of the studies concentrate on the direct consequence of losing people living with the virus. This study questions what would happen in addition to this and incorporating the impact that sustains on their offspring who dearth basic education and health, future human capital stock; destroying credit market and social cohesion factors. In the long-run the disease exposes generations for low education, poor health and finally lower productivity of youth due to the gap infected parents unable to provide to their offsprings as required (ibid). Therefore, it is holistic and preferable to exhibit the real pros and cons of the disease according to this framework.

Another growth theory relevant for developing countries is structural view (Seyoum, 1997). More of imperfection, immobiliteis of resources and some structural bottlenecks characterize the nature of developing economies. Therefore, this disequilibrium if adjusted into its long run equilibrium trend can achieve economic growth in such countries. Reallocation of resources from less productive into more productive sector would help to attain growth in developing economies.[2]

3.2 CONCEPTUAL FRAMEWORK

One of the manifestations of poor health situation, in contrast to better health, is to be infected by HIV/AIDS in particular and invaded alarmingly by its prevalence at a country level. Good health contributes to boosting the economy while illness- HIV/AIDS infection stagnate the overall economy. The impact of AIDS among others and largely originates from morbidity

[2] In aggregate structural transformation refers to changes in the composition of demand, trade, production, and factor use that takes place as per capita income increases.

and mortality (Cuddington, 1993).The mechanisms of how it retards and the channels through which it affects the economy are explained next.

The two fundamental ways of transmission mechanisms through which HIV/AIDS epidemic affects the aggregate economy emanates from morbidity and mortality with consequent influence on labor size and productivity, and health expenditure and saving.[3]

3.2.1. HIV/AIDS EFFECT ON LABOR EFFICIENCY

Effect on labor efficiency fundamentally indicates the impact of illness on labor productivity, labor force size and its composition. Composition is meant to refer to experience, skill, and age of worker. The virulent disease adversely affects the quality and quantity of effective labor as a result of morbidity and debility. Morbidity cuts working days and hours due to absenteeism while debility spirals down productivity of the person (Barlow, 1967; Cuddinton, 1993).

According to neoclassical microeconomics models wage certainly equivalent to marginal product of labor depends on health and other factors. Poor health affects marginal product hence productivity negatively due to absenteeism. Primarily, it affects earning capacity and hours to be supplied to the market (Bartel & Taubrman, 1979). The robust /healthier the worker is the more he/she can produce efficiently for a given time of work (Behrman, 1996; Bloom et al. 2001). AIDS mainly weakens the immunity of the patient due to severe and long-lived morbidity. Differently, it debilitates the robustness of the worker that in effect leads to attenuate productivity considerably, especially in LDCs where stamina and physical strength

[3] Cogneau & Grimm (2004), however, described five channels namely, impact on level and composition of labor supply, accumulation of human capital, on productivity of labor, on health expenditure and in turn on investment and saving, and lastly on disorganizing enterprises operation. Essentially, they are the same with the two channels already cited.

are at the hub of employment opportunities provided that the infected persons appears at work place. Therefore, morbidity that stems from HIV/AIDS cut productivity of labor and ends at adversely influencing output growth. The productivity of labor falls not only from the health status alone, but also the disease discourages people to make investment on schooling and on job training (Cuddington, 1993). It raises a risk of short period of life and people are not sure on the likely to reap the return on their investment. Health induces investment on schooling and other factors so long as people are sure to live longer and able to avail of from its return thereof (Weil, 2005). Productivity loss exacerbated substantially as a result of low level of workers knowledge /education. Besides, families or relatives engaged in provision of nursing to the patient cut dramatically supply of work hours to the economy (Haacker, 2004). Amalgamated with productivity deterioration because of psychological stress the repercussion is quiet destructive from the latter side too.

After long time illness, the pandemic finally culminates in escalating mortality rate and claims heavy toll of human life. The effect of this rise is straightforward on the population growth and composition of labor force. Overtime as death rate due to HIV/AIDS upsurges, population growth on the other side declined which is worsened by a decline in birth rate (Cuddington, 1993). HIV/AIDS epidemic increasing mortality rate and at the same time reducing birth rate (loss of mostly affected adult women and people refrain themselves from unsafe sexual intercourse) in effect dwarfs population growth significantly (Haacker, 2004). Population growth affects output growth negatively as discussed clearly above.[4] In this case, since we have lower number of workers and larger level of capital relatively a fall in population growth creates a possibility of increasing capital- labor ratio. Because of capital deepening to equip

[4] For a detailed discussion, see Solow 1956 and Mankiw et al. 1992

labor much more times, the economy would flourish successfully that increase income per capita in the end.

In view of its second channel, mortality rate alters the composition of labor force into less skilled and experienced. Because it prematurely kills the most highly productive age groups with better skill and experience, the option remains to substitute by young and low adept workers (ibid). Thus, mean age of the working force group obviously scales down. HIV/AIDS destroy disproportionately highly educated and experienced workforce (Birsdsau & Hamoudi, 2004). HIV/AIDS also expedite retirement age (Haacker, 2004). In order to fill these vacancies created, companies and service providers in general the economy should hire less experienced and at younger age workers. As a repercussion, it tremendously devastates existing human capital stock and depletes experienced staff pool. From one side of the context this factor coupled with productivity loss has impeded the likelihood to attain the dynamics of economic growth.

However, the actual aggregate impact (on output) associated with labor, cannot be predicted beforehand for the reasons of the two conceptually opposing effects, at least at this level.

Idiosyncratic proposition by researchers encouraged by this transmission mechanism that makes the outcome ambiguous advocate instead positive or insignificant impact of HIV/AIDS especially in developing countries (Bloom & Mahal, 1995). Their argument rotates predominantly on the widespread and vast prevalence of unemployment and underemployment in such economies. Therefore due to high morbidity and mortality in the formal sector workers from informal sector (unemployed and underemployed) get employment opportunity in a sector with high/more wage (Bloom & Mahal, 1995; MacFaran & Sgherri, 2001; Haacker, 2002). Higher wage or marginal product implies higher productivity, which in effect, increases growth in output and GDP per capita.

3.2.2. HIV/AIDS EFFECT ON HEALTH AND RELATED EXPENSES

From many dimensions, the catastrophe has an adverse impact on resource mobilization. But, initially it affects health expenditure positively (Cuddington, 1993). The cost of AIDS can be associated with opportunistic infections treatment or acquiring ART (Over, 2004) albeit we concentrate only on the expenses attached to opportunistic illnesses. A need for covering treatment cost at individual level, companies, and health budget at a country level escalates with the spread of the disease. Households /individuals as well as industries are obliged to incur quantifiable amount of money for patients to obtain treatment for opportunistic illnesses such as TB, diarrhea, pneumonia etc. that occurred and aggravated intensely following the infection. Morbidity increases the cost of production as the enterprises covers medical costs and provide sick leave. Besides, the government has to allocate huge amount of fund for the provision of care and prevention against the deadly infectious disease. Treatment and fringe benefits continue until the patient collapses while the impact sustains even after death in the form of personal benefits and arrangement of funeral services. Personnel cost substitutes the burden in money terms (Haacker, 2004; Over, 2004) but the burden is beyond that and far-reaching.

Besides, the economy should replace the vacant posts created after the death of the worker infected by AIDS accompanied by huge recruitment and training costs that further exacerbated the rising cost of the disease (Haacker, 2004).

As death occurs, affected households deplete their saving or forgo investment opportunities in order to finance funeral and related expenses. Eventually such costs covered by afflicted agents mount health expenditure obligations to be financed partly from domestic saving (without undermining the cut on consumption expenses and foreign aid). The cost crowds out second best alternative projects or investment opportunities, perhaps the country desperately in

need of, from its meager resources. For instances the burden of HIV/AIDS on limited health facilities pushes out treatment of other illnesses (Over, 2004).

Indirectly, it affects saving via its influence on income, life expectancy (shortening at birth), age structure and healthiness of population that contributes profoundly to accumulation of capital in the long-run. As the odds of survival for people fall down sharply, they devote their resource into more consumption than saving.

Higher mortality in the youngsters hinders people from making an investment that carry sustainable advantages in the long run such as education and saving. It affects life cycle saving that grow with the longevity of the persons' probability of living (Lorentzen et al., 2005). Briefly, mortality influence the incentive to make physical and human capital investments and saving instead oblige adults to turn their face into short-term benefits but with long-term costs that have sound economic growth meaning. People devote their resources on accumulation of capital as long as they do live longer that ensures to benefit from its return (Aisa & Pueyo, 2004).

In spite of these plausible arguments researchers like Lorentzen et al.(2005) argue the effect of mortality, be it negative or positive, depends above all on the magnitude of its impacts on fertility which directly determine population growth and income per capita and growth. It entails in its substance that instead HIV/AIDS creates positive opportunity to improve per capita income in the long-run since the epidemic's impact on fertility outweighs that of on human capital investment (Young, 2004). He stated his controversial statement which sounds logical as

> "The positive effects of lower population growth are strong enough to counteract the most pessimistic forecasts of the human capital losses of AIDS orphaned children, implicitly endowing the economy with extra resources which can be

used to extend the lifespan of the afflicted and still leave reserves that raise the per capita welfare of future generations" (Young,2004:38).

Lastly but not least, as HIV/AIDS damages adults and qualified workers at their productive lives, contribution to pension/social security dramatically plummets but indirectly piles up dependents, together that tighten public expenditure base (Phamondon et al., 2004). On top of a rise in health care, sickness, and unemployment benefits, AIDS therefore creates financial pressure on government triggered from pension schemes demand for early retirement, premature death, and orphans surviving loosing their parents, but limited supply to the coffer of the social security institute.

In general, via the above paths the pandemic affects saving level at micro and macro level, especially domestic saving by escalating aggregate health expenditure. Ultimately, medication cost lowers and/or crowds out investment interchangeably both human and physical capital formation by scrambling or diverting resources into unproductive outlays (Were & Nafula, 2003) and discouraging investment desire of people. As one of the fundamental determinants of growth, this channel too leads to a sharp fall in output growth and level of per capita income. To encapsulate, HIV/AIDS adverse effect would outweigh the reverse with expected negative impact on economic growth and people's wellbeing.

3.3 EMPIRICAL LITERATURE

In this section, an attempt is made to explore empirical evidences witnessed on the relationship between health and economic growth in general and HIV/AIDS in connection to GDP, income per capita growth and levels in particular. The studies in review involve those conducted by directly incorporating the HIV/AIDS factor on the production function and those

studies carried out which treat other health indicators or proxies as a component of human capital.

An early work but indirect analysis conducted by Barlow (1967) on health effect depicted a 10% increase of consumption per person owing to malaria eradication program against no intervention at all. Wheeler (1980) analyzed the effect of human capital on output growth and vice versa. The study approximated human capital as a combination of health, education and nutrition. Using 3SLS (three stages least squared) method, the report found in general strong and positive effect of improvement in the physical quality of life (synonymous word as a catchall for the three variables) on productivity and conversely[5]. In particular, poor countries, which had registered a rapid improvement in life expectancy at birth depicted an increase in productivity or output growth.

Knowles & Owen (1995) gave an emphasis to incorporate health capital as a determinant of human capital accumulation on augmented Solow model designed by MRW. This study assesses contribution of health outcome to output growth and per capital income. Health capital in their approach is proxied by the short fall in life expectancy at birth i.e. equal to 80 minus life expectancy. They found eventually strong and significant association between life expectancy (health stock) and income per capita, i.e., GDP per capita increases by 35% for each unit percentage improvement in life expectancy[6]. Likewise, in another study a 13-year life expectancy attainment contributed to 1.4% GDP growth (Croix & Licandro, 1999).

Bloom et al. (2001) analyzed critically the theoretical and empirical evidence of the impact of health on productivity of labor and output growth. This paper recognized human capital as a function of education, health (proxied by life expectancy) and experience. It tried to elicit the

[5] Conversely in essence positive and strong effect of output change on education, nutrition and health.
[6] Likewise Heshmati (2001) found significant and direct/positive effect of health-proxied by health care expenditure per capita- on economic growth and speed of convergence between countries

health impact on labor quality and productivity with a value added on what previous studies totally hinged up on education. Their findings conveyed that health status affected output growth positively and significantly more than education and experience of the worker. One-year improvement in population life expectancy contributed to a 4% increase in output. By analogy, although it is difficult to copy the figure as it is, illness or disability by rising death rate thereby a decline in life expectancy at birth in effect leads to an equivalent drop in output growth. Recently explored study across countries reported health capital, being a component of human capital, accounted for 22.6% of income per capita variation among countries (Weil, 2005).

On top of these, several studies have been conducted on the socio-economic impact of HIV/AIDS and poor health in sub Saharan Africa (SSA) and other countries. Part of the studies has focused on macro while others emphasized on micro impact of HIV/AIDS in different countries since the outbreak of the pandemic. This survey focuses to survey those dealt with macro economy issues alone.

Among the early notable works worthy of discussion after the epidemic began to impose its adverse impact was the one conducted by Cuddington (1993). This study attempted to model the macroeconomic effect of AIDS on Tanzania's economy using demographic figure projected by other study. It tried to model the effect of AIDS directly on labor productivity and capital formation thereby GDP growth and per capita income augmenting Solow growth model. Basis of its approach was simulation for AIDS and non-AIDS scenarios. According to the study, Tanzania's GDP was estimated to fall ranging from 15 to 25% by the year 2010 under different values for labor productivity loss and AIDS cost financed from saving. Similarly, per capita income was projected to fall between 0 to 10 percent by 2010 if AIDS cost financed out of saving and labor productivity loss ranged from 0 to 2. Thus, the findings

have embarked and made of the matter worthy of close analysis and shed light on the significant adverse ramifications of the disease often pretty threatening to development vision of countries. Somehow, likely to reverse the economic development that has been achieved for decades.

Cuddington & Hancock (1994) used again the same extended Solow growth model to assess the disaster that the epidemic creates on growth path of the economy of Malawi. They did in a sort of a slight distinct approach i.e. under scenarios of zero, medium and extreme AIDS cases for the period 1985-2010. According to their report real GDP growth declined ranging from 0.2-0.3 and 1.2 to 1.5 percentage points on average during the review period in medium and extreme cases respectively, while real GDP per capita was projected to fall from 0.1 to 0.3% respectively. This study by Cuddington & Hancock (1994) had ascertained the result obtained in the case of Tanzania, i.e. negative and significant effect of HIV/AIDS on those economies' (especially) hard hit by the HIV scourge.

Despite the above empirical facts, negative and significant influence of HIV/AIDS spread, researchers criticized the outcomes for varying reasons. Few of them stick to the problem of the model others target at the accuracy of HIV/AIDS data while the remaining doubt the exaggerated result itself.

The blame first targets on the single sector Solow growth model applied for African economies, acknowledged for widespread prevalence of unemployment and underemployment, which the model assumed full capacity level. According to these critics, the findings derived under these circumstances finally last in overestimating the likely impact of the epidemic. So, Cuddington (1993) to address this doubt reassessed the study on Tanzania with an instrument of dual economy, i.e., informal and formal sector separately. The plausible presumption behind this argument is that people- unemployed and underemployed will shift to

the formal sector, with higher and sticky wage, as a result of death occurrence in the formal sector due to AIDS. Eventually, this leads to a rise in output and per capita income because they have been disguised or engaged in a sector with lower productivity previously. Nevertheless, this impact affects both supply and demand for labor in the formal sector due to sticky wages and a rise in medical expenses to the firm which indirectly affect its cost of production and profitability. At the end of the day, to be workable hypothesis it all depends on the magnitude of the two antagonistic side effects.

Given these logical arguments however, the Tanzanian case revealed a decline by 15 to 25 on its GDP growth by 2010 against no-AIDS scenario. Similarly, GDP per capita was estimated to be short of by 0 to 10 percent than without AIDS by 2010. Thus, Cuddington's (1993) outcome did not refute the outcome obtained using single sector growth model. Instead it reassured the same negative and significant effect of the pandemic with similar magnitudes even after taking into account no-full employment situation.

As a critic and in contrast to the above reports but with the same objective was a study made by Bloom & Mahal (1995) after one or two years of Cuddington's study in different countries, i.e. cross-country. They argue that the effect of AIDS was not what the previous studies had concluded; instead, it has insignificant influence on growth rate of per capita income.

The paper found for each additional AIDS case per 1000 persons per year a 0.86% point reduction in the average annual rate of growth. The study substantiates with empirical evidence the hypothesis of insignificance. Even such immaterial growth decline, according to them, attributed to the historical slower growth rate registered by such countries (without AIDS). Their approach was distinct from the preceding studies. They estimated AIDS cases by EPIMODEL making in use of national level data of HIV and AIDS prevalence. In this case, AIDS level per 1000 persons computed from EPIMODEL was included directly as one of

explanatory factors. Besides, they criticize other studies that claimed considerable impact owing to an overestimated national HIV and AIDS prevalence data in use, which contributed to such biased impact report on welfare of the economies reviewed. In short, they put their finding in more elaborative and concisely as "our findings suggest that there is more flash than substance to the claim that AIDS impedes national economic growth" (ibid: 21).

Besides the foregoing studies, Haacker (2002) had attempted to model the impact of HIV/AIDS on per capita output applying various assumptions and approaches. Ranging from closed to open economy, one-sector to dual economy with formal and informal sectors. His endeavor was to reconcile contesting results that have been forwarded by different researchers on the sign and magnitude impact of the deadly disease.

In one sector growth model the paper analyzed the impact on disaggregated labor between highly skilled and unskilled, other factors remained constant, like the previous models. Secondly, his model focused on formal and informal sector relationship and cross substitution between the sectors. The justification behind this proposition is that labor (skilled and experienced) loss due to AIDS from the formal sector can be replaced back from the informal sector with low productivity, which would contribute to boost the economy and improve per capita income. In both cases, his conclusion however consolidated again negative effect of the pandemic on the aforementioned dependent variables. In reply to Bloom & Mahal (1995), He recapitulates his findings in a statement:

> "the hypothesis that HIV/AIDS will result in a decline in unemployment as workers from the formal sector who die are replaced by unemployed workers or workers from the informal sector is incomplete and potentially misleading: HIV/AIDS affects both the supply of and the demand for labor" (Haacker, 2002:11).

On top of this Haacker implemented capital mobility assumption in open economy into his model but could not deny the first findings. As capital to labor ratio increases due to population growth decline capital will flight to a place with higher return or interest rate. Rather the potential output loss may be aggravated. According to Haacker, uncertainty against the findings and arguments forwarded by Bloom & Mahal perhaps originated from low prevalence in 1990's which was at its early period and poor macroeconomic information applied by such studies (ibid).

Botswana is a typical country that represents the most highly infected countries in the world. MacFaran & Sgherri (2001) extended Solow model to incorporate skilled and unskilled labor, and informal & formal sectors to explore the effect of HIV/AIDS on the GDP growth of Botswana. Their finding projection revealed a likely fall in GDP of non-mining sector from 5½ growth a year in no AIDS scenario to 1½ to 2½ percent growth annually with AIDS scenario. To put differently, it may face an overall economic slowdown of 33 to 40% than it would have been without HIV/AIDS.

Inspired and Puzzled by the contrasting findings over the deadly infections disease on economic development, Papageorgiou & Stoytcheva (2004) reexamined the impact of AIDS on cross-country income. This approach differs from others in essence stressed at levels rather than growth of per capita income and implemented OLS departing from simulation. They assumed AIDS as productivity shock and embodied it as an additional regressor on the extended Solow model with human capital. They built AIDS incidence per 100,000 per country annually based on AIDS cases reported by UNAIDS. They found negative and significant influence that AIDS inflicted on the level of income across countries. In order to illuminate much more the paper went half way and separated the data into OECD and non-

OECD countries and reported AIDS as having an insignificant impact on living standard of developed countries but imposed considerably its repercussion in developing countries. This was mainly due to, according to the study,

> "Since people in advanced countries can afford treatment using antiretroviral drugs, this can increase productivity, delay the transmission of the disease, and potentially cause positive externalities by protecting other people" (ibid: 11).

The explanation sounds constructive which is in line with what is down-to-earth fact in developing countries plus very low prevalence in the former countries. Specifically, the finding depicted for each additional AIDS incidents per 100,000 per year, income per worker was down by 0.0031%. Moreover, in an attempt to apprehend on disaggregated age cohorts, above all they found extremely massive loss for age group 16-34 commonly known by productive period. Exceptionally, for Africa the output effect in magnitude originated from this age group was more than doubled compared to the general figure described above. Cogneau & Grimm (2004) in a similar fashion but using different approach i.e. micro-simulation, forecasted the economy of Cote d'Voire to shrink by 6% in 15 years period.

Lastly, let us explore the findings of studies conducted in Ethiopia focusing HIV/AIDS and economic growth.[7] A well-organized approach on the macroeconomic effect of HIV/AIDS in Ethiopia was conducted by Daniel (2002). The study made use of aggregate demand and supply framework for this assessment in attempting to draw the impact of the pandemic on different sectors and variables with the assumption of the occurrence of a decline in labor

[7] Bonnel (2000) found GDP fall by 0.6% in Ethiopian case due to HIV/AIDS by the year------

force and a rise in medication cost with a consequent impact on output – that ranges from 0.5 to 1%. He found, among others, agricultural output declined by 2%, non-agricultural output declined by 1.8% and investment by 2.4% on average in comparison to non-AIDS scenario.

The study by Papageorgiou & Stoytcheva (2004), we have just described above, included Ethiopia as one of the countries for analysis that conveyed a significant adverse impact on the dynamics of its economy like the non-OECD countries. Thus, like other highly infected countries, HIV/AIDS adversely and significantly affects the performance of the aggregate economy in Ethiopian case too. It needs more and thorough work though.

In a nutshell, no matter what kind of model we have adopted, as far as the effect on population growth or mortality rate and then capital-labor ratio does not outstrip the reversing effect that emanates from labor productivity and saving rate, it is unlikely to backup, with empirical evidences, the insignificant or positive impact of AIDS epidemic on economic development. Nevertheless, it remains open for empirical witness of any candidate country highly affected by the epidemic. This research paper heads finally to address the issue at hand in the Ethiopian case.

Against the foregoing, the research paper tests the contesting hypothesis with an application of extended Solow growth model, which incorporates AIDS presumably to capture productivity loss, population growth decline and diversion of financial resources into treatment altogether as one[8].

[8] MRW model suits best both from the perspective of theoretical and empirical advantages in addressing the objective properly.

4. METHODOLOGY, MODEL SPECIFICATION, AND DATA

4.1 METHODOLOGY

On top of the usual econometric tests, mainly R^2, t-test, Reset that focus on the model specification and significance of coefficients in this section we see some features of time series. In particular, we emphasize on how these time series process behave or are generated with regard to suiting or some violation of classical assumptions.

First and for most that comes to fore while dealing with time series is to examine whether the series depicts stationary or non-stationary property.

Weak or covariance stationarity requires, despite variation with time of mean, variance and covariance to remain constant for stationary stochastic process (Thomas, 1993; Johnston & DiNardo, 1997; Pindyck & Rubinfeld, 1998; Thomas--------). To put algebraically,

Mean $E(Y_t) = \mu$ for all t

Variance $Var(Y_t) = \sigma^2$ for all t

Covariance $Cov(Y_t, Y_{t+k}) = \sigma_r = cov(Y_{t+k}, Y_{t+k+r})$ for all t & $k \neq 0$. Covariance or correlation does not vary with time but depends only on their difference apart from time. These preconditions imply that in stationary process, some cyclical shocks die out immediately and return back to its trend while with non-stationary the problem sustains permanently (Enders, 1996). Conducting estimation on time series data could work only if the stochastic process does not vary in time or the coefficients remain fixed. Therefore, according to classical assumptions OLS regression works for stationary series. Otherwise, if we apply on non-stationary we violate the basic classical assumptions.

Of all the difficulties, however, our concern prominently focuses on the consequence of non-stationary process regression, which ends in spurious regression. In such case the usually used test statistics have non standard distributions and its difficult to apply the conventional test

statistics such as t, F and X^2 (Johnston & DiNardo, 1997) Spurious regression has statistically significant coefficient or t-test and high R^2 even if the variables are unrelated in reality. In effect, we may wrongly reject no correlation hypothesis, but worst of all we obtain economically unauthentic and meaningless outcomes. Hence, it becomes quite difficult to continue estimation with non-stationary stochastic process but it is not without remedies. Rather it is important to check for its real presence before we employ remedies to tackle non-stationary, and transform into stationary process.

The order of integration can classify the type of time series generated i.e. stationary or non-stationary process. From within integration first comes level of stochastic process generated by white noise, i.e. integration of zero I(0) which is stationary. We have also first order homogenous function commonly known by random walk, I(1) and higher order homogenous functions I(n), n>1. These degree of integration indicates how much times we have to difference in order to convert the data into stationary (Johnston & DiNardo, 1997).

TEST FOR UNIT ROOT

Random walk or first order autoregressive process is characteristics of most of macro variables. And we work with the famously applied method to test the presence of random walk known by unit root test introduced by Dickey and Fuller (1979) (Pindyck & Rubinfeld, 1998).

Assume the time series is generated by autoregressive with drift & trend as

$Y_t = \alpha + \beta_t + \rho Y_{t-1} + \varepsilon_t$

Where $\varepsilon_t \sim NID(0, \delta^2)$ & $\alpha > 0$, $\beta=0$ & $\rho=1$

Subtract Y_{t-1} from both left & right sides

$\Delta Y_t = \alpha + \beta_t + (\rho-1) Yt_{-1} + \varepsilon_t$

$= \alpha + \beta_t + \theta Yt_{-1} + \varepsilon_t$

Where $\theta = \rho-1$

H_o: $\theta = 0$ or $\beta = 0$, $\rho=1$ indicates unit root /non-stationary series

H_A: $\theta < 0$

We reject the null hypothesis or non-stationary in favor of the alternative or stationary process if the OLS estimate of θ is sufficiently negative (Thomas-------; Johnston & DiNardo, 1997). Otherwise, if the null is true our data is random walk with drift or non-stationary.

Nevertheless, due to the caveat detected in DF approach, which does not consider for serial correlation, ADF extended this model anew with ability to take into account autocorrelation making the residuals white noise (ibid). Autocorrelation makes OLS of DF test less efficient. ADF, thus, embodies lagged changes on the dependent variable that approximate autocorrelation as additional explanatory variable with k lags.

$\Delta Y_t = \alpha + \beta_t + \theta Yt_{-1} + \sum^{k}_{i=1} \lambda i \Delta Y_{t-k} + \varepsilon_t$

The null hypothesis once again is similar to DF test i.e. $\theta = 0; \beta = 0$ the coefficient of Yt_{-1}, which conveys the existence of non-stationary process against the alternative stationary time series.

CO-INTEGRATION

Once we are certain for the existence of random walk, inevitably we difference them at appropriate order (lag) to make them stationary type. Under normal circumstances, the linear combination of different integration variables fall in either of the following possibilities,

$X_t \sim I(d)$ & $Y_t \sim I(b)$, $b < d$

Suppose Z_t constitutes their linear combination either

$Z_t \sim I(b)$ if $b < d$

$Z_t \sim I(d)$ if $d = b$

or $Z_t \sim I(0)$ if $d = b = 1$

The latter exceptional case creates a stationary series due to a linear combination of two separately random walk variables. That is when linear combination of I(1) process yields I(0) process (Hendry, 1995). We call this co-integration, which entails several advantages.

First, differencing is the recommended panacea for non-stationary to convert into stationary process. Nevertheless, mere differencing without testing for the interconnection among variables carry a probability of great long-run information loss on the relationship between the variables(Pindyck & Rubinfeld, 1998; Thomas-------). Working in terms of first differences also leads quiet frequently to equations with unsatisfactory long-run properties, i.e. we obtain a change in dependent variable though the explanatory variable remains constant.

Co-integration confirms the existence of long-run equilibrium relationship between two non-stationary variables. In other words, we would not face the problem of spurious regression while undertaking OLS estimation on variables having such kind of property while linearly combined.

Therefore, it requires the task of running for real presence of co-integration between variables as a precondition before jumping into differencing. To this end, we have two alternative methodologies with their respective pros and cons to carry out co-integration test. These are Engle-Granger two steps procedure and Johansen's test (Thomas-------; Elias 1998; Equar, 2001). This paper however, employs the former one.

Engle-Granger procedure supposes we have two variables X_t and Y_t with random walk series separately. The two-procedure co-integration test involves (Pindyck & Rubinfeld, 1998; Thomas------),

1. estimate co-integrating regression using OLS

   $Y_t=\alpha + \beta X_t + e_t$

   and save the residual ê

2. Test for $\hat{e}_t$ whether it shows random walk process or stationary type. If $\hat{e}$ is stationary series it confirms the existence of co-integration among the variables under consideration.

$$\hat{e} = \alpha + \beta_t + (\rho-1)e_{t-1} + \sum\lambda\Delta e_{t-1} + U_t$$

Thus, we test for the null hypothesis of the no co-integration and the alternative is that the linear combination of the two variables form stationary process. We apply ADF test likewise the previous regressions. Thus if we find the variables co-integrated their integration becomes stable in the long run apart their individual character. This resolves the difficulty of spurious regression often arises owing to non-stationary variables.

Despite its simplicity and other uses, ADF has some pitfalls associated with, firstly, the difficulty to know accurately the order of auto regressive process a priori. Secondly, with extra lagged or differenced terms the possibility of loss of degrees of freedom and associated reduction in the power of the testing procedure are still there (Thomas----; Elias, 1998; Equar, 2001).

ERROR CORRECTION MODEL

Differencing introduced in order to avoid non-stationary process and associated spurious regression entails dangers of ignoring long run relationships between the variables. Because we are ignoring the impact of the disequilibrium error being summed with other variables or error term. ECM, however, at one shoot tackles occurrence of these problems and at the same time prevent the appearance of the former weaknesses.

Because most of economic theories are interested on testing long-run relationship hypothesis, therefore, ECM model would ideally suit for such purpose by providing additional helpful information such as showing how the disequilibrium error adjust in short run (Thomas, 1993).

Moreover, it forwards short run relationship between the variables. Its representation is formulated as follows,

$$\Delta Y_t = \sum^{k}_{i=1}\beta i\Delta Xt_{-1} + \sum^{k}_{i=1}\lambda i\Delta Y_{t-1} + \alpha ECM_{t-1} + \varepsilon_t$$

Or

$$\Delta Y_t = \beta\Delta X_t + \alpha(Y-\beta X)_{t-1} + \varepsilon_t$$

ECM captures any deviation from long-run steady state between the variables manifested on the residual. And α, the coefficient of the disequilibrium error, shows the adjustment of the dependent variable to its long-run relationship. We use the usual t-test to check the null, which is expected to be negative. In effect, implicitly it means the disequilibrium error that disturbs equilibrium dies off overtime.

GRANGER NON-CAUSALITY TEST

Having co-integration indicates the real presence of Granger causality from one side or bi-directional. It constitutes one of the quests of proper model specification. Sometimes it creates a problem to assign variables as endogenous and exogenous a priori. Thus, we apply Granger non-causality test to identify the direction of the cause in both cases. Given,

$$Y_t = \sum\alpha i Y_{t-1} + \sum\beta i X_{t-1} + \varepsilon_t$$

If $\beta_i = 0$, we conclude that x does not Granger cause y, but if different from zero we reject the null hypothesis in favor of the alternative. To check such conjectures we make use of F-stastic test. Similarly, the assumption works from Y to X causation

$$X_t = \sum\alpha i X_{t-1} + \sum\beta i Y_{t-1} + \varepsilon_t$$

We apply again the same procedure like the above equation.

4.2 MODEL SPECIFICATION

Most studies dealing with determinants of growth standing on the shoulder of Solow model have made breakthroughs in this discipline based on their objective of study and endeavor to address problems. In our case, we apply neoclassical growth model later extended to include human capital by MRW (1992). We augmented MRW further to incorporate health capital as a component of human capital in addition to education (Wheeler, 1980; Knowles & Owen, 1995; Heshmati, 2001).

The first Solow model tried to assess and explain growth difference across countries using the saving rate, population growth and technological progress. Cobb-Douglas production with constant returns formulation of the model (Mankiw et al. 1992; Heshmati, 2001) looks

1. $Y(t) = K_t^{\alpha} AL_t^{1-\alpha} \quad 0<\alpha<1$

Where: Y= aggregate output/ GDP

K= total capital stock

A = level of technology

L= total labor force /population size

Population and technology are assumed to grow exogenously at constant rates, n and g, respectively having functional representation of

2. $L_t = L_0 e^{nt}$

3. $A_t = A_0 e^{gt}$

The above production function (1) can be rewritten in per effective labor form

(y=Y/AL, k= K/AL) as

4. $y_t = k_t^{\alpha}$

In addition to the production function, the framework uses capital evolution as well. Capital accumulation or new investment in closed economy, which equals to saving, is a fraction of

GDP. It depends on population growth, technological progress, and depreciation rate of capital. Net changes of capital stock per capita stock if at all exists should be saving in excess of capital required to equip the population and replace worn out capital. Thus, change in the capital stock over time (Dornibusch et al. 1998; Jones, 2001; Barro & Sala-i-Martin, 2004) for physical capital (k) is represented by

5. $\Delta k_t = [s_k].y_t - (n + g + \delta)k_t$

$= [s_k]. k_t^{\alpha} - (n + g + \delta)k_t$

At the steady state, at which capital formation required to maintain capital per effective worker is constant, there must exist no excess capital. So,

6. $\Delta k_t = [s_k].y_t - (n + g + \delta)k_t = 0$

$[s_k]. y_t = (n + g + \delta)k_t$

Substituting y_t for k_t

7. $s_k. k_t^{\alpha} = (n + g + \delta)k_t$

Capital to labor ratio k_t converges at steady state to k_t^* which is

8. $k_t^* = (s_k / n + g + \delta)^{1/1-\alpha}$

where a dot reflects change, s_k is a fraction of output invested in physical capital in period t and δ is rate of depreciation. Equation 8 indicates the direct and an inverse relationship between saving rate and rate of population growth respectively against capital.

Hence Solow model for empirical estimation substitute equation 8 into 1 which yields per capita income,

9. $y^* = [s_k / (n + g + \delta)]^{\alpha/1-\alpha}$

Taking the log of equation 9 and including disturbance term, income per capita at steady state convenient for OLS regression can be rewritten as[9]

10. $\ln Y(t)/L(t) = (\ln A_0 + g) + (\alpha/1-\alpha)\ln(s_k) - (\alpha/1-\alpha)\ln(n+g+\delta) + \varepsilon_t$

This helps to examine income per capita variation across countries as a result of difference in s_k and n empirically[10].

Many scholars dissatisfied by the above model pose their doubt on the empirical value of the coefficients of saving and population growth that provide very large magnitude. Theoretically, the influence of human capital, as discussed in the literature review section, has obtained significant place in explaining growth theories. The doubt stressed on omission of an important explanatory factor from the Solow model. Hence, Mankiw et al. (1992) encompassed human capital proxied by educational level in their extended Solow framework known by MRW model.

Extended production function (1) yields,

11. $Y_t = K_t^{\alpha} H_t^{\beta} AL_t^{1-\alpha-\beta}$

where H_t is stock of human capital while the others remain similar to the previous definitions. As clearly defined above, human capital is comprised of education and health capital (Behrman, 1996; Wheeler, 1980; Knowles & Owen, 1995; Heshmati, 2001; Bloom et al. 2001; Weil, 2005)

In this study, however, we rely on and substitute health capital in place of human capital. Because it is our main interest and next when the two factors are inserted together in a function education most of the time provide insignificant effect (Knowles & Owen, 1995;

---

[9] With the assumption of independent s_k and n against ε in order to obtain consistent OLS estimator(Mankiw et al. 1992; Heshmati, 2001)

[10] Majority of neoclassical models employ this reduced model to explore income per capita or growth difference across countries.

Heshmati, 2001). Holding the foregoing physical capital change intact, additionally human/health capital evolves,

12. $\Delta h_t = s_h.y -(n +g +\delta)k_t$

where h_t = H/AL represents for change in health capital stock overtime and s_h is fraction of output committed on health capital alternatively in this course health outcome.

Equation 6 & 12 imply the convergence of k_t and h_t in steady state to

13. $k_t^* = ([s_k^{1-\beta}. s_h^{\beta}]/ n +g +\delta))^{1/1-\alpha-\beta}$

14. $h_t^* = ([s_k^{\alpha}. s_h^{1-\alpha}]/ n +g +\delta))^{1/1-\alpha-\beta}$

Substituting 13 & 14 in equation 11 yields income per capita at steady state as a function of population growth, accumulation of physical and health capital,

15. $y^* = \{[s_k^{\alpha}. s_h^{\beta}]/ (n +g +\delta)^{\alpha+\beta}\}^{1/1-\alpha-\beta}$

15'. $y^* = s_k^{\alpha/1-\alpha-\beta}. s_h^{\beta/1-\alpha-\beta} (1/n +g +\delta)^{\alpha+\beta/1-\alpha-\beta}$

Taking the log of 15' the income per capita at steady state can be fully reformulated as with error term,

16. $lny_t = \gamma+ (\alpha/1-\alpha-\beta)ln(s_k) + (\beta/1-\alpha-\beta)ln(s_h) - (\alpha+\beta/1-\alpha-\beta)ln(n+g+\delta) + \varepsilon_t$

where $\gamma= lnA_0 +g_t$ & ε_t is error term

From this function, we expect accumulation of physical capital and population growth to affect income per capita positively and negatively respectively. Whereas health capital sign depends on the type of health, we are dealing with. Health capital/outcome variable can represent either good or poor health status. For poor health, which we assume HIV and AIDS

spread as one of those health outcomes, which captures labor efficiency and capital loss, as a proxy we expect adverse impact and negative sign.[11]

Alternatively, we can formulate income per capita as a function of health outcome level instead of its growth rate. Solving for s_h in terms of h_t^* from equation 14 and substituting in equation 16 gives income per capita function determined by rate of population growth, rate of investment in physical capital and the level of health HIV and AIDS.

17. $$y^* = s_k^{\alpha/1-\alpha} . h^{*\beta/1-\alpha} \ (1/n +g +\delta)^{\alpha/1-\alpha}$$

Taking the log of 17 yields,

18. $$\ln y_t = \gamma + (\alpha/1-\alpha)\ln(s_k) + (\beta/1-\alpha)\ln h^* - (\alpha/1-\alpha)\ln(n+g+\delta) + \varepsilon_t$$

Though the type of data gathered determines which way to use we examine in both cases. We rely on AIDS prevalence and incidence, constituting for stock and flow respectively, as a proxy for level of health capital.

Thus, equations 16 & 18 provide basic framework for the assessment of the economic and welfare impact of HIV/AIDS in the long-run or at steady state.

In short, we can reformulate equations 16 & 18 suitable suit for empirical regression as,

16' $$\ln y_t = \alpha_0 + \alpha_1 \ln s_k + \alpha_2 \ln s_h - \alpha_3 \ln(n+g+\delta) + \varepsilon_t$$

18' $$\ln y_t = \beta_0 + \beta_1 \ln s_k + \beta_2 \ln h^* - \beta_3 \ln(n+g+\delta) + \varepsilon_t$$

Based on our theoretical framework we expect the sign of α_2 and β_2 that are the coefficients of AIDS incidence and prevalence in equations 16' & 18' respectively to be negative.[12] Whereas the remaining α_1 and β_1 for investment to GDP ratio and α_3 and β_3 for population growth would be positive and negative respectively.

---

[11] We can apply proxies for health capital various variables namely, health care expenditure, life expectancy, mortality rate, maternal mortality and perinal mortality (Heshmati, 2001). Nevertheless, we opt to use AIDS as a proxy, which is inversely related to good health status.

[12] We can reformulate the relationship between AIDS and health parameter as, 1/H, in order to portray the negative sing of the parameter.

4.3 DATA TYPE AND SOURCES

Our study collects variables relevant to our assessment, namely, historical data of GDP, gross fixed investment, population growth, HIV and AIDS prevalence and incidence, life expectancy and educational expenditure. The major constraint of this study was the unavailability of actual AIDS prevalence and incidence data. Often few reports disseminated here and there bear the problem of underestimation. With such limitations, fortunately, MOH (2005) makes progression of adult HIV/AIDS prevalence and life expectancy lost due to AIDS from 1982-2008. Besides, we directly use data compiled by UNAIDS & WHO (2002) on new AIDS cases reported to MOH of different countries since 1979, while since 1986 for Ethiopian case.

As long as we use AIDS as additional explanatory variable we have made an adjustment to control the effect of AIDS on population growth to avoid the double counting effect. To this end, we rely on population growth forecasted by CSA up to 2030 based on the census of 1984, the year when the epidemic did not begin to impose its repercussions. It is better than the successive forecasts made by CSA, which would for sure entail HIV/AIDS impact. We gathered these secondary time series aggregate data from various governmental and international organizations, namely, NBE, CSA, MOH, WHO, UNAIDS. Specific feature of each variables are explained as follows.

1. **Real GDP Per Capita**

This constitutes an economic growth of a country. GDP per capita is computed by dividing real GDP to the total population. We gather real GDP from NBE and population from CSA.

2. **Population Growth Rate**

In countries like Ethiopia, it is quiet difficult to obtain reliable and enough data especially on labor force size and its participation rate. Due to such limitations, we opt to use population

growth in place of labor force like most of the studies. Moreover, in order to take into account the effect of AIDS mortality on population growth we use population forecast made by Central Statistical Authority based on the census year 1984 due to the aforementioned reasons.[13] Besides, we assume technological progress and depreciation summed with population growth to account for 5% like in various studies (Mankiw, et al., 1992; Papageorgiou & Stoytcheva, 2004).

3. Investment to GDP Ratio

Owing to a constraint on the availability and unreliability of capital stock, we collect Gross Capita Formation or investment to GDP ratio than capital stock. Moreover, the logic that lie behind this and in favor of investment to GDP ratio than the absolute investment growth rate are some countries with lower level of investment may depict faster growth rate better than those countries with high level of investment but low or stable in growth terms which perhaps makes meaningless relationship. Our source of data for these variables is NBE (National Bank of Ethiopia)

4. AIDS Incidence and Prevalence

We collected AIDS incidence as one of the health variable proxies as is done in many studies. AIDS incidence and prevalence that constitutes for flow and stock measurement respectively are collected and computed from datasets reported by UNAIDS and MOH. We compute the dataset for AIDS incidence using AIDS cases compiled by UNAIDS/WHO from 1986 to 2001 and MOH since 2001. The officially reported AIDS cases represent the number of new AIDS infections occurring each year. Unfortunately, reported AIDS cases cover for about 6-7 % of the total AIDS incidence in the country in contrast to the forecast by MOH (2001, 2005).

[13] We deduct from the estimated population the share of Eritrea which is predicted to represent roughly 6.3% of the total population (Goitom, 1999)

Therefore, we employ three scenarios within the two extreme cases. Scenario one examines the impact of AIDS using only the compiled but underreported cases. Scenario two determine the extreme case by deriving the 100% AIDS case forecast. Scenario three, which is employed in estimation, falls in the middle of the two cases by taking 50% of the latter. Finally, as an alternative we gather data on life expectancy lost due to AIDS, and HIV/AIDS prevalence forecasted by MOH covering for the period 1982-2008 which mirror of AIDS prevalence at some years latter).

5. Education Expenditure to GDP Ratio

We attempted to incorporate education as additional explanatory variable. Education sector expenditure collected from the NBE is divided to real GDP to obtain the budget allotted on the sector as a proxy to educational attainment.

Finally, in order to incorporate the possible impact of the change in policy and the government which represent structural break we tried to include dummy variable. The variable captures government change from Derge to EPRDF.

5. EMPIRICAL RESULTS AND ANALYSIS

5.1. STATIONARY TEST

Before turning into the formal regression, it is indispensable to check primarily for the properties of our time series data against the preconditions set out to run OLS. As have discussed on the foregoing chapter, non-stationary series does not follow and does not allow to use the standard t, F, R^2 ,X^2 and DW distributions (Johnston & DiNardo, 1997). It becomes difficult to use these conventional distributions at this juncture; rather estimation on these types of variables provides us spurious regression. And in fact, with spurious regression we it is impossible to make meaningful economic analysis and interpretation thereof.

Testing for order of integration initially rescue from the shortcomings already described and enable to take necessary measures to change into stationary series or proceed the usual regression. This method of test informed us to undertake necessary remedies before trying to employ conventional OLS regression if the data of non-stationary type, otherwise to go ahead of the usual estimation.

To this end, ADF test is implemented to identify the order of integration on each of the candidate variables. In a sense, verifying whether our data follow random walk process or white noise. The null hypothesis is that the variable shows random walk/unit root, viz are generated of non-stationary process. Rejection of the null concedes the alternative hypothesis, i.e., the data depicts stationary process. Table 5.1. below displays ADF outcomes for unit root test on all candidate variables with critical value in bracket.

Table 5.1. ADF test for unit root and stationarity

Variables	Without drift and trend	With drift & trend
LGPC	-0.4841(-1.9583)	-3.3673(-3.6454)
LINV	-1.9770(-1.9583)	-1.9518(-3.6454)
LNGD	-2.0074(-1.9583)	-11.9173(-3.6454)
LHAP	-1.8074(-1.9583)	-7.2707(-3.6454)
LHPN	-6.5870(-1.9583)	1.1394(-3.6454)
LEPG	-1.6403(-1.9583)	-1.0942(-3.6454)
ΔLGPC	-6.8127(-1.9592)	-6.6991(-3.6591)
ΔLINV	-1.7776(-1.9592)	-2.2697(-3.6591)
ΔLNGD	-22.0802(-1.9592)	-28.8226(-3.6591)
ΔLHAP	-3.6705(-1.9592)	-0.4847(-3.6591)
ΔLEPG	-3.7823(-1.9592)	-4.8108(-3.6591)
LAIDSR	0.4234(-1.9642)	-1.9789(-3.7347)
LAIDSF	-0.9989(-1.9642)	-1.9739(-3.7347)
ΔLAIDSR	-2.6420(-1.9658)	-3.2021(-3.7611)
ΔLAIDSF	-2.6681(-1.9658)	-3.1995(-3.7611)
LLELA	-1.4928(-1.9614)	-23.1748(-3.6920)
Δ LLELA	-9.3796(-1.9627)	-3.3677(-3.2964)

From the above table we can conclude (that) all variables are integrated of degree one-I (1). In particular, LGPC= I(1), LINV =I(1), LNGD= I(1), LHAP= I(1), LHPN= I(1), LEPG= I(1), LAIDSR= I(1), LAIDSF= I(1), LLELA=I(1) are non-stationary at level. It is impossible to

reject the null hypothesis of unit root test i.e. their computed value is greater than the critical value. However, their first difference shows stationary process in both tests with and with out intercept and trend. Except LHAP, LAIDS and LINV variables which marginally exceeds their respective critical values. We further proceeded to use graphical methodology of correlogram to check whether the residual dies out fast or sustains for longer period in case of the two variables. By doing so, their difference confirmed to be stationary.

Once we make sure the variables are generated by random walk process, therefore, before we hastily run into differencing to transform them into stationary it is quiet indispensable at this state to detect for the presence of integration among the variables, another influential statistical property. In other words, we have to identify if the variables in review are co-integrated in the long-run or not at all of course.

5.2.CO-INTEGRATION TEST

Based on the above level of integration we have determined the variables are non-stationary on which it is difficult to apply OLS regression straightforward and make use of conventional distribution tests. It is not, however, unusual to find stable long-run relationship in such cases, amongst non-stationary variables. If variables are co-integrated, albeit they are non-stationary independently their linear combination ascertain that they do not drift apart in the long-run. To put it differently, we can obtain stable or long-run equilibrium relationship provided that the variables are co-integrated at degree one.

Co-integration (between variables), firstly avoids a need for differencing and, secondly, we can get the green light to conduct OLS regression without the probability to encounter the aforementioned drawbacks. Instead, OLS estimators on the normal function with co-integrated variables are super consistent (Thomas, 1993; Thomas------; Hendry, 1995; Enders, 1996). Most of the time, for variables with order/degree of integration of d the resulting co-

integration degree is *b* which is often lower than *d*. For instance the co-integration of I(1) of variables may provide I(0). Therefore, it is imperative to test for the presence or absence of co-integration.

To this end, we employ Engle-Granger procedure test using ADF test on the saved residual from co-integration regression for the null hypothesis of no-cointegration or unit root test (detail analysis on the procedure you can see chapter 4). Based on OLS regressed on e_t – residual of the long run function- we have found the existence of co-integration among the variables we are dealing with. Table 5.2 confirms this outcome at 1% level of significance in both models underlay previously.

Table 5.2. ADF test result for co-integration

Model with data type	Computed ADF test	1% critical value
HIV prevalence	-5.4262	-2.6819
AIDS cases	-3.1948	-2.7275
Life expectancy lost	-5.5885	-2.7057

Due to the caveat Engle-Granger procedure entails, especially with the number of cointegrating vectors, it warrants to undertake Johansen methodology, which as well confirmed the existence of one co-integrating vector. See annex table 5.2.

Thus, we can move now into estimating the long-run equilibrium function using OLS without the fear of spurious regression and other pitfalls we have just described. Because, "co-integration is the statistical implication of the existence of long-run relationships between economic variables" (Thomas, 1993:164).

5.3 ESTIMATION RESULTS

5.3.1. LONG RUN RELATIONSHIP

Having overcome statistically notified troubles our task forthwith is to undertake OLS regression on our model. And we try to look deeply at estimated output and make the appropriate analysis therefrom. To begin with, our first model captures different explanatory variables just described among them HIV/AIDS prevalence rate covering for the period 1982/83- 2004/05.

Hence, we obtained the following result,

LGPC= 5.67 + 0.14LINV* - 0.05LNGD -0.07LHAP* ..... (5.1)

(56.79) (2.69) (-1.06) (-3.00)

R^2= 0.33 F (3, 19) = 3.20 DW=1.24

Diagnostic tests

AR (1) $X^2(1)$ =1.0700(0.3611) F (1, 18) =0.8783(0.3611)

ARCH (1) $X^2(1)$ =0.1440(0.7043) F (1, 18) =0.1358(0.7204)

RESET F (1, 19) = 0.3429(0.5654)

NORMALITY $X^2(2)$ =6.9976(0.5654)

* Significant at 1% level of significance

** Significant at 5% level of significance

*** Significant at 10% level of significance

The F value confirmed that all variables jointly determined the dependent variable at 5% level of significance. Around 33% of the change in GDP per capita is explained by the regressors included in the equation. Though the R^2 looks small for time series, it is not still unlikely to

encounter such type of results. Besides the plot of actual and fitted value is presented in annex 2 in demonstrating the goodness of fit.

Referring to the diagnostic test table above, we do not have a problem that violates the classical assumptions which precludes us from applying the usual test statistics. AR (Breusch-Godfrey LM) evidences the absence of serial correlation. The ARCH test rejected the null hypothesis of hetroscedasticity. The Jarque Bera value is below the X^2 critical value at 2% and is compelling to concede normality assumption in the disturbance error terms. According to RESET test, our model does not have the functional form problem or omitted variables in other words no misspecification.

Moreover, we attempt to look the parameter stability and predictive power using recursive least squares test. Again, we found this result in favor of constant parameter over time. Thus, the model has the power to make forecast outside its sample period because the recursive residual graph lies within the given band (See annex 3).

When we turn to examine economically sensible outcomes, we have found theoretically expected signs in particular to the variables investment to GDP ratio, population growth and the prevalence of HIV/AIDS. The sign of educational expenditure to GDP ratio being statistically insignificant and against the apriori expectation, we dropped it and reported only the parsimonious model presented.

The association of income per capita with respect to investment (in physical capital) is positive and statistically significant at 1% level of significance. The coefficient implies income per capita has grown positively owing to an accelerating expansion of investment in the country, *ceterius paribus*. The change in the economic policy from command to market oriented may

have attributed to a growth and expansion in investment over the last decade. And, investment growth on one hand creates an opportunity to exploit untapped resources, on the other hand, by rising capital to equip labor force it boosts the overall economy and per person share. Our result, therefore, justifies the underpinnings of growth theory and resembles what most studies have found across countries[14] and studies carried out in Ethiopian case as well (Seyoum, 1997; Elias, 1998).

We have found an inverse relationship between population growth and output per capita, which is statistically significant at 10% level of significance. Our finding confirmed what growth theories predicted a priori and supports empirical findings of several studies just cited. The plausible explanation designated to this is that population growth forces to divert resources from investment opportunities to consumption expenditure. Even those part of the population who are able to participate in production scramble for existing capital the work force has equipped with causing workers contribution to diminish. These two forces worked together to a country's realized output decline and negative correlation.

Finally, with paramount importance, our study reported a statistically significant negative correlation between the prevalence of HIV/AIDS and income per capita. There are two contentions on the literatures dealing with HIV/AIDS and output as illustrated in detail in previous chapter. To put it again concisely, part of scholars argued HIV/AIDS influences economic growth of countries adversely and considerably while at the opposite extreme there are people who stress that either the epidemic has quiet insignificant or perhaps positive effect

[14] Knowles & Owen, 1995; Heshmati, 2001; Bloom et al. 2001; Weil, 2005; Mankiw et al. 1992; Jones, 2001; Barro & Sala-i-Martin, 2004

(at least theoretically)(Bloom & Mahal, 1995). Their arguments have their own workable reasons that are substantiated by some sort of empirical evidences.

HIV/AIDS rigorously affects the most skilled, experienced and the productive age group. It retards them from work, spiral down their productivity while at the same time deepening medication cost need. A fall in quality and size of labor, in tandem with capital depletion drastically reduces and weakens the economic performance.

Even so, according to the latter group, in countries recognized for high level of unemployment and underemployment the pandemic instead creates an avenue to those unemployed in place of the lost ones. So, it increases productivity and output of countries more meaningfully in developing and highly infected economies.

Given these premises, though Ethiopia is one of those mentioned economies, our finding conveys in support of the former hypothesis or argument. The rapidly spreading epidemic has affected the economic performance and income per capita of the country adversely. Among the studies that have reported the negative impact using OLS regression, we can cite that of Papageorgiou & Stoytcheva (2004) done across OECD and non-OECD countries. In fact, most of the studies employ the simulation methodology, comparing the AIDS scenario against no-AIDS scenario. And their findings indicated the economy of highly infected countries would have worked better without the epidemic than it is doing now (Cuddington, 1993; Cuddington & Hancock, 1994; MacFaran & Sgherri, 2001).

So far, the data we have employed constitutes HIV/AIDS prevalence based on the progression made by MOH covering from 1982 to 2008. Bearing in mind the limitations just jot down previously favoring the prevalence, yet, attempt is made to regress the dependent variable on

AIDS incidence in place of HIV prevalence as an alternative plus to see the robustness of the model. The estimated result regressed is,

LGPC= 5.45 + 0.08LINV* + 0.11LNGD*** -0.01LAIDS** [15] ..... (5.2.)

(42.61) (2.84) (1.49) (-1.84)

R^2= 0.45 F (3, 14) = 3.7897 DW=1.14

Diagnostic tests

AR (1) $X^2(1)$ = 2.4549(0.1172) F (1, 13) =2.0580(0.1755)

ARCH (1) $X^2(1)$ = 0.6874(0.4071) F (1, 13) =0.6321(0.4390)

RESET F (1, 18) = 2.0985(0.1711)

NORMALITY $X^2(1)$ = 0.9649(0.6173)

The F static result of the equation at 5% level significance shows the explanatory variables are different from zero. In other words, they jointly determine the change in the dependent variable. R^2 asserts that 45% of the variation on the dependent variable devoted to the explanatory variables. Look at the actual and fitted values for further explanation (seen annex 4).

Like the preceding model, here too, we did not find significant evidence that violates the classical assumptions or against using OLS. All the diagnostic tests are below their respective critical values. According to this test as presented above, AR (Breusch-Godfrey LM) test rejected the doubt of serial correlation among the variables. ARCH (1) does not detect for the presentation of hetroscedasticity. Jarque Bera value ensures that the error terms are distributed normally. RESET test with a computed F value below critical value at 1% ruled out the

[15] Level of significance in brackets are similar to the one given previously.

problem of omitted variables in our model or misspecification to put it more expressively. Besides, we have to detect for the parameter stability and predictive power equipped by Chow test. The plot as shown in the annex it passes the suspect of parameter instability (refer to annex 5).

When we go beyond the statistical implications, in the same vein as the first function, we still find statistically significant expected signs for investment to GDP ratio and AIDS incidents except for population growth displaying conversely (of expected).

Physical capital formation/investment determines income per capita positively and it is statistically significant. However, against the framework and most empirical evidences population growth in this case affects GDP per capita positively[16].

The sign of the coefficient of AIDS variable, which is our main concern, is significantly negative at a level of 5%.[17]A unit percentage increase in AIDS incident causes 0.01% fall in income per capita. We can imagine how it adversely affects the welfare of the society and the extent it destroys a commitment to improve income of the population and escape out of abject poverty. So, the epidemic forms hollow-out on potential achievable income.

A person who reaches AIDS stage can be considered as sick because its immunity does not prevent the patient from other opportunistic illnesses. Rather the person is vulnerable to opportunistic infections that expedite its retirement off work and death. The patient spends much of its working time at bed, and hardly contributes to the overall production. To the

[16] Elias (1998), similarly, found positive sign between population and economic growth.
[17] AIDS variable sustains robustness test.

contrary these vulnerable group of the society, at this particular stage, claim persistently substantial amount of money out of scarce resource for consumption and medication (need).

In countries highly infected by the epidemic, the influence does not confine to the infected individual or afflicted household alone while the negative ramifications spill over to the wellbeing of the population. The second justification is that extended type household contributes its share to this effect. Family members in such households are engaged in nursing the AIDS patient. They spend lots of their time off work and income generating activities, which exacerbates the adverse impact of AIDS catastrophe emanating from the infected person.

On top of this, the fundamental factor that makes AIDS different from other contagious disease is that it does not show an evenly scattered distribution among different age groups. Nonetheless, it is skewed on the younger or most productive class, i.e. 15-49, which shows humped in the middle rather than the usual J curve type. The implication is that, by affecting the most productive class, constituting productivity, labor force size and financial resource, altogether destroys the engine of an economic growth. That is why, in the end, the epidemic appears to be influential and disastrous by any measurement, more strikingly to AIDS-ridden developing countries.

Finally, an attempt is made to regress the dependent variable GDP per capita on life expectancy lost due to AIDS, in place of AIDS cases. This result exhibits negative impact at 1% level of significant like the above once but more figurative in magnitude. Life expectancy lost caused by an increasing rate of mortality as a consequence of AIDS spread has been rising since the over the last two decades. In spite of the critics, it merely reflects the mortality impact than morbidity, life expectancy constitutes one of commonly used health outcome indicators in various studies. AIDS case growth implicated in increasing fall of life expectancy

has imposed income per capita adversely in this model as well. Needless to mention, we have not faced with all diagnostic tests (see annex 6 & 7). The estimated result is,

LGPC= 4.64 + 0.22LINV* + 0.14LNGD* -0.045LLELA*+ 0.01T* [18] ..... (5.3.)

(26.09) (3.49) (2.73) (-2.25) (2.05)

R^2= 0.83 F (4, 16) = 17.5502 DW=1.60

Diagnostic tests

AR (1) $X^2(1)$ = 0.5856(0.4441) F (1, 15) =0.4223(0.5263)

ARCH (1) $X^2(1)$ = 0.6301(0.4273) F (1, 15) =0.5831(0.4555)

RESET F (1, 21) = 1.2729(0.2782)

NORMALITY $X^2(1)$ = 1.4911(0.4745)

From all of our regressions, we have obtained the expected sign between GDP per capita and AIDS cases, but we are not sure on the direction of causality. To test this we carried out granger non-causality test in both ways. Comparing computed F value with F statistic, AIDS incidence, life expectancy lost due to AIDS, and HIV prevalence are exogenous to GDP per capita but not the other way (see annex 8).

SHORT-RUN DYNAMICS (ECM)

According to Granger representation theorem, co-integration among the variables imply error correction model (Thomas, 1993 & -----). As described well before, co-integration consolidates the existence of long-run equilibrium as long as the disequilibrium has zero mean and oscillates around it. ECM by itself contributes to assess how the short-run deviation adjusts to its long-run equilibrium. In other words, it provides a coefficient indicating the

[18] Level of significance in brackets are similar to the one given previously and T stands for trend variable.

speed of adjustment to attain the equilibrium if after all there prevails disequilibrium error or shocks.

To this end, we regress OLS on the ECM model having included the lagged residual that is saved from the long-run equilibrium function, which happens stationary. ECM representation yields the following outcome,

$\Delta LGPC = 0.003 + 0.01\Delta LINV_t + 0.08\Delta LNGD_t - 0.003\Delta LAIDS^*_t - 0.81 RESID^*(-1) \ldots$ (5.3)

(0.25) (0.1696) (1.51) (-2.78) (-2.62)

$R^2 = 0.54$ $F(4, 13) = 3.57$ DW=1.81

Diagnostic tests

AR (1) $X^2(1) = 3.4927(0.1744)$ $F(1,12) = 1.2929(0.3166)$

ARCH (1) $X^2(1) = 0.3929(0.5308)$ $F(1,12) = 0.3524(0.5622)$

RESET $F(1, 12) = 0.7115(0.4169)$

NORMALITY $X^2(2) = 0.6669(0.7164)$

The F static suggests that the explanatory variables are different from zero and jointly explain the dependent variable significantly since it exceeds the critical value at 1%. The R^2 value is larger in this model than was in the long run. Around 54% of the change in the dependent variable attributed to the included factors of the model.

From the diagnostic test result, we do not find any evidence in favor of serial correlation, hetrescedasticity, and misspecification or omitted variables. Besides, our data are distributed normally.

In the short run investment and population growth affect change in income per capita negatively for the first case and positively in the second function. Despite non-consistent

signs, however, they are not statistically significant. It implies these factors do not influence GDP per capita in the short run.

AIDS, in contrast, has a significant and negative impact on the change in per capita income. Each year AIDS drives out people and some financial resources from the economic system or productive activities with far-reaching implication. Therefore, AIDS not only impose the long-run economic activity but also it entails an immediate/short run serious damage.

Most importantly, as statistical framework expected the coefficient of the disequilibrium error is negative and statistically significant at 1%. In essence, it indicates any deviation or departure occurred from the equilibrium corrects virtually 80% in a year. Hence, in addition to the co-integration among variables we have found previously, here too, the ECM model and the disequilibrium coefficient consolidates the existence of long-run equilibrium in our model.

6. CONCLUSION AND POLICY IMPLICATION

6.1 CONCLUSION

Currently there is a common consensus that HIV/AIDS epidemic far beyond a mere health indicator, is growing as development challenge especially to developing countries. The catastrophe stands against and undermines countries' relentless effort and endeavor to succeed in progress and make poverty history. Most strikingly, it has eroded the achievements of African countries since the aftermath of independence. This is confirmed in several sub Saharan African countries (refer to the empirical findings).

Some years ago, Ethiopia had been cited as one of the five next wave countries globally by the US government due to its rapid and alarming rate of HIV spread, large number of people living with the virus and size of total population. Despite this fact there are not much studies trying to highlight the likely effect of this virulent disease. Triggered by this background this study targets to investigate whether HIV/AIDS has affected economic growth of the country, as represented by income per capita, since its outbreak.

To address this question the extended Solow growth model is applied using times series data of HIV/AIDS prevalence, AIDS cases, and life expectancy lost due to AIDS, alternatively.

Hence, over the review period physical capital injected or investment committed in the country has contributed to an improvement in economic growth and income per capita. In a catchall terms welfare of the population has benefited from capital formation like most developed and developing countries.

In contrast, with regard population growth the effect is inconclusive. In the first model though the sign was negative it was not significant but in the remaining models, population growth determines GDP per capita positively and significantly.

As it is already elaborated vividly, the prime focus of this piece of work is to determine the likely effect of HIV/AIDS on the economic performance of the country. Our finding evidences in favor of our hypothesis- HIV and AIDS in collaboration or separately have imposed their quantifiable adverse impact on the economic growth in general and welfare of the people in particular. In all approaches employed in place of the epidemic, viz, HIV prevalence, new AIDS cases and life expectancy lost caused by AIDS, confirmed the negative repercussion it imposes on the economy. To summarize, HIV/AIDS affects quiet significantly income per capita negatively both in the short-run and long-run, and does not depart from the findings reported on the counterpart/sub Saharan countries.

Negligence that stems from considering HIV/AIDS as mere health problem and not of development plague, as we have seen, claims extremely profound cost the country could not afford eventually. The negative repercussions may range from eroding what the state have achieved so far and envisages meeting in the future.

6.2 POLICY IMPLICATION

Based our findings we attempt to forward the following policy implications. Despite the delay on the intervention to combat the spread of the epidemic, government and other development partners have been registering good and promising results. However, the spread rises rapidly and remains alarming at rural areas where around 85% of the total population resides in. To the worse, the economy extremely hinges up on the agriculture sector, which is fragmented, and labor intensive by its nature sustaining as the mainstay of the economy. High HIV prevalence in rural area may hence result not only in slowing down the economy but at the extreme case may devastate the economy by large.

Therefore, government, non-governmental organizations, and other stakeholders have to intervene on prevention multiplying their effort to curb or minimize the transmission of the virus at rural areas.

Prevention policy has double faceted advantage in this regard,

i. it deters the spread of the virus in the short run and AIDS case in the long run

ii. it affects population growth via fertility rate

With regard to those who have already developed AIDS, the best policy is to provide ART /ARV drug to prolong their life and thereby make use of maximum contribution they can make to the economy in addition to ethical motives. Current HIV persons certainly would be users of the drug in some time in the future. ART beyond its selling price claims other concomitant cost such as nutrition expenditures. Together the burden is unconceivable and perhaps difficult to the economy to endure. ART donation by different initiatives should not be considered like recurrent humanitarian aid while this crisis possibly persists all the time. The have to have sustainable source of funding and supplying this therapy until it combats the disease to affordable level. To this end, the government should design policies and strategies in order to institute local source of ART financing such as AIDS fund and promote health insurance (with particular emphasis paid to covering AIDS medication cost), provision of appropriate incentives to insurance companies engaged in this field.

BIBLIOGRAPHY

Aisa R & Pueyo F (2004), endogenous *Longevity Health and Economic Growth: a Slow Growth for a Longer Life*? Economic Bulletin, vol.9, no.3

Barlow R. (1967), "*The economic cost of malaria eradication*," The American economic Review, vol. LVII. No.2.

Barro R.J. & Sala-i-Martin X.S. (2004), "*Economic Growth*" 7th ed. MIT press.

Bartel A. & Taubman P. (1979), "*Health and Labor Market Success: the Role of Various Diseases*," The Review of economics and statistics, vol.LXI, no.1.

Becker (1965), "A Theory of the Allocation of Time" The Economic Journal

Bell C., Devarajan S. & Gersbach H. (2004), "*Thinking About The Long-Run Economic Costs of AIDS*," in Haacker M (ed.) The Macroeconomic Impact of HIV/AIDS, IMF.

Behrman J.R. (1996), "*The Impact of Health & Nutrition on education*" The World Bank Research Observer, vol, 11, no.1 Washington.

Berhanu & Seid (1999), *Performance of the Ethiopian Economy: 1991-1998*. In Alemayehu & Berhanu, (ed) The Ethiopian Economy Performance Evaluation, EEA & AAU, Addis Ababa.

Birdsall N. & Hamoudi A. (2004), "*AIDS & the Accumulation and Utilization of Human capital in Africa,*" in Haacker M (ed.) The Macroeconomic Impact of HIV/AIDS, IMF.

Bloom D.E. &. Mahal A.S (1995), "*Does the AIDS Epidemic Really threaten Economic Growth?*" NBER, Working paper no.5148

Bloom D.E. Canning D. & Sevilla J. (2001), "*The Effect of Health on Economic Growth: Theory and Evidence,*" NBER Working paper, 8587.

Bonnel R. (2000), "*Economic Analysis of HIV/AIDS*," ADF Background Paper, the World Bank.

Chima R. (2003), "*Strategic Response and the Opportunities for Financial Resource Mobilization against HIV/AIDS in Ethiopia*" UNECA Addis Ababa.

Cogneau D. & Grimm M. (2004), "*AIDS & Income Distribution in Africa: A Micro-Simulation Study for Cote d'Ivoire*".

Cuddington J.T. (1993), "*Modeling the Macroeconomic Effects of AIDS, with an Application to Tanzania*," the World Bank Economic Review, vol. 7. no.1:171-89.

_____ (1993), "*Further Results on the Macroeconomic Effects of AIDS: The Dualistic Labor-Surplus Economy,*" The World Bank Economic Review, vol. 7, no.1:403-417.

_____ & Hancock J.D. (1994), "*Assessing the Impact of AIDS on the growth path of the Malawi Economy,*" Journal of Development Economics, 43:363-368, North-Holland.

_____ Hancock J.D. & Rogers C. (1994), "*A Dynamic Aggregative Model of the AIDS Epidemic with Possible Policy Interventions,*" Journal of Policy Modeling, 16 (5), A Social Forum of World Issues, N.Y.

Daniel Z. (2002), "*The Macroeconomic Impact of HIV/AIDS in Ethiopia*," A.A.U Department of Economics,

De la Croix D. & Licandro O. (1999), Economic Letters, 65:255-263.

Dornbush R. Fischer S & Startz R. (1998), *Macroeconomics*, Irwin McGraw-Hill, 7th ed. NY

Elias K. (1998), *Exports and Economic Growth and Evidence from Eastern and Southern Africa,* unpublished Msc thesis, Addis Ababa University.

Equar D. (2001), *Determinants of Real Exchange in Ethiopia: An Empirical Investigation (1985Q1-2000Q2)*, unpublished Msc thesis, Addis Ababa University.

Espstein B.G. (2004), "*The Demographic Impact of HIV/AIDS*," in in Haacker M (ed.) The Macroeconomic Impact of HIV/AIDS, IMF.

Goitom (1999), *Highlight on the Historical Evolution of Ethiopia's Population: Growth Distribution & Direction of Population Change.* In Alemayehu & Berhanu,(ed) The Ethiopian Economy Performance Evaluation, EEA & AAU, Addis Ababa.

Haacker M. (2002), "*Modeling the Macroeconomic Impact of HIV/AIDS*," IMF working paper WP/02/195.

_____ (2004), "*HIV/AIDS: The Impact on the Social Fabric & the Economy*," in Haacker M (ed.) The Macroeconomic Impact of HIV/AIDS, IMF.

_____ (2004), "*The Impact of HIV/AIDS on Government Finance & Public Services*," in Haacker M (ed.) the macroeconomic impact of HIV/AIDS, IMF.

Hall R.E. & Jones C.I. (1999), "*Why Do Some Countries Produce so Much More Output Per Worker than Others?*" The Quarterly Journal of Economics 83-116.

Hatanaka M. (1996), "*Time-Series-Based Econometrics Unit Roots & Co-integrations,*" Oxford University press.

Hendry D.F. (1995), *Dynamic Econometrics*, oxford university pressk, NY.

Heshmati A. (2001), "*On the Causality between GDP& Health care Expenditure in Augmented Solow growth model*," SSEIEFI, Working paper series No. 432.

Jones.C.I. (2001), *Introduction to Economic Growth*, second edition.

_____ (2002), "*Sources of US Economic Growth in a World of Ideas*," The American Economic Review, vol.92, no.1:220-239.

_____ & Manuelli R.E. (1994), "*The sources of Growth*," SSRI working paper No.9428.

Kalemli-Ozcan S. (2002), "*Does the Mortality Decline Promote Economic Growth*",

Kambou G, Devarajan S. & Over M, (1992), "*The Economic Impact of AIDS in an African country: Simulations with a computable General Equilibrium model of Cameroon*" Journal of African Economies, v-1, N-1

Knowles S. &. Owen P.D. (1995), "*Health Capital and Cross-Country Variation in Income Per Capita in the Mankiw-Romer-Weil Model*," Economic Letters, 48: 99-106.

Lasky M. (2004),"*The Role of Saving in Economic Growth When the Cost of New Human Capital Depends on the Cost of Labor,"* technical paper series congressional budget office, Washington D.C.

Lorentzen P, McMillan J & Walziare R. (2005), "*Death & Development*," NBER working paper series, 11620

Lucas Jr., R.E. (1988), "*On the Mechanics of Economic Development*," Journal of Monetary Economics, 22:3-42. North Holland

Macfarlan M. & Sgherni S. (2001), **"***The Macroeconomic Impact of HIV/AIDS in Botswana***,"** IMF working paper WP/01/80.

Mankiw G.N. Romer D & Weil D.N. (1992), "*A Contribution to the Empirics of Economic Growth,"* Quarterly Journal of Economics vol. 107, no.2: 407-437.

MOH (2002), *AIDS in Ethiopia*, 4th report, Addis Ababa

_____(2004), *AIDS in Ethiopia*, 5th report, Addis Ababa.

MOLSA (2003), "*Survey On the Prevalence and Characteristics of AIDS Orphans in Ethiopia*," Addis Ababa unpublished.

NBE , *Annual Bulletin*, various issues, Addis Ababa

Over M. (2004), "*Impact of the HIV/AIDS Epidemic on the Health Sectors of Developing Countries,*" in Haacker M (ed.) The Macroeconomic Impact of HIV/AIDS, IMF.

Papageorgiou C. & Staytcheva P. (2004), "*What Do We Know About The Impact Of AIDS On Cross-Country Income So Far?"* LSU working paper, 2005-01.

Phamondon P. Cichon M. & Annycke P.(2004), "*Financial Effects of HIV/AIDS on National Social Protection Schemes*," in Haacker M (ed.) The Macroeconomic Impact of HIV/AIDS, IMF.

Romer P.M. (1986), "*Increasing Returns & Long-Run Growth*," Journal of Political Economy, vol. 94 no 5.

Schultz T.P. (2002), "*Wage Gains Associated With Height as A Form of Health Human Capital*". Economic growth center Discussion paper No.841.

Seyoum C. (1997), *Economic Performance of Ethiopia (1972-1995): Growth Determinants and Implications*, unpublished Msc thesis, Addis Ababa University.

Shewit E. (2002), "*The Economic Impact of HIV/AIDS: Medical Cost on Akaki Fiber Factory*". Unpublished MSc. thesis, AAU

Solow R.M. (1994), "*Perspectives on Growth Theory*," Journal of Economic Perspectives vol.8 no 1:45-54.

Strauss J. & Thomass D. (1998), "*Health, Nutrition and Economic Development*" Journal of Economic Literature, vol. xxxvi.

Thomas R.L.(1993), "*Introductory Econometrics:Theory and Application*" Longman, London.

UNAIDS/WHO (2002), "*Epidemiological Fact Sheets on HIV/AIDS & Sexually Transmitted Infections*". Geneva.

_____(2005), "*AIDS epidemic update*". Geneva.

UNECA (2000), "*African Development forum 2000 AIDS: the Greatest Leadership Challenge*". Addis Ababa.

Weil D.N. (2005), "*Accounting for the Effect of Health on Economic growth.*" NBER, working paper series, 11455.

Were M. & Nafula N.N. (2003), "*An Assessment of the Impact of HIV/AIDS on Economic Growth: the Case of Kenya*". CESIFO working paper No. 1034.

Wheeler D. (1980), "*Basic Needs Fulfillment & Economic Growth: A simultaneous Model*", Journal of Development Economics, 7:435-451

Young A (2004), "*The Gift of The Dying: The Tragedy of AIDS & The Welfare of Future African Generations*". NBER, working paper series 10991.

ANNEXES

ANNEX 1. CO-INTEGRATION TEST RESULTS OF JOHANSEN METHODOLOGY

1.1. For the Equation with Life Expectancy Lost Due To Aids

Eigenvalues	Likelihood ratio	5% critical value	1% critical value	Hypothesis
0.9153	63.12	39.89*	45.58	P=0
0.6044	21.13	24.31	29.75	p≤1

1.2. Equation with AIDS Cases

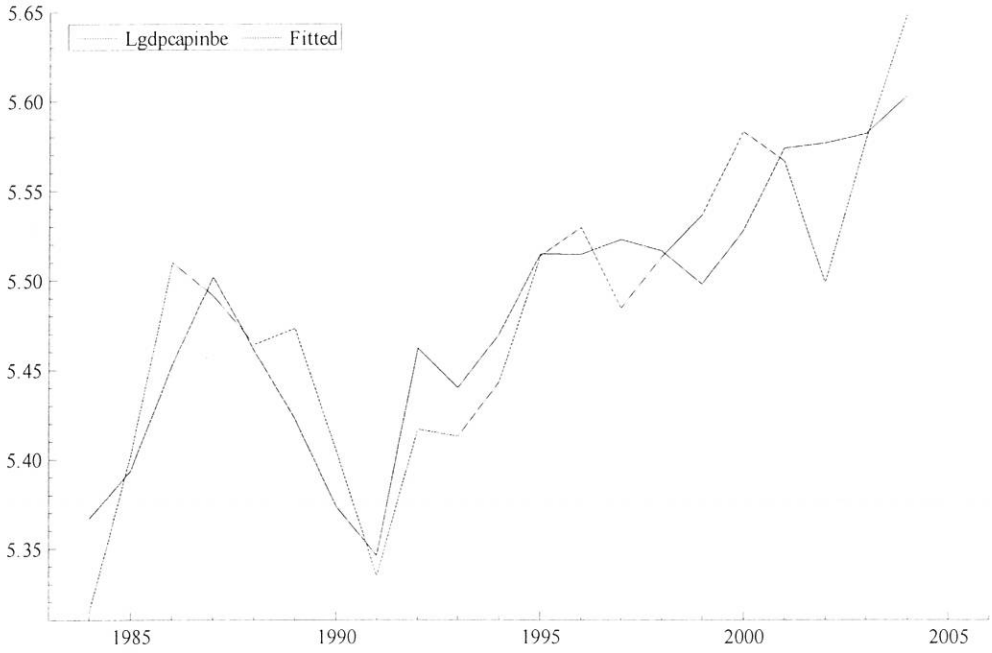
0.8017/0.9577	55.03/78.04	53.12*/39.89	60.16/45.58	P=0
0.5519/0.4877	25.91/21.07	34.91/24.31	41.07/29.75	p≤1

1.3. Equation with HIV Prevalence

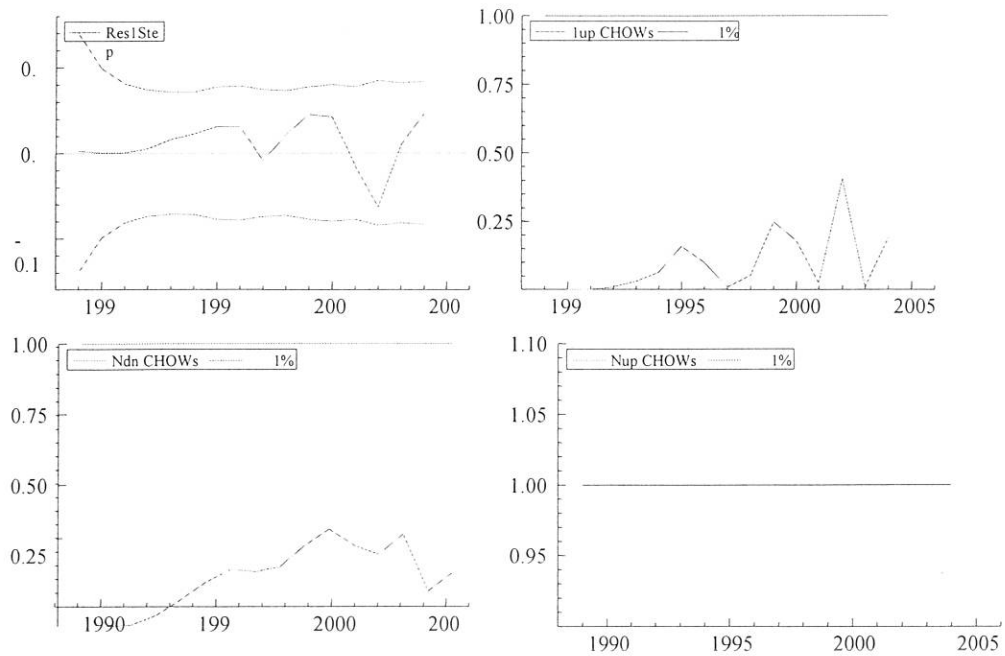
0.9048	61.39	39.89*	45.58	P=0
0.4738	19.05	24.31	29.75	p≤1

* The LR indicates one cointegrating vector at 5% significance level.

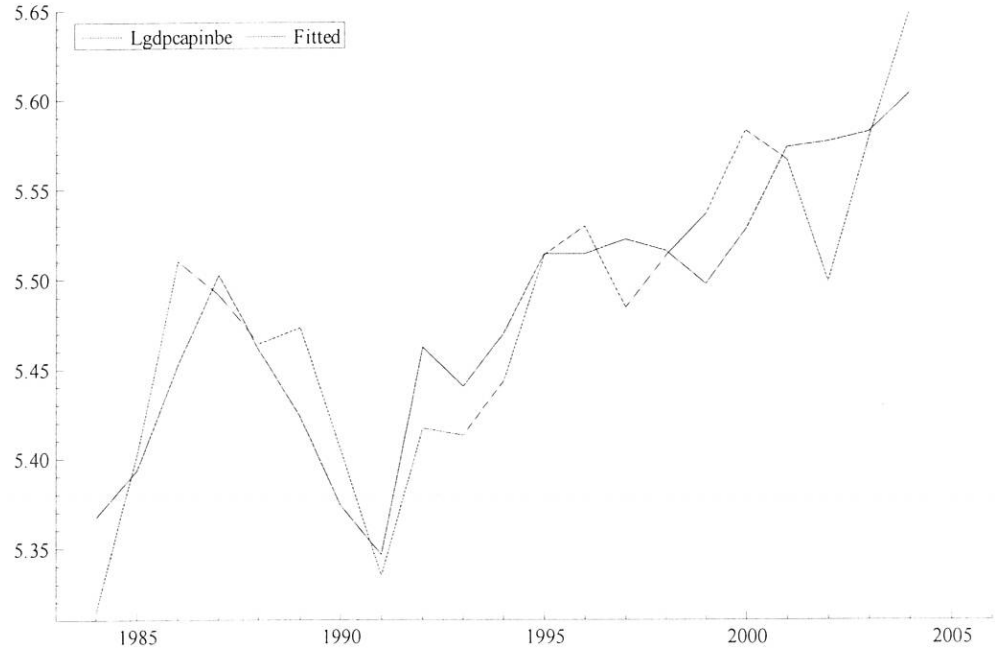
ANNEX 2. ACTUAL AND FITTED VALUE FOR HIV PREVALENCE



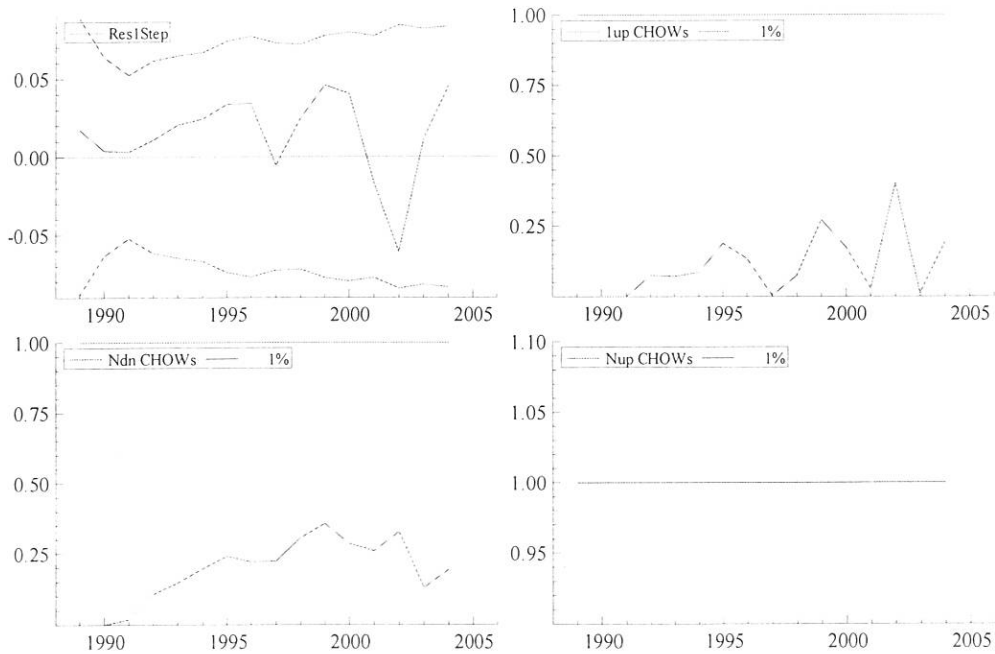
ANNEX 3.ONE-STEP RESIDUALS AND CHOW "BREAK POINT" FOR HIV PREVALENCE



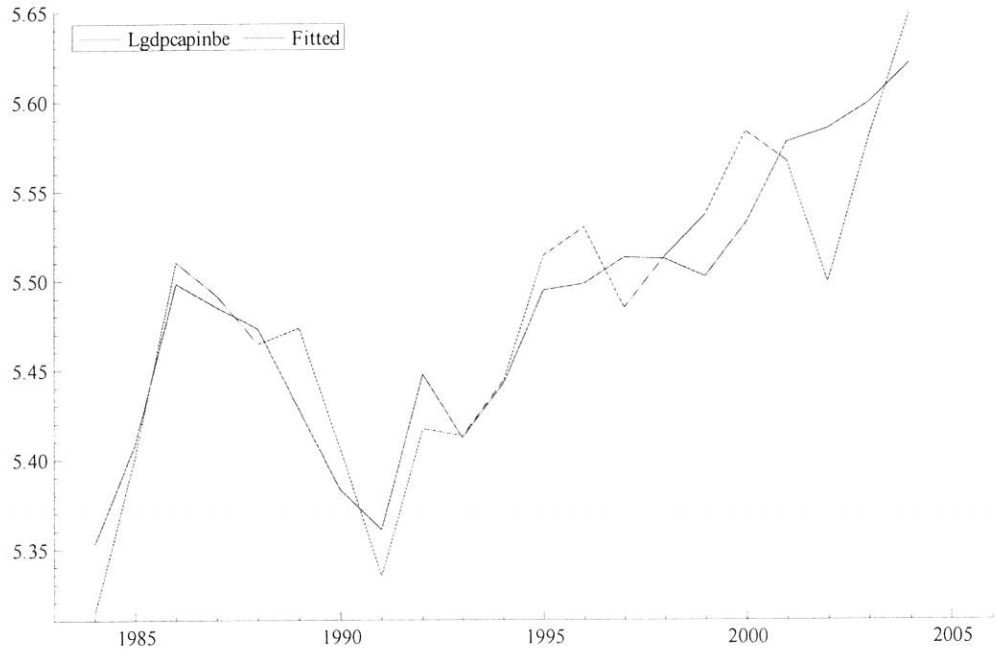
ANNEX 4. ACTUAL AND FITTED VALUE FOR AIDS CASES



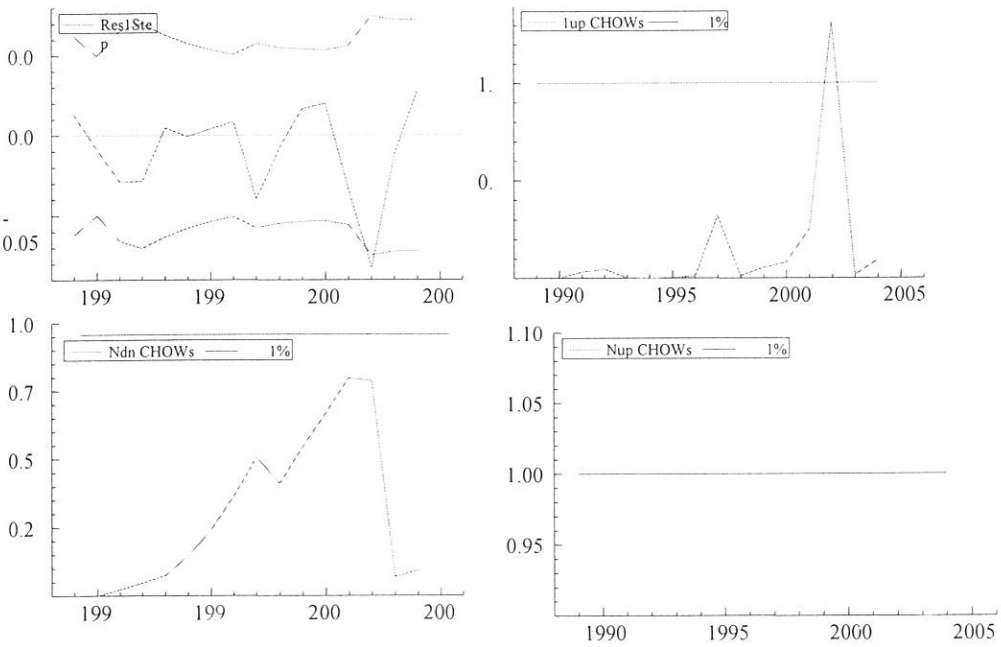
ANNEX 5.ONE-STEP RESIDUALS AND CHOW "BREAK POINT" FOR AIDS CASES



ANNEX 6. ACTUAL AND FITTED VALUES FOR LIFE EXPECTANCY LOST DATA



ANNEX 7. ONE-STEP RESIDUALS AND CHOW "BREAK POINT" FOR LELA DATA



ANNEX 8. GRANGER NON-CAUSALITY TEST

Variable	lngpc	lnhap	lnainc	lnlela
lngpc		1.99(0.17)	2.07(0.09)	0.89(0.43)
lnhap	2.83(0.09)			
lnainc	3.64(0.05)			
lnlela	3.38(0.06)			

ANNEX 9. ECM MODEL USING HIV PREVALENCE

$\Delta LGPC = 0.03 - 0.006\Delta LINV_t - 0.012\Delta LNGD_t - 0.42\Delta LHAP_t^* - 1.03RESID(-1)^*$

(1.42) (-0.10) (-0.65) (-2.91) (-6.67)

$R^2 = 0.75$ F (4, 17) = 12.84 DW=1.54

Diagnostic tests

AR (1) $X^2(1) = 0.8015(0.3706)$ F (1, 16) = 0.6049(0.4480)

ARCH (1) $X^2(1) = 0.5896(0.4425)$ F (1, 16) =0.5489(0.4678)

RESET F (1, 16) = 8.3414(0.0107)

NORMALITY $X^2(1) = 1.3234(0.5159)$

Declaration

I, the undersigned, declare that this thesis is my original work and has not been presented for a degree in any other university, and that all source of materials used for the thesis have been duly acknowledged.

Declared by:

Name: BEHANU HABTU

Signature: _____

Date: _____

Confirmed by Advisor:

Name: DR. J. MANOHAR RAO

Signature: _____

Date: 4th April 2006

Place and date of submission: Addis Ababa, March 20, 2006.

ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATES STUDIES

ASSESSING THE ECONOMIC GROWTH IMPACT OF AIDS: *THE ETHIOPIAN CASE*

BY
BRHANU HABTU BERHEA

March 31, 2006
Addis Ababa