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Human Capital and Economic Growth:

Empirical Analysis of how Human Capital Affects Economic Growth in Sub-Saharan Africa.

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Abstracts:

Human capital encompasses knowledge, information, ideas, skills, and health of individuals. Technology may be the driver of present day modern economic growth (MEG), especially for the science base sector and advanced economies of the world, but human capital is certainly the energy required to drive the vehicle of modern economic growth (Becker, 2002). From the periods of first industrial revolution to the present day information and communication technology (ICT) revolution, human capital continues to play an important role to different regions and countries economic growth and standards of living. The analysis of human capital's effects on economic growth in Sub-Saharan Africa is geared towards determining and analysing the growth potential of this region with education as an important growth determinant.

Key words: Economic Growth and Development, Human Capital and Sub-Saharan Africa.

INTRODUCTION

The economic and living condition of Sub-Saharan Africa (henceforth SSA in this research) is comparatively the most unfavourable situation among different regions of the world. The continent is characterised by low economic performance, adverse demographic conditions, low and poor quality of human capital. Different factors are assumed to be responsible for the region's poor performance and varying recommendations by different international and local development institutions have been put forward for alleviating these conditions towards improving the living standard in the region. We aim to analyse the role of human capital towards economic growth and hence long term development of the region. Human capital has gain prominence among varying growth theorists. This paper aims to examine its role in the economic development of SSA.

Human capital is expected to enhance productivity in SSA. The direct effects of human capital is analysed in the context of its private and social returns. The private effects discuss the potential individual effects of human capital whilst social benefits discuss the potential societal gains from education. The overall aim of human capital returns to education being its aggregate effects on economic growth in the region.

Human capital externalities analyse the effect of education on SSA's demographic conditions in particular fertility, life expectancy at birth, mortality and population growth. The analysis

concentrate on the potential effects of education to these factors and which are assumed to have positive effect on the region's economic growth. The aim of this section is not to examine the effect of these demographic factors to economic growth but rather educations effects on them and assumedly their long term positive contribution to growth.

SSA's infrastructural development is argued to be hindered by low quality of man power in the region. The quality versus quantity argument has varying support and we aim after testing for human capital's role, to examine the role of quality of human capital in economic growth. The distribution and provisions of educations have greater political motives than an economic consideration is one of the many reasons given for low educational accumulation in SSA.

The regressions analysed and models estimated are based on pooled panel data for 38 countries in SSA. The countries were selected basically on data availability for the indicators of interest. The regression estimates and their p-values are presented with detail results of the regression presented in the appendix.

This paper is structured as follows. Section II outlines the research background. What motivates the research; the aims, objectives and the research question are outlined here. It gives a brief historical and present day economic conditions in SSA from time of independence to the turn of century. Section III dwells on the theoretical perspective. It discusses the likely impact of human capital in SSA's economic growth from the perception of its direct impact in the context of private and social returns, the externalities which basically discuss the potential impact of human capital on SSA's demographic conditions which in the long run are assumed will positively affect the region's economic growth. The quality of human capital is also touched upon in line with its role on economic growth especially with regards it to effects on infrastructural, institutional development and distributional justice. Section IV, the research method part, discusses the methodology used. The data formulation and hypothesis were developed with the corresponding econometrics models and methods used to analyse our results. Section V gives our empiric results and discussion of the results in relation to our research topic interest. Section VI concludes the research and briefly outlines some recommendations for future researches of the role of human capital in SSA's economic growth and development. The reference and appendix part gives detail content of resources used for this research and detail empirical result that were analysed and abbreviations used in this research.

II RESEARCH BACKROUND

The population of Africa has passed the one billion mark, the UN Population Fund reveals in a recent report and annual figures showed that the continent's population had doubled in the last 27 years. Population of SSA countries are all growing fast due to varying factors but chiefly to large number of women who have no or minimal knowledge of modern day family planning. With the populations of Nigeria and Uganda leading the continent's fastest growing countries. It's an African phenomenon of a large growing population and with a large percentage of young people in the population. UNPFA reports that the world's population currently stands at about 6.8 billion and it is projected Africa's population will reach 1.9 billion by 2050 (UNFPA, 2009). Unfortunately, this increasing population growth is not matched by increasing economic growth hence the standard and quality of living is among the lowest in the world. This expanding population growth coupled with the poor performance of the continent's economic growth is a cause of concern for the international community. To the international community several factors are responsible for SSA's poor economic performance including but not limited to civil wars, rampant corruption, political assassinations, poor and unfavourable economic and trade policies, poor industrialisation.

After gaining independence from colonial powers in the mid 20th century, many African countries adopted economic growth programs that required them to maintain and develop further trade partnership developed during colonialism. They concentrated heavily in the primary sector of production, as during colonial period, producing and exporting primary goods to the developed economies notably to old colonial masters. As a result from mid 1960s to the turn of century, agriculture dominates most African manpower and economic activities primarily in the rural agricultural sector with petty trading and commerce dominant off season i.e. after the rainy season as most methods of agriculture were primitive farming, irrigation even as of today plays a very minimal role in SSA's agriculture. Despite important strives for industrialization, agriculture still employs about more than half the working population in most part of the continent. The sector remains an important contributor to gross domestic product (GDP) in many of these countries (Elu, 2000 and World Bank, 2009).

In the late 1980s the percentage contribution of agriculture to GDP in SSA ranged from low of 3 to a high of 66 in Botswana and Tanzania respectively. SSA as a whole incur a 9 percentage point decrease as the weighted average contribution of agriculture to the GDP stands at 32 percent, declining from 41 percent in the mid 1960s when most of these countries

attain independence. At end of the century, agriculture's contribution to the GDP varies from a low of 7 percent to a high of 64 percent in Angola and the Democratic Republic of Congo respectively. The low figures for some countries for the varying periods (and other countries in the continent) does not in any way indicate an increased or successful industrialization of these economies, but a shift by policymakers to more lucrative sectors of mining and other extractive industries. From mid 1970s, with the discovery of petroleum and other precious natural resources, substantial number of SSA countries shifted their economic activities from the agricultural sector in favour of increased exploitations in the extractive sectors as the contribution of the sector to GDP growth outpaced agriculture in exemplary countries like Angola, Botswana, Cameroon, Nigeria and Sudan. In fact, Nigeria's and Cameroon's agriculture have been devastated by the increased investment in the petroleum sub-sector that its contribution to GDP growth and employment are very minimal and among the lowest in the continent. The declining output in the agricultural sector can be attributed to the discovery of valuable natural resources but another important contributing factor too for many SSA productivity diversifications can be linked parity to unfavourable prices for agricultural outputs. For example, between 1981 and 1990, the world commodity price index fell by 3.2% (World Bank, 1998/99 and 1991). Hence the profitability and productive contribution of agricultural sector to economic growth being undermined and manipulated by world commodity price index thereby the need for SSA to diversified its economic activities an important economic policy intervention (Elu, 2000 and World Bank, 2009).

Most of SSA exports are exclusively concentrated on the primary commodities for their foreign exchange earnings. For the period of our research, most of the growth in export trade registered in these economies came exclusively from extractive and agricultural sector with little and in some instances no growth from the industrial sector. From late 1960s up to late 1980s spanning a period of two decades, primary commodities like fuels, minerals and metals and to some extend agricultural outputs accounted for as high as 99 percent of export revenues in most countries in SSA. For example, uranium accounts for as much as 76 percent of export earnings for Niger, diamond and beef accounts for more than 90 percent of Botswana's export revenue, whilst Nigeria dependent so much on petroleum export that it accounts for about 90 percent of its export earnings for this period. SSA as a whole did not strive well in its march to industrialization as primary output export accounted for 89 percent of export earnings around end of the century, down from 92 percent in 1965 when most were gaining independent. For a period of more than three decades, the region reduces its

dependency on primary exports by only 3 percentage points hence raising some questions as to the difficulties of the region's quest for industrialisation (Elu, 2000 and World Bank, 2009).

Since gaining independence more than forty years ago for most countries, the industrialisation prospect for SSA still looks slim. The dependency on primary exports undermines the industrialisation potentials of this region and with the lowest stock of global human capital this dream still looks far fetch. SSA still lacks universal access to both primary and secondary education and hence a very low literacy rate common across Africa. These variables are conventionally used to proxy for human capital stock and accumulation in a country. As of 1975, the gross percentage school enrolment for primary and secondary were 57.26 and 9.36 respectively. Great strives were made in increasing gross school enrolment but SSA is yet to achieve universal primary and secondary education, as of 2007 the figures for primary and secondary gross percentage enrolment were 96.84 and 35.6 respectively (World Bank, 2009). The gross enrolment ratios tend to overestimate the number of educated individuals. The above gross primary enrolment figure gives near universal primary education in SSA which is remote from the fact. Gross enrolment contain individuals registered in a given level of schooling to the population of age group expected be enrol at that level without considering repeaters who might be outside the age group. Hence a major problem with this measurement is that the ratio is usually above the 100 mark (Barro and Lee, 1996). These are just school enrolments but the quality of education is an important determinant of returns to the knowledge accrued.

There are important concessions and views that regard education as an important component of economic growth and development hence national, regional and international development organisational policies being geared towards provision of universal education (in particularly primary education) for citizenry. Education is given greater importance, an example being the value European Union attached to education for the sustainability of its economic growth and development, The Lisbon vision of Europe as the "world's most competitive, dynamic, knowledge-based economy" depend on the region's ability to radically expand education system (Björklund and Lindahl, 2005). Economic growth and human capital accumulation in totality have been complementary to each other and simultaneously gone hand in hand with increasing human capital accumulation due in part to higher education spreading and increasingly covering larger portion of the population assumedly resulting into higher economic growth. The expansion of human capital is due to many favourable factors given to the role of education in economic growth, but there is no argument that chief among these

factors is policy decisions undertaken by varying governments in their attempts to expand the growth of their economies hence contributing to the expansion of education and human capital accumulation. Education can be viewed as futurist investment which is expected to contribute to stock of human capital accumulation thereby leading to higher productivity of the population hence stimulating economic growth (Björklund and Lindahl, 2005).

Theoretically it is somehow eclectic an approach to use the concept of human capital accumulation in the measurement and analysis of economic growth as measured in the growth accounting procedures of GDP. Subconsciously and assumedly human capital is seen as a promoting factor in economic growth and its contribution to GDP growth usually far less effective as compared to what is implied in the national accounts (Ljungberg, 2009).

II.I *Aims and Objectives*

This research strives to analyse the role of human capital, proxy by school enrolment rates, on the economic growth and development of SSA. We will focus on the influence or impact of human capital development on the economic growth of SSA and explore how human capital development and accumulation could affect SSA economic growth. It's cautious to note that human capital is an important prerequisite for economic growth and development, but it alone and in isolation cannot lead to economic growth. Hence one has to be careful in reviewing and analysing conclusions drawn from this study.

Direct role of human capital will be the focus of the research, but we will branch of to analyse the externalities of human capital and what are the potential impact of these externalities on SSA's economic growth. Varying arguments were forwarded in relation to the positive effects of human capital accumulation towards the fertility rate, infant and maternal mortality, controls population growth, reduce crime, increases human welfare etc. hence aggregately affecting economic growth in the long run.

The quality of education in SSA is believed to be very low. We will analyse the quality of human capital and its potential resultant impact on economic growth. Human capital accumulation has always been low and slow in SSA since independence than in other developing economies. Many strives were taken to increase human capital and these result in neglecting some prerequisite for human capital accumulation hence affecting the quality of human capital in the region (Grier, 2005). The distributional impact of education will be analysed in light of distributive justice and equity of education in SSA. The disparity of

educational distribution in urban and rural area in relation to accessibility can affect the quality of education in the region.

The main objective of the research is to test empirically the role of human capital in SSA's economic growth. We will develop models to test empirically both the direct effects and externalities of human capital to economic growth.

II.II *Research Question*

The research aims and objective is to study the effect of human capital in SSA's economic development. Volumes of literatures about the role of human capital are published by individuals and organisations outlining the importance of human capital to growth. It's with conviction that human capital has a positive effect on both private and social benefits and demographic development hence an aggregate gain for nations' economic development. The research question being:

What economic effects do Human Capital accumulation and development have on Sub-Saharan Africa's Economic Growth and Development?

III THEORETICAL PERSPECTIVE

Human capital encompasses knowledge, information, ideas, skills, and health of individuals. Technology may be the driver of present day modern economic growth (MEG), especially for the science base sector and advanced economies of the world, but human capital is certainly the energy required to drive the vehicle of modern economic growth (Becker, 2002).
There exist extensive sources and theories for the studies of human capital development in relation to economic growth. Varying growth theorists have varying approaches to human capital as an important component of economic development. The endogenous and exogenous growth theorist have varying concepts, views and approaches to human capital as measure of economic growth but both agreed upon its importance to the composition of the economic growth accounting.

Economists from different generations have emphasised the importance of human capital as vital determinant of growth and development of varying world economies. Hence assumption

among many economic theorists that ignoring human capital in economic growth measures can lead to inconclusive results in the growth data. Kendrick (1976) estimates that about more than half the total U.S. capital stock in 1969 was human capital. Exploring the effect of human capital accumulation to the Solow growth model can help in predicting a more accurate growth for the economy. Adding human capital to various economic growth models can potentially influence and affect both theoretical model and empirical analysis of economic growth and development. At the theoretical level, proper accounting for human capital might alter the generally accepted concept of the nature of the growth process. Lucas (1988) argues that there are decreasing returns to physical capital accumulation when human capital is held constant, the returns to capital investment, i.e. human and physical, are constant. At the empirical level, the growing importance of the inclusion of human capital in economic growth accounting can impact the analysis of cross-country differences and growth comparisons (Mankiw et al, 1992).

Different research papers of human and physical capital argued that they are vitally related and have important effect on economic growth for varying countries. Nelson and Phelps (1966) find that working population with good quality education are relatively prone to be more innovative and absorptive of new technology compare to a labour force with minimal, poor or no education. They conclude that more educated economies grow faster than less educated economies. Fishlow (1966) claimed high education levels in the late 19th and early 20th century accelerated the speed of physical capital accumulation in USA thereby stimulating the creation of new technology and innovations in the later parts of the 20th century. Romer (1993) formalised the argument of education and technological integration. He concludes that a labour force with better human capital stock is more advantaged at the assimilation and diffusion of new innovation hence a better prospect for economic growth. Other studies explore the effect of physical capital accumulation on human capital requirement and accumulation over time. Caballe and Santos (1993) and Graca et al (1995) relates that increment in the stock of physical capital would have a positive relationship with the accumulation of human capital, as increasing physical capital requires an increasing requirement for productive human capital over time to sustain the investment in physical capital. Lucas (1993) and Greiner (1999), correlate physical and human capital as the increase in one must be matched with an increase in the other for the possibility of sustained per capita income growth. Upadhyay (1994), formulate the possibility that new technology may destroy existing human capital especially for labour intensive economies, but over time with

increasing innovation the result is a derived demand for new types of human capital hence an increase in the need for high quality human capital stock. In a cross-country study of 78 economies, Benhabib and Spiegel (1997) concludes and upheld an earlier argument by Nelson and Phelps that more educated countries grow faster. They find that increases in human capital stock result significantly to a higher growth in the stock of physical capital.

 Knowledge which is a product of education is an important engine of economic growth. The Kuznetsian concept of "useful knowledge" which was developed in 1966 argues that "useful knowledge" is an engine or stimulant for technological change which confers a stimulating effect on economic transformation thereby resulting to economic growth (Kuznets, 1966). Technological changes and innovations are mostly derived from radicalisation of knowledge which accrues over time and for a while have characterised economic transformation over human history most importantly from period of industrial revolution to date. The steam engines, combustion engines, electricity, computers etc. all contributed immensely towards the transformation and growth of the global economy and were all result of knowledge radicalisation. One can argue that these innovations were possible through progresses in science which for over centuries increasingly interacted with and become dependent on education for its absorption and diffusion hence becoming beneficial to global economic transformation and growth over the long run (Ljungberg, 2009).

The diffusion and accumulation of useful knowledge stimulates the transformation of modern science to open science and developed a feedback mechanism between science and technological development. It further facilitates the development and growth of discoveries and inventions as search for answers to why and how results in the development, growth and diffusion of useful knowledge (Mokyr, 2005). This stimulated the literacy creation process, increases reading activity and motivated the willingness to seek knowledge by the society (Baten and van Zanden, 2008). Useful knowledge was the main drive towards escaping the Malthusian trap to first industrial revolution thereby leading to modern economic growth. The time span for escaping the Malthusian trap varies from regions around the world with SSA relatively subject to the conditions of the Malthusian trap presently. As presented later in figure 1-4, demographic conditions in SSA differ from global trend negatively.

Human capital accumulation enhanced participation in the industrial revolution. Economies with low level of human capital accumulation were peripheries and unable to partake in the industrialization processes which lead to the transformation of the world economy. On a

comparative basis, economies with better human capital position managed to converge with Great Britain i.e. the economic superpower of the time and some even overtaking its performance in the industrial revolution. Japan for example is argued to have invested comparatively higher in schooling as early as the 18th century hence enabling its participation in the later part of the first industrial revolution resulting into the remarkable variation to other economies in that region. The manifested and successful modernisation of Japan being attributed to its high level of education where as other Asian countries with low human capital lagging behind and not able to partake in the industrial revolution (Baten and van Zanden, 2008). For a modern day example, the Asian tigers were able to converge economically with the USA due, in part, to the high level of human capital availability. Economic convergence for SSA with leading economies of the world still remains to be seen.

Another perspective for the role of literacy to industrial revolution reveals an interesting pattern in human capital accumulation and its resultant effect on first industrial revolution was book production as proxy for human capital accumulation used by Baten and van Zanden (2008). For periods before first industrial revolution, Belgium and Italy had high levels of book production per capita, until the early part of the 17th century when Netherlands and Great Britain become leaders in book production. This is an interesting outcome as literacy rates in England during the industrial revolution were assumed to be relatively modest and stagnant (Mitch 1993). Such a pessimistic assumption of human capital accumulation for the period 1750-1850 tends to ignore the strong human capital accumulation that preceded the industrial revolution period. The strong growth of human capital formation in the preceding period has a positive influence on the growth and sustainability of the industrial revolution (Baten and van Zanden, 2008). The 21st Century is refer to as the "age of human capital" in that human capital is increasingly becoming the most important form of capital in modern economies. The private and social economic returns of individuals and society as a whole depend exclusively on how extensively and effectively people and nations invest in human capital (Becker, 2002). Modern economic growth requires educated workforce, managers, entrepreneurs, and innovative citizenry (Goldin and Katz, 2008). USA invested extensively on its human capital thereby enabling to converge and overtake Great Britain in economic growth hence the economic superpower of the world today. Studies reveal that investment in human capital make up over seventy percent of the total capital investment in the United States. The investment for schooling, on-the-job training, health, information, and research and development constitute over twenty percent of USA's GDP (Becker, 2002). SSA remains

backward and far from economic converge with the world economy due among other factors its low investment in human capital accumulation and stock.

The importance of human capital accumulation to economic growth outlines the need for SSA to improve its human capital stock to enhance economic growth and prosperity of living standard for its citizenry. The economic productivity of education has both direct and indirect influence on aggregate economic growth. Directly it influences the national income per person and thereby affecting GDP growth and indirectly affects demographic factors in a country (McMahon and Boediono, 1992) which are specifically important for SSA's development. The varying mechanism through which human capital might affect economic growth in SSA will be analysed from the perspective of *human capital returns*, *human capital externalities* and *human capital quality* in SSA. This analysis might be too broad but attempts will be made to be more specific to factors that are important for SSA.

III.I *Human Capital Returns*

Human capital returns is our expected effect of human capital on economic in SSA but examine for both its private and social returns thereby enabling aggregating its overall economic impact. The majority of the working population in SSA is engaged in the primary or extractive sector and hence this sector dominating the economic activities of the region, we will analyse both the private and social returns to education in this context. Many arguments have been put forward for and against the returns to education. Hence the two term human capital and signal factors used in arguments for the role of education to economic growth.

The effect of agricultural productivity can serve as another measure of how human capital can impact economic growth. Education is an important input in modernising agriculture whose impact on productivity influences both the farmers output and economic gains. It enables the efficient use of fertilizers, hybrid seeds, animal genetic and veterinary services, ability to read and repair machinery and other mechanism that enables farmers to take advantages of commercial farming instead of subsistence farming the common norm in SSA. Studies in agricultural economies in Asian countries of Malaysia, Nepal, Thailand, etc. concluded that an additional 4 years of basic education increases farmers output by 10 percent (McMahon and Boediono, 1992). Majority of SSA's exports of agricultural and primary outputs are in raw form. Through the process of modernising agriculture, productivity can be increase and value can be added to the products hence increasing returns on the primary outputs produced in SSA. Agriculture is seasonal in most part of SSA depending greatly on the rain. In 1968

only about 3% of SSA agricultural crop land was irrigated and as at 2005 there have been only 2% point increment to about 5% (ADI, 2008). Therefore it can be argued that SSA is producing below its potential output in agricultural production and if the essential knowhow and tools are available e.g. irrigation to make agriculture an all year round economic activity instead of it depending on the raining season. We will therefore be with the assumption that human capital can increase the productivity and output of farmers in SSA as it has done in other regions until proven otherwise.

The signalling theorists argue that education serves as source of information for buyers and sellers of labour. Arrow (1973) argued that higher education serves the purpose of screening that sorts out potential employees varying abilities; Stiglitz (1975) augmented this argument further by arguing that education as a screening mechanism enables differentiation for returns of individual based on their abilities. Their argument basically favours education having greater private returns than social returns thereby having limiting economic growth potential. This section attempts to outline the private and social returns to education and hence formulating the potential aggregate return to education thereby enabling us to induce the potential impact of education to economic growth.

The returns to education vary among regions of the world and it's higher for developing countries. Psacharopoulos (1985) concluded that education returns are highest in Africa and other low advanced industrial countries due mainly to relative shortage of human to physical capital. Returns to education has higher private return than social return mainly due the publicly subsidised educational systems common in all part of the world especially for the primary and secondary education which constitute bulk of SSA's human capital.

III.I.I *Private Returns to Human Capitals*

The signalling theory of education tend to serve as objection to the importance given to human capital in modern economic growth accounting but rather as more or less of measuring individual capability hence determining private returns. Private returns to education according to varying researches are higher than social returns especially for developing countries where there exist scarcity of human and physical capital. The accumulating private gains can in the long run stimulate economic growth as the population with higher income due to higher education can improve the living condition in a country.

The direct private benefits for individuals, among others, include good employment prospects, higher salaries and the added advantage of the ability to save and invest (Bloom et al, 2006). High human capital will enhance the private income of the citizenry. High income due to

education can influence the individuals' health thereby improving living condition and better health resulting to longer life. SSA being the region of the world with the shortest life expectancy hence the shortest working life, will benefit immensely from increasing life expectancy. The increase in individual working life can increase productivity in SSA and thereby increasing the social benefit of education. Education can enable individuals acquire low risk jobs, become more aware of health and safety at work, become aware of varying health risks and adopting life style that promote healthy living and access to appropriate medical services (McMahon and Boediono, 1992). This argument might appear vague but the living condition in SSA and low life expectancy are mainly due to lack of basic knowledge and exposure to health risk that could be easily avoided with the minimal knowhow.

Increasing human capital also translate into greater consumption as higher income increases private disposable earning hence the taste for luxury goods increasing thereby enlarging the market size of the economy (Bloom et al, 2006). SSA with big population but small earning and low disposable income make it one of the smallest and less attractive markets to attract Multinational corporations (MNCs). Income being an important determinant of the demand theory can influence the market size. With higher private income comes larger disposable earning hence an increase in market size and thereby attracting more MNCs and a resultant employment opportunity and more tax for the SSA. Brain drain in SSA is mostly attributed to its low wages and working conditions which as a result is reducing the potential market attraction and size.

Health being a determinant of productivity, human capital increment can improve individual productivity too. Individual economic return as measured by internal rate of return in Björklund and Kjellström (2002) concludes an investment profitability of 1 to 2 percentage point if assumed that an educated individual work up between 60-65 years. This increase will greatly benefit individuals in SSA hence enabling them to make long term plans for retirements in the form of savings which can be used as source of funding for enterprising individuals to promote entrepreneurship in the region.

Education facilities the development of new skills and know how. This knowledge can improve the skills and understanding of the labour force, while the increasing skill acquired can instil greater confidence and know how thereby facilitating entrepreneurial skill of individuals. Entrepreneurship, especially low indigenous participation, hampers the growth of SSA economy. Education facilitates creativity of individuals. Indigenous entrepreneurship can serve as point of contact for MNCs in SSA.

The human capital in SSA being the lowest in the world and shortage of universal primary and secondary education with gross levels of 96% and 36% respectively as at 2005 (AfDB report, 2008). Let's imagine the aggregate private returns impact on the long term social returns and economic growth as a whole if the figures can reach the net enrolment rate of 100% point for both primary and secondary education in SSA. The investments to attain this will result into higher employment both for academics and unskilled labour whilst at the same time uplifting the regions infrastructural development as discuss in detail in the human capital quality section later.

III.I.II *Social Returns to Human Capital*

The relatively higher private returns compare to social returns to education in developing countries with a small industrial sector can deter the development of human capital as most the forms of human capital in the countries are the primary and secondary educated and a greater percentage of whose funding are publicly subsidised. The social returns to education follows a descending pattern by increasing level of education in SSA hence this can greatly undermine government investment in human capital accumulation and development in the long run (Psacharopoulos, 1985). The social returns alone do not favour investment in human capital development in SSA as states will tend to prioritise their investments to sectors with higher social returns than private returns. Our argument however is that the higher private returns in the long run will compensate for the low social return hence leading to higher long term social returns to education in SSA. A disturbing aspect is that some educational investments are instant but the effect to nations significantly cannot be expected until periods of 25-45 years for stagnant economies (Appiah and McMahon, 2002), but this can be view as major future development oriented investment for developing countries the future returns of which are expected to be high.

In the "new growth theory", economists outline the importance of innovation in economic growth and that this can be facilitated through accumulation of human capital i.e. educated engineers. These impacts can be achieved if points of contact are created between engineers and entrepreneurs who can translate innovations into business enterprises (Björklund and Lindahl, 2005). Points of contact play an important role for centuries to countries economic development and that knowledge plays a pivotal role in the creation of networks in the periods of industrial revolutions and in today's economies knowledge is a vital component in cross border collaborations between firms and institutions., Mokyr (2005) argued that the creation of networks as conduit for the creating knowledge in the scientific world into successful

business operations as in the case of Watt's steam engine. These networks can greatly increase social returns to education in SSA with the appropriate private knowledge.

These points of contact can stimulate entrepreneurial development as owners of ideas and owners of capital can interact and create business ventures both in primary and other sectors of the economy. This entrepreneurial skill can help diversification in SSA with positive effects on job creation. SSA's productivity can improve due, in part, to acquired skills and technical diffusion in the agricultural sector as modernising agriculture spread due in part to more technical knowhow as a result of better and improved human capital.

Entrepreneurships might result in diversification in the primary sector and adding values to raw agricultural and primary output hence increasing the export values of the commodity. The social return to education in one important area for developing countries is its facilitation of the movements of underutilised labour from low productive sectors into higher productive sectors. Human capital accumulation can foster transfer of employment in SSA which has bulk of its labour force in the low productive unskilled agriculture sector to the more productive modernised agriculture sector (McMahon and Boediono, 1992). Over time human capital accumulation facilitates the shift in economic activities from the predominantly agricultural economy as the case in SSA thereby broaden the base of industrialisation and increasing the total number of employment for citizenry participating in the economic growth process hence on the way broaden the government source of funding through increased tax pool.

Private returns to education can broaden government sources of funding as higher earnings for educated individuals due to improving productivity even in the agriculture sector thereby increasing tax revenues for governments and reducing demands on state finances. Government source of fund through taxation for employment is very low in SSA due in part to high unemployment rates and low income hence tax avoidance being high as individuals can't afford their daily needs hence reluctant to part their income for tax.

We conclude this section that we agree with other theorist that private returns to education are higher comparatively to social returns but when viewed as a long term investment plan the social returns will outpace private returns in the long run. We can conclude that the aggregate private and social returns can facilitate economic growth in SSA as it does to other agriculture or primary based economies in other parts of the world.

III.II *Human Capital Externalities*

Several studies concluded that human capital accumulation has externalities other than the private and social returns. This study will focus on the human capital externalities on the framework of human capital impact on demographic factors which can influence economic performance of SSA. Several studies conclude a negative correlation between human capital accumulation on fertility, population growth and mortality factors that are of real concern for SSA economic and living standard development. Becker (1981) found negative relation between increasing per capital due to increasing knowledge and family size. He concludes that family's with increasing per capita prefers quality over quantity of children thus investing more on children's education, health and other necessities for their upbringing. This is as important observation as in many low income countries quantity is prefer over quality as children are viewed as source of cheap labour especially in the agriculture and low productive economic sectors. Becker et al (1990), shows that increases in human capital per person results in higher investment in both human and physical capital and therefore higher per capita growth. They conclude that human capital reduces fertility as it is more productive at goods and additional human capital than producing more children thereby leading to decreasing fertility and low population growth in the long run. Increases in human capital tend to decrease these demographic factors whilst increasing life expectancy. Changes in these demographic factors can positively influence economic growth in SSA.

However there are other arguments in favour of increasing fertility and population growth as positive feedback on economic growth. Smith (1976) state, the most important sign of any country's progress is the increase in the number of its population. Ram and Schultz (1979) using data from India concluded that higher population promote economic growth. Galor and Weil (2000) outlines that in the post Malthusian economies, higher population growth enhance rising national income.

Since our focus is on human capital and its impact on economic development in SSA, we will concentrate on its impact on these demographic factors and how it can facilitate a region with very poor demographic condition as compared to other regions of the world.

III.II.I *Fertility*

There are varying researches that link the relation between fertility and economic growth. Our focus here is the relation between education and fertility. The educational attainment of women in particular affects fertility in different ways. Education can delay child bearing age,

reduce early marriages, increases economic value of individuals especially the female populations economic productivity.

Early marriage and child bearing at young age are fundamental problem in SSA as it undermines the productivity of the youth population particularly the women folk. Education can help reverse this problem as it might result to delayed marriages or child bearing. The economic importance of education on fertility in this case is that universal primary and secondary education in SSA can be assumed to increase female productivity and long run decreasing population growth. Education of women at primary level might stimulate economic growth indirectly as it will induce lower fertility rate (Barro, 2002).

With more human capital for the female population in SSA, whose educational attainment are comparatively lower than male population, economic options available to them will increases rather just making babies. McMahon (1987) argued that female education aids capital deepening and hence productivity as it delays marriages by few years and decrease number of children born per educated woman.

The graph below present fertility rate in varying regions of the world from 1970 to 2005 on 5 years intervals. The regions with the lowest fertility are those with the most human capital and leading economies. SSA has the highest level of fertility in the world and this can be link to the arguments above of early marriages and the limiting economic options available to majority of women due to lower rate of education. There is convergence in the lower end for fertility with regions of MENA, LAC Area, EAPacific and S.Asia registering tremendous efforts to reduce fertility rate and this might have probably aid their growth effort over this period as compared to SSA with the minimal reduction in fertility rate and hence the lowest living standard and economic condition in the world.

Figure 1: Global Fertility rates by region
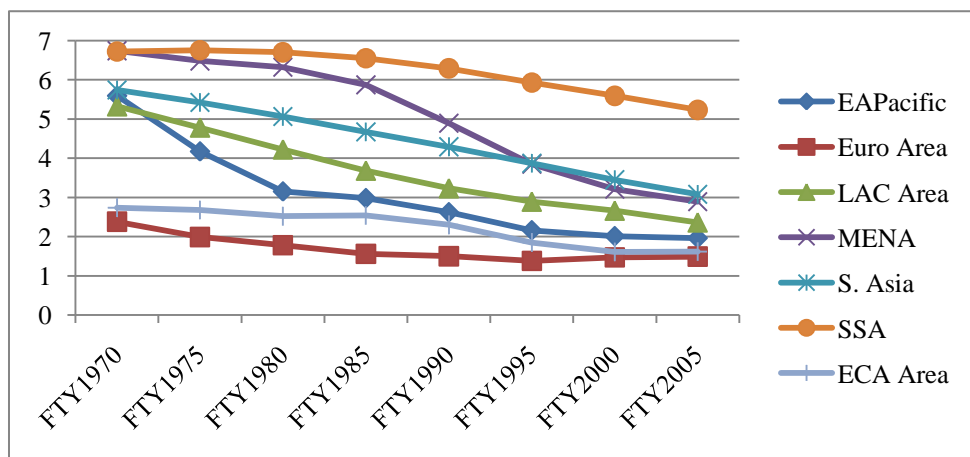
Source: WDI from World Bank Database

From the above graph, it can be presumed that SSA needs to reduce its fertility rate to converge with the global trend to foster economic growth in the region. The increase in human capital increases the value of parents' time and thereby increasing the cost of child bearing. This causes a shift from saving in the form of more children, the norm in many developing regions, to savings in physical and human capital (Barro, 1991).

III.II.II *Life Expectancy*

Life expectancy can be proxy or assumed as the quality and standard of living of individuals in a country or region. The standard of living is an important determinant of individual productivity which affects the cumulative per capita growth hence resulting to economic growth. Life expectancy can influence the working life of a regions labour force. How human capital accumulation does translate to longevity in life?

Education can result into individuals living a healthier life hence increasing their life span (Björklund and Lindahl, 2005). As mentioned earlier, human capital fosters increasing disposable income which can be spend on efforts to promote healthy living hence a more productive and longer life for the populace.

The knowledge theorist classified knowledge into tacit and codified knowledge the accumulation of which requires different modes of contact and time span. Long life for individuals with tacit knowledge can foster the diffusion of this type of knowledge over a wider time span as compared to shorter time in regions where life expectancy is short hence knowledge accumulation costlier and probably to be of lesser quality.

The graph below shows varying life expectancy at birth for different regions of the world from 1970 to 2005 on a 5 years interval. The life expectancy for SSA in 2005 is even lower than most regions' 1970 values. Since economic growth has positive correlation with life expectancy we can conclude that all regions experience economic growth for this period with the exception of SSA. With such a low life expectancy we can assume low productivity due to the short productive life period in SSA. Increasing human capital and it resulting externality on life span could increase the productive capacity of labour force in SSA over time.

Figure 2: Global Life Expectancy at Birth by region
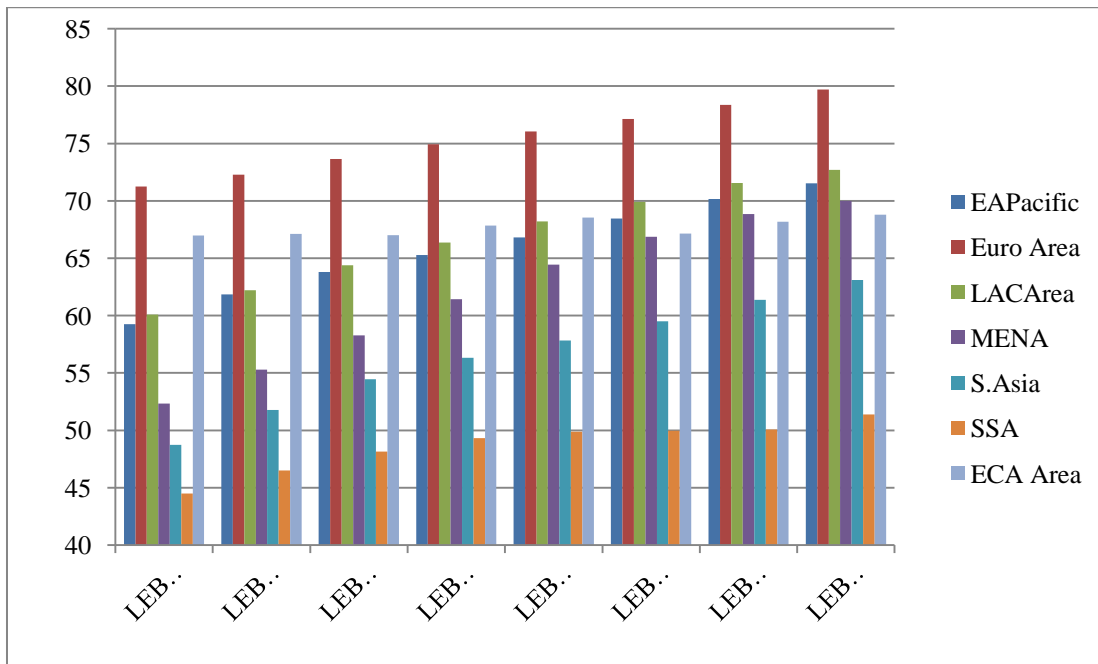
Source: WDI from World Bank Database

III.II.III *Population Growth*

As mention in the opening chapter of the study, SSA's population pass the billion marks and from the graph below it's the region with highest rate of population growth. For the period under study, SSA's population growth was similar to most of the developing regions in 1970 around 2.5 to 3 % per annum. Whilst others were able to decrease population due in part to declining fertility and growing economies, SSA succeed at a lesser declining pace due to high fertility and lesser economic growth.

Figure 3: Global Annual Percentage Population Growth rates by region
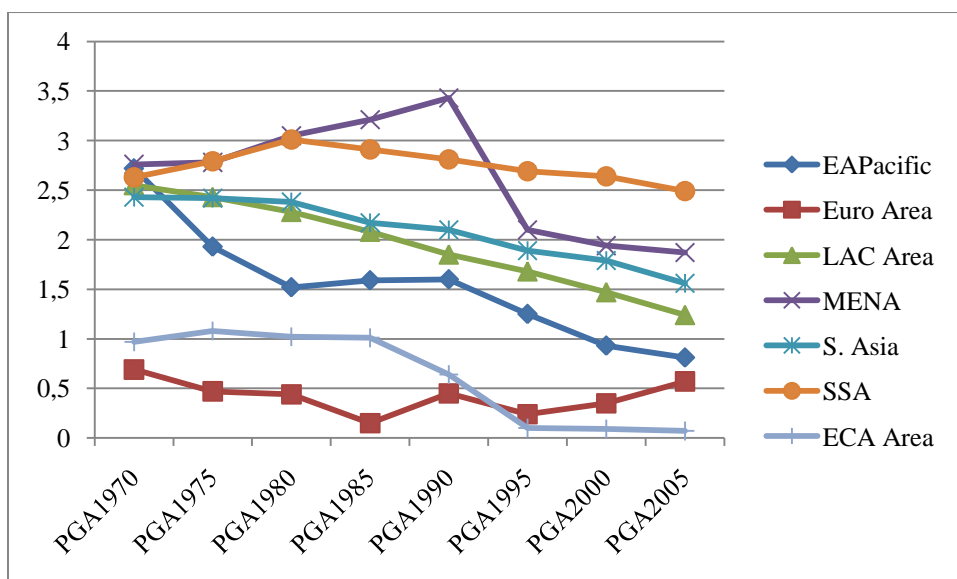
Source: WDI from World Bank Database

The effect of education on fertility and life expectancy will directly impact population growth hence the influence of education on population growth being aligned to effects on fertility and life expectancy. Decreasing population growth for SSA can affect the quality of human capital in the region. This will be presented in detail in the human capital quality section of the discussion.

III.II.IV *Mortality*

Mortality is another measure of health status. High rate of infant mortality is one of the major causes of lower women economic productivity in SSA. This is due in part the efforts to replace to the departed babies to keep the balance of savings in more children than in human and physical capital (Barro, 1991).

Universal primary and secondary education especially for women have consequences for their children. Knowledge accrued is valuable in the upbringing of the children hence the quality of child bearing increasing with minimal infant mortality (Björklund and Lindahl, 2005).

Figure 4: Global Infant Mortality rates by region
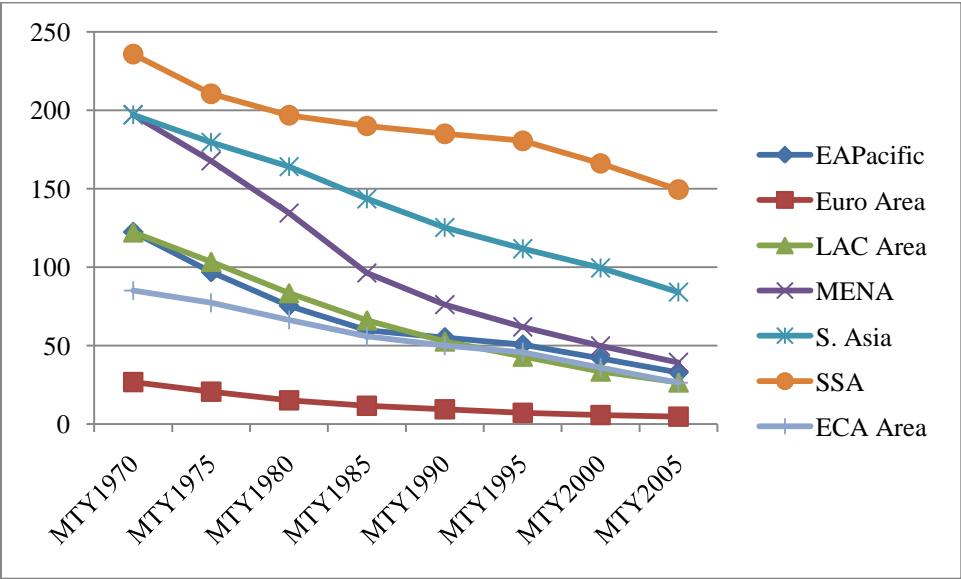
Source: WDI from World Bank Database

The above graph presents regional infant mortality rate from 1970 to 2005. As can be observed, regions with the high volume of human capital and high economic prosperity have low infant mortality whilst SSA has the highest infant mortality rate even higher than most regions 1970 rate.

We conclude this subsection with the assumption that human capital influences demographic factors and that can lead to economic growth. Therefore the externalities of human capital

alone can serve as incentives for governments to invest in varying for of human capital development rather just concentrating on the private versus social returns as measures to investment in human capital development.

III.III *Human Capital Quality in SSA*

The quality of education in SSA is presumed to be among the lowest in the different regions of the world that it affects its growth potential. This is due mostly the amount of government budget dedicated to the provision of education.

There exist a positive correlation between formal educations and learning on the job i.e. the adaptive capacity of worker is influence by prior knowledge gain through formal education (Björklund and Lindahl, 2005). Hence the arguments that quality of education is more important than quantity. Bloom et al (2006) argued that the quality of human capital in SSA is negatively affecting the region's infrastructural development thereby lessening educational effect of economic growth. They argued that the cost of road construction for example are as high as those in OECD countries and three times the cost in other developing regions because of the cost on importing equipment and lack of skilled engineers. Their conclusion being that cracking this dilemma requires enhancement of educational opportunities in the region.

Prevailing legislations and norms undermines the efforts to provide universal education and teaching quality in SSA (Bloom et al, 2006). In some countries highly centralised and politicise policies restricts these efforts. The provision of education might be politicised in that politicians using its provisions for political gains rather than for economic returns hence the distributive quality and quantity of education determine by political need rather than economic needs. Thereby subverting learning outcomes to political objectives, which is to stay in power for a longer time?

Distributional justice or equity effect of educational provision in SSA affects the quality of the human capital in the region. In this respect we analyse the impact of education in enhancing efficiency. The equity effect among those receiving education as in SSA those in urban and rural centres and areas assumed to be political opponents. How schools are distributed across the region and how they are maintained affects quality of the output of the schooling program. The distribution involving education and in the long run income generally differs in society and may involve conflict to resolve (McMahon, 1998).

The high fertility and population growth rate in SSA tend to undermine the quality of education. It put more strain on government budget to provide more schools to keep up with growing population thereby limiting improvements in the quality of education (McMahon and Boediono, 1992).

The theoretical discussion enables the conclusion that human capital accumulation and development can influence economic growth in SSA through varying ways both quantitatively and qualitatively. We will therefore develop our hypothesis in the methodological section of how we will measure the interaction of human capital and economic growth in SSA.

IV RESEARCH METHOD

This research focuses on human capital as a determinant of economic growth in SSA. Human capital as stated earlier entails education (knowledge), information, ideas, skills, and health of individuals. However we will use education (i.e. primary and secondary school gross enrolment rate) to proxy for Human capital in SSA. Since this is an empirical research, the method applied here is generally secondary research where data are sourced from already available dataset provided by World Bank. Secondary research facilitates imitation of data application and provides the ability for differing analysis and conclusions (Hakim, 2000). Secondary data should not be taken for granted as considerable efforts are needed to understand, manipulate, and motivate the data's relation and relevance to the research topic (Glover, 1996). Secondary research offers the merit of speed and comparatively low cost in contrast to other research methods. It facilitates precise specification of research area before commencing the research. However it can limit the scope and depth of study due to data availability hence on going modification and shift away from original research focus (Hakim, 2000 and Glover, 1996).

Data availability and reliability is a common problem especially for studies in economic history and for developing regions in particular. Limited existence and availability of relevant dataset over time hinders secondary analysis. Data mining is vital for developing nations where access and existence of data are controlling factors for research undertakings (Hakim, 2000). International comparative studies are mostly restricted to developed economies but this should not hinder analysis of emerging and low income regions. Improving data collection

and storage by different institutions for differing motives is reducing the limitations that data shortages impose on research for developing countries.

Human capital inclusion in economic growth have been rationalised by different authors as outlined in our theoretical analysis part. It's however important to outline briefly how others attempt to include human capital as determinant on growth in regression analysis before outlining the approach we will develop later. Romer (1990) develops an endogenous growth model where economic growth results directly from physical capital and research and development for generating innovation. Hypothesising that innovation is dependent on the development and accumulation of human capital. Mankiw et al (1992) demonstrate that extending the Solow model of growth can remedy equilibrium steady state per capita income level with a resultant growth equation where human and physical capital entering the analysis separately. Gemmell (1996) argued that standard sources of growth based on the dynamic Cobb-Douglas aggregate production function can be extend to include human capital so that the aggregate output growth becomes a function of, among others, the rate of human capital growth. We will however develop a simple growth model where we will try to incorporate with the principle of ceteris paribus economic growth as solely dependent on human capital. The human capital externalities will later entre into our growth model to ascertain their impact on economic growth.

IV.I *Data Formulation*

SSA comprises different countries with differing economic, institutional, cultural and political conditions. However since our study focus on the region as a whole with no importance given to varying conditions in the different countries, our data formulation and analysis need to take this into account. To solve for this problem of data shortage, we therefore use the simple panel data model. We combine or pool data from different countries of SSA to make up our database use for this study. An important underlying assumption here for the pool data of SSA is that marginal effect is uniform across the whole region. We assumed that the marginal effects of our variables are the same for all countries and time in SSA. This might not be realistic on the ground but for our study it is a realistic approach as we are analysing the whole region and our interest is limited on individual country variations.

The database used for this research is sourced from world tables of economic and social indicators, 1970-2005 with five year intervals, provided by Word Bank Group's African Development Indicators (ADI) a data collection of the World Bank's international economic

department. The database contains economic and social indicators for all SSA countries containing different measures of social and economic indicators. The indicators of interest to this paper are the GDP-growth, primary and secondary gross enrolment rate, fertility, life expectancy at birth, mortality (under 5), population growth and the pupil teacher ratio for primary and secondary education. Data source is important for any research as sources need to be reliable, valid and stand the test of time. Reliability and quality are important determinant factors coupled with accessibility and researchers need to keep this in mind when they set out to collect data. Reliability relates to research result in terms of replication i.e. similar result attainable if the same undertaken again with the same method and data (Hussey et al, 1997). Validity entails probability that conclusions and results are true (Dooley, 1984).

Data were secondarily collected and filtered to the requirements of this topic with some difficulties as some important indicators were omitted due to shortage or unavailability. Emphasis is given to importance of data quality in any research as no usage or implementation of econometric sophistication and theoretical rigour can alternate for the absence of data or overcome forged datasets (Ayogu, 2007). Statistical inference and randomisations were used to predict the values of missing years as certain data are periodically collected hence annual values missing for some variables used in the research. Since we are unable to determine annual values through theoretical reasoning, the need to randomise to obtain estimates of the missing year figures becomes a statistical necessity for this research (Hogg et al, 2006).

GDP-growth indicates economic growth, whilst the primary and secondary enrolment proxy for human capital development over the period under study. The primary and secondary enrolment variables, based on information from the United Nations, measure number of students enrolled in the designated grade levels relative to the total population of the corresponding age group. Primary education is assumed to provide children with basic reading, writing, and mathematics skills along with an elementary understanding of such subjects as history, geography, natural science, social science, art, and music. Whilst secondary education is assumed to complete the provision of basic education that began at the primary level, and aims at laying the foundations for lifelong learning and human development, by offering more subject or skill oriented instruction using more specialized methodologies (World Bank, 2010).

Fertility rate represents the number of children that would be born to a woman if she were to live to the end of her childbearing years and bear children in accordance with current age specific fertility rates. Life expectancy at birth indicates the number of years a new-born infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life. Annual population growth rate for year t is the exponential rate of growth of midyear population from year t-1 to t, expressed as a percentage. Population is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship who, except for refugees not permanently settled in the country of asylum, are generally considered part of the population of the country of origin. Mortality refers to under 5 years mortality rate that is the probability per 1,000 that a new-born baby will die before reaching age five, if subject to current age specific mortality rates (World Bank, 2010).

Primary school pupil-teacher ratio is the number of pupils enrolled in primary school divided by the number of primary school teachers with no regard to their teaching assignment. Secondary school pupil-teacher ratio is the number of pupils enrolled in secondary school divided by the number of secondary school teachers with emphasis given to their teaching assignment (World Bank, 2010).

IV.II *Hypothesis*

In order to empirically test the impact of human capital in SSA we outline the hypothesis to be test in the varying categories that human capital was analysed in the theoretical background of this study. Since the assumptions made earlier were all in favour of human capital having a positive impact on economic growth in SSA the need arise to hypothesise this and test if the assumptions and empiric results are the same or varies.

Human Capital Returns: We give varying theories to back our argument that human capital could affect economic growth in SSA directly in the human capital returns section earlier. We argued that private and social benefits to education will result to increasing economic growth. We therefore hypothesise that; increasing human capital in SSA increases the likelihood of higher economic growth. We are looking at the aggregate impact hence not developing hypothesis for the private and social returns to education but the overall direct impact on economic growth with the principle of ceteris paribus assuming economic growth to be a function of human capital.

Hence: GDP-Growth$_{it}$ = β_{1i} + β_2HCP$_{it}$ + β_3HCS$_{it}$ + ε_{it} (model 1)

Human Capital and Fertility: The effect of education on fertility as theorised earlier entail its effect on delayed marriages and child bearing ages hence increasing the economic productivity and the economic value of the women labour force hence diversifying the economic activities of women in particular in SSA. Due to data problem for the time under review it would have been more appropriate to differentiate human capital into male and female. We will however use the total human capital as proxy by education in SSA. The primary and secondary human capital could however enable us to analyse the effect of additional education on fertility in SSA. We can hence hypothesise that; an increasing human capital in SSA will have a significantly corresponding decrease in fertility rate.

Hence: FTY$_{it}$ = β_{1i} + β_2HCP$_{it}$ + β_3HCS$_{it}$ + ε_{it} (model 2)

Human Capital and Life Expectancy: We outline earlier that extended life expectancy for SSA would increase the working life span of the labour force hence increasing individual productivity. We therefore hypothesise that an increasing human capital in SSA will have a significant resulting increment in life expectancy.

Hence: LEB$_{it}$ = β_{1i} + β_2HCP$_{it}$ + β_3HCS$_{it}$ + ε_{it} (model 3)

Human Capital and Population Growth: We argued with varying theories that increasing human capital can halt population growth in SSA. We conclude that high population growth, among other factors, is due to low human capital in the region. Therefore we hypothesise that human capital accumulation will positively and significantly halt SSA's population growth.

Hence: PGA$_{it}$ = β_{1i} + β_2HCP$_{it}$ + β_3HCS$_{it}$ + ε_{it} (model 4)

Human Capital and Mortality: Knowledge accrued from education we argued are valuable for child upbringing thereby increasing the quality of child bearing and reducing infant mortality which in the long run influences economic growth. Education therefore reduces infant mortality. We hypothesise that increment in human can significantly reduce infant mortality in SSA thereby leading to long run economic growth.

Hence: MTY$_{it}$ = β_{1i} + β_2HCP$_{it}$ + β_3HCS$_{it}$ + ε_{it} (model 5).

Model 2-5 outlines the demographic hypothesis of the impact of educational externalities and its resulting assumption of economic impact in SSA.

Quality of Human Capital and Economic Growth: After analysing the impact of education on economic growth in SSA, we intend to analyse the quality of SSA's human capital on economic growth. As arguments were given that due that low quality of SSA's human capital it infrastructural development is costlier compared to other developing regions, hence we hypothesise that human capital quality have effects on SSA's economic growth.

GDP-Growth$_{it}$ = β_{1i} + β_2PTRP$_{it}$ + β_3PTRS$_{it}$ + ε_{it} (model 6).

Human Capital, Human Capital Externalities and Human Capital Quality on Economic Growth: Finally we make a combine model where we include all the variables to test for their impact on economic growth. Model 7 outlines the combination of human capital with the its externalities and quality on economic growth whilst in model 8 we try to analyse the externalities and quality impact on economic growth by controlling for human capital in the model.

GDP-Growth$_{it}$ = β_{1i} + β_2HCP$_{it}$ + β_3HCS$_{it}$ + β_4FTY$_{it}$ + β_5LEB$_{it}$ + β_6PGA$_{it}$ + β_7MTY$_{it}$ + β_8PTRP$_{it}$ + β_9PTRS$_{it}$ + ε_{it} (model 7)

GDP-Growth$_{it}$ = β_{1i} + β_2FTY$_{it}$ + β_3LEB$_{it}$ + β_4PGA$_{it}$ + β_5MTY$_{it}$ + β_6PTRP$_{it}$ + β_7PTRS$_{it}$ + ε_{it} (model 8).

In the above econometric models, we outline that the behavioural differences between countries over time are captured by the intercept. The fixed effect model for pooling data permits cross-sectional heterogeneity by enabling the intercept or constant to vary across countries (Griffiths et al, 2008).

Where:

β_1 is the constant coefficient i.e. the parameter measuring the averages of the dependent variable.

$_{it}$ denotes the time and country observations. That is country $_I$ and time $_t$.

ε_{it} is the error term of the residual

HCP is human capital primary i.e. gross school enrolment rate primary.

HCS is human capital secondary i.e. gross school enrolment rate secondary.

FTY is fertility rate.

LEB is life expectancy at birth

PGA is annual population growth

PTRP is pupil teacher ratio primary

PTRS is pupil teacher ratio secondary.

IV.III *Empirics*

Before testing the above models to determine the relationship between various variables in the model, we need to filter the dataset for standard applicability and usage and present the details of the data with brief explanations.

IV.III.I *Summary Statistics:*

Following is the summary of data set after checking for unusual observations or bad data filtration. The summary statistics gives details distributions of our observed variables. The total number of observation is 304. The various columns outline the distributions of the observed variables. The column mean gives details of the average values of the observed variable. The standard deviation values shows how far the data is spread away or deviates from the observed means. The min and max column give the minimum and maximum number of observed variables. The years observed are from 1970 to 2005 with five intervals and total a total periodic observation of 8 for 38 SSA countries.

As the summary below shows, there are wide ranges in our variables studied implying that performance varies in countries over time. There are low and high achieving countries for all variables but since individual country variation not focus of this research, the region as a whole will be analyse with the assumption that marginal effect is uniform for whole SSA.

Table1: Descriptive statistics of variables under study, SSA 1980-2005.

Variable	Obs	Mean	Std. Dev.	Min	Max
Fty	304	6.02	1.22	1.82	8.25
Gdp	304	3.65	6.79	-51.03	35.22
Leb	304	51.00	6.93	31.9	72.43
Mty	304	172.79	68.64	15.2	371.5
Pga	304	2.66	0.94	-1.97	6.92
Ptrp	304	44.20	13.25	19.27	90.38
Ptrs	304	24.21	7.38	10.72	64.78
Hcp	304	74.69	32.51	12	167.58
Hcs	304	20.80	17.25	1.06	95.83

Source: ADI from World Bank Database.

IV.III.II *The Correlation:*

The correlation coefficients summarises the relationship between different variables in a given data set. It outlines how variables are related. The level and fit of correlation dependency varies from -1 to +1. That is variables are either positively or negatively related (Griffiths et al, 2008).

Table2: Correlation matrix of variables under study, SSA 1980-2005.

	Gdp	Hcp	Hcs	Fty	Leb	Mty	Pga	Ptrp	Ptrs
Gdp	1								
Hcp	0.1529	1							
Hcs	0.0302	0.6150	1						
Fty	-0.0292	-0.5654	-0.7751	1					
Leb	0.0761	0.5160	0.5810	-0.5188	1				
Mty	-0.0877	-0.6758	-0.6736	0.6742	-0.8286	1			
Pga	0.1936	-0.0614	-0.2381	0.4384	0.0833	0.1128	1		
Ptrp	0.0061	0.0357	-0.3370	0.2487	-0.2790	0.2080	0.0393	1	
Ptrs	-0.0426	0.1552	0.1076	-0.0749	0.0720	-0.0721	0.0751	0.4295	1

Source: ADI from World Bank Database.

The problem of multicollinearity among variables can result to high standard errors of the regression coefficients coupled with insignificant coefficients even though size of un-standardised being only minimally affected, this problem could affect the result obtain. Table2 presents the correlation matrix for the variables under study (Griffiths et al, 2008). We examined for the likely problems of collinearity and there is no problem of serial colleration for the independent variables.

V RESULTS AND DISCUSSIONS

The results of fixed effect regression model estimates are presented from table 3-10 respectively. As previously outlined in the method section, the models are discussed in line with human capital returns, human capital externalities, human capital quality and their combined effect on economic growth.

Human Capital Returns

The results given in table 3 indicate the relationship between GDP growth and the different level of human capitals. The regression shows a significant relationship between human capital and economic growth in SSA but with a positive and a negative effect respectively for the two levels of human capital under study.

Table 3: Regression result for model 1of variables under study, SSA 1980-2005.

Variables	Coefficients	P-Values	Standard Error
Human Capital Primary	.0614148	0.013	.0246935
Human Capital Secondary	-.0850388	0.044	.0419602
R^2	0.0256		
Number of Observations	304		
Countries	38		

Source: ADI from World Bank Database

A unit increase in primary human capital significantly and positively increases economic growth in SSA by 0.06 units whilst a unit increment secondary human capital significantly but negatively decreases economic growth by -0.0085 units.

Human capital has significant effect on SSA's economic growth but different levels have different effects. The private and social returns to education in the region could be a factor that influences the differences in the effect of human capital. Since provision of both level of human capital are highly subsidised by government, the social and primary returns to primary level is higher compared to the social and private returns to secondary education. The cost effectiveness of subsidising primary education is greater than that of secondary education. This cost effectiveness could be a factor that affects their resultant impact on economic growth. This result upheld Psacharopoulos 1985 argument that private returns are higher than social return at the secondary level human capital hence undermining efforts to increasing secondary human capital in the region.

The agricultural productivity argument present by Boediono and McMahon is withheld to certain degree but not wholly. Since agricultural activities to a greater scale in SSA is far from modernisation the effect of secondary human capital, in particular, on productivity might not be great as compared to regions with modernised agricultural sector. Since primary human capital can provide basic knowledge needed to improve old farming methods, it will have greater effect on growth in the region compared to secondary capital which might be more useful for modernised agricultural activities.

Human capital can be argued to be more productive at the primary level in SSA than secondary. This could puzzle observers but an in depth analysis of the region's economic activities will reveal and help to understand this observation. Since bulk of SSA's economic activities are locked in the primary sector with low skill requirement, this affects the productivity of the labour force hence it resulting economic impact. Primary human capital improves the primary sector production whilst the secondary human capital requires improvement in the sector's machinery and activities for it to effect labour productivity. In short physical capital needs improvement before human capital beyond primary level could have significant positive effect on economic growth in the region.

Low stock of secondary educated labour force as compared to primary educated in SSA could be the reason why secondary human capital has significantly negative effect on growth. One can argued that with time, increasing stock and availability of universal secondary education, secondary human capital in SSA will contribute positively to growth thereby enabling the transformation of the significant negative effect to a significant positive effect.

We can conclude that the variation in effect of the different level of human capital in SSA might be due, in part, to cost effectiveness. The returns to investment in secondary education does not commensurate the cost for the provision of this form of human capital especially with low transition from primary to secondary education in the region. With time and higher transition rate coupled with modernised agricultural practices and value added extractive activities, as majority of labour force being employed by these sectors, the negative effect of secondary human capital can become significantly positive to SSA's economic growth.

Human Capital and Fertility

Human capital from the result obtain in table 4 has significant and negative effect on fertility for both levels in SSA. A unit increment in primary and secondary human capital in SSA correspondingly decreases fertility rates by -0.006 and -0.0047 units respectively.

The significant and negative effect of education on fertility corresponds with the conventionally held belief that human capital reduces fertility. It withheld all the arguments theorised earlier that increasing human capital decreases fertility as the economic options of the women population will increase hence reducing the number of child bearing coupled with delayed marriages and costlier child bearing as people will be tempted to be more economically active and saving in the form of physical and human capital rather than having more children.

Table 4: Regression result for model 2 of variables under study, SSA 1980-2005.

Variables	Coefficients	P-Values	Standard Error
Human Capital Primary	-.0060049	0.002	.0019467
Human Capital Secondary	-.0471835	0.000	.0033079
R^2	0.5707		
Number of Observations	304		
Countries	38		

Source: ADI from World Bank Database.

Barro's argument that primary human capital lowers fertility can be augmented with the observation that secondary human capital reduces fertility rate more than primary in SSA hence the need to improve secondary human capital if the region want to control its exploding population growth. As shown in figure 1, high fertility of SSA compared to comparatively

low rates in other regions of the world underlines the regions low economic opportunities for the women labour force.

The problem of early marriage and child bearing can be remedy with the provision of universal primary and secondary education. The secondary education has greater effect on fertility and one can assumed it delays marriages and child bearing more due to additional years of school going. The investments parents put into their children's education at levels higher than primary education can serve as incentives to increase the productive and economic opportunities for the girl child in particular hence delaying accepting marital proposals from potential suitors. This can indirectly enhance women empowerment and increases their decision making ability in their future families.

Human Capital and Life Expectancy

Primary human capital has a positive and significant effect whilst secondary human capital has positive but insignificant effect on life expectancy at birth in SSA. A unit increase at primary level significantly increases life span by 0.096 units but insignificantly increases by 0.026 units due to unit increment in secondary level.

Table 5: Regression result for model 3 of variables under study, SSA 1980-2005.

Variables	Coefficients	P-Values	Standard Error
Human Capital Primary	.09624	0.000	.0133978
Human Capital Secondary	.0264135	0.247	.0227661
R^2	0.2406		
Number of Observations	304		
Countries	38		

Source: ADI from World Bank Database.

Increasing human capital in SSA results to an increasing life span but the additional life due to secondary human capital is insignificant. Since our argument were based on increasing productivity of the labour force resulting to higher disposable income thereby enabling a healthier life, we can argue that since productivity due to secondary human capital is significant but have negative effect on economic growth this could be a reason why it has positive but insignificant effect on life expectancy in SSA. The difference here is due to

quantity effect as there is more primary capital than secondary capital and productivity as at the moment is higher for primary human capital.

The region's dependence on primary sector economic activities needs to be shifted towards industrial, service or modernised agricultural activities. Diversification need to be improved upon for human capital beyond primary level to have significant effect on life span. These efforts will increases productivity for higher human capital hence resulting to healthier living, savings and consequently a significant contributor to life span.

Human Capital and Population Growth

Human capital has significant effect on population growth in SSA. A unit increase in primary human capital significantly decreases population growth by -0.964 units whilst a unit increment in secondary human capital significantly decreases population growth by -0.85 units.

The exploding population growth in SSA can be halted with increasing provision of human capital. This part of the analysis can be tied in with the fertility and life expectancy part. Since decreasing fertility and increasing life expectancy can be argued to have decreasing effect on population growth.

Table 6: Regression result for model 4 of variables under study, SSA 1980-2005.

Variables	Coefficients	P-Values	Standard Error
Human Capital Primary	-.9640208	0.000	.092645
Human Capital Secondary	-.8507964	0.000	.1557272
R^2	0.5068		
Number of Observations	304		
Countries	38		

Source: ADI from World Bank Database.

Primary education has higher effect on population growth. This decreases in population due to human capital can lead to increasing the quality of labour hence in the long run resulting to improved labour productivity and improved provision of quality education due to relative smaller need for the provision of more quantity but rather quality.

Human Capital and Mortality

Primary human capital significantly increases mortality whilst secondary human capital significantly decreases mortality in SSA. An additional unit of primary human capital significantly increases mortality by 0.011 units and a corresponding unit increment in secondary human capital decreases mortality by 0.023 units.

Table 7: Regression result for model 5 of variables under study, SSA 1980-2005.

Variables	Coefficients	P-Values	Standard Error
Human Capital Primary	.0107764	0.000	.0030107
Human Capital Secondary	-.0227865	0.000	.005116
R^2	0.0772		
Number of Observations	304		
Countries	38		

Source: ADI from World Bank Database.

Primary education has significant but positive effect on mortality and this was not the expected result. We assumed it would be significant but negative hence increasing primary education resulting to decreasing mortality. Secondary education on the other hand confers with our expectation. The knowledge accrued at these different levels could be the factor behind the varying effects. The knowledge accrued at secondary level is more valuable for child upbringing. This results to quality provision of child care and a resultant minimal infant mortality.

Low investment at primary level will not deter parent from accruing the potential economic returns of the girl child whilst secondary educational expenses could motivate and delay marriages thereby delaying child bearing and reducing the number of children per woman. The increased economic value increases the quest to work more and have less children thereby increasing investment per child hence greater chances of surviving.

The effects of human capital on demographic factors are significant at all levels with exception of secondary human capital on life expectancy. The question that arise now is does these significant effects result to economic growth.

Quality of Human Capital and Economic Growth

The quality of education has no specific significant effect on SSA's economic growth. A unit increase in quality at the primary level insignificantly increases economic growth by 0.044 units and the same unit increment in secondary quality insignificantly increases economic growth in the region by 0.012 units.

Table 8: Regression result for model 6 of variables under study, SSA 1980-2005.

Variables	Coefficients	P-Values	Standard Error
Pupil Teacher Ratio Primary	.0444536	0.462	.0603326
Pupil Teacher Ratio Secondary	.0124155	0.877	.0800265
R^2	0.0023		
Number of Observations	304		
Countries	38		

Source: ADI from World Bank Database.

The positive but insignificant effect of educational quality for SSA's growth is not the expected result. It could therefore be that for SSA quantity matters as at now and with increasing stock then comes the importance of quality. Quantity effects will in the long run with the provision of universal education lead to quality effect on growth.

The level of education can be a factor that controls for the importance of the quality effect on economic growth. As theorised earlier lack of specialist hinders the region's infrastructural development but our observed level of education throws little light on these specialist skills like engineering, doctors, technicians which are developed at higher levels of education. Therefore our proxy of student teacher ratio at primary and secondary level for quality might not be the appropriate measure.

Human Capital, Human Capital Externalities and Human Capital Quality on Economic Growth

Since varying arguments were given in favour of human capital effects on economic growth and the demographic conditions in a region. We decide to test if the effects on demographic conditions will affect economic growth. We try here to analyse demographic effects on economic growth in relation to the quality and quantity of human capital in the region. In this

model, only primary human capital and population growth have significant effect on economic growth in SSA.

Table 9: Regression result for model 7 of variables under study, SSA 1980-2005.

Variables	Coefficients	P-Values	Standard Error
Human Capital Primary	.0604044	0.054	.0312323
Human Capital Secondary	-.0682291	0.222	.0557281
Fertility	-1.356355	0.120	.8686574
Life Expectancy at Birth	-.1025758	0.544	.1689484
Mortality	.0232067	0.327	.0236085
Population Growth (Annual)	2.267927	0.000	.5970494
Pupil Teacher Ratio Primary	.029987	0.631	.0623113
Pupil Teacher Ratio Secondary	-.0350937	0.688	.0872638
R^2	0.0895		
Number of Observations	304		
Countries	38		

Source: ADI from World Bank Database.

The result attained differs from expectation to a greater degree. This could be a problem of the direction of causality. Since we conclude that demographic factors are significantly affected by human capital but the relationship between these factors and economic growth need to be established. What causes what and the chicken and egg dilemma thereby coming into play? The directions of causality need to be establish to enable concrete conclusion on the effects of demographic factors on growth.

We can however argue and supported by theory that educational effect on demographic factors could affect long run economic growth. When we control for human capital, there is very little change in the result as population growth remains the only variables to have a significant effect on economic growth in the region. Human capital omission therefore has no omitted variable effects on the analysis.

Table 10: Regression result for model 8 of variables under study, SSA 1980-2005.

Variables	Coefficients	P-Values	Standard Error
Fertility	-1.091048	0.122	.702962
Life Expectancy at Birth	-.1109588	0.514	.1696262
Mortality	.0108336	0.632	.0225626
Population Growth (Annual)	2.476094	0.000	.5905167
Pupil Teacher Ratio Primary	.0653491	0.279	.0602472
Pupil Teacher Ratio Secondary	-.0150104	0.858	.0840059
R^2	0.0732		
Number of Observations	304		
Countries	38		

Source: ADI from World Bank Database.

The small standard errors value for our variables in the regression results in table 3-10 implies that their influences have been accurately estimated whilst the R^2s of the results ranges from low to medium implying that the measures of goodness of fit for the regressions models are not very strong.

VI CONCLUSIONS

As shown in other studies, the role of human capital to economic for varying regions of the world is considerably consistent in the case of SSA using both microeconomic and demographic data with the regression result attained. We can therefore conclude as follows:

The effect of human capital accumulation to SSA's economic growth is significant with some variation. The direct effects are affected by the returns to cost of provision. Primary capital significantly increases economic growth whilst secondary capital accumulation significantly decreases growth. Our regression result indicates the need for the improvement in physical capital for the secondary capital to have any positive effect on economic growth.

The quantity of secondary human capital is still low in the region to have a considerable positive effect on economic growth. The significant negative effects can only be transformed to positive effects if the region can successfully diversify its economic activities to areas that

required more skill and capital as compared to presently highly unskilled economic activities in the form of primary and un-modernised agriculture.

Human capital externalities results indicate an important role in improving the demographic conditions of SSA. The primary and secondary human capital both have varying important significant effect on SSA's demographic conditions. We argue therefore that even in cases where the significance is not as expected, with the provision of universal education in the region can enhance improvements in living conditions which can assumedly enhance economic conditions.

Quality of education has no significant economic impact in the region, in the short run quantity should be given much consideration which will in the long run correct the quality of human capital as its improvement will have external effects which will reduce the demand for the provision of schooling space but rather the provision of quality schooling overtime.

Finally statistical significant varies from economic significance hence care is needed when analysis the statistical significance into an economic context. The economic significance is the desire of all major development policies hence policy recommendation from these findings should be in line with economic significance.

We therefore conclude that that in aggregate term human capital has an important role to play in SSA's economic growth but certain provisions need to be available before the effects can be uniform across all measures.

Future research recommendations for the role of human capital to SSA's economic growth could focus on; the demographic conditions and economic growth, tertiary human capital's quantity and quality in relation to economic growth, human and physical capital's contribution to economic growth among others.

VII REFERENCES

AfDB, (2008). The ADB Statistics Pocketbook 2008.

Appiah, E.N. and McMahon, W.W., (2002). The Social Outcomes of Education and Feedbacks on Growth in Africa. The Journal of Development Studies, Vol.38, No.4, pp.27-68.

Arrow, K.J., (1973). Higher Education as Filter. Journal of Public Economics; 2: 193-216.

Ayogu, M., (2007). Infrastructure and economic development in Africa: A review, Journal of African Economies, Volume 16, AERC Supplement 1, pp. 75-126.

Barro, R. (1991). Economic Growth in a Cross Section of Countries, The Quarterly Journal of Economics, Vol. 106, No: 2, pp. 407-443.

Barro, R. (2000). The Contribution of Education to Economic Growth; OECD Quebec Conference Proceedings, March 2000 Paris: OECD.

Barro, R.J., and Lee, J.W., (1996). International Measures of Schooling Years and Schooling Quality. The American Economic Review, Vol. 86, No. 2.

Baten, J., and van Zanden, J.L., (2008). Book Production and The Onset of Economic Growth. Journal of Economic Growth, 13; 217-235.

Becker, G.S., (1981). A Treatise on the Family. Harvard University Press, Boston.

Becker, G.S., (2002). The Age of Human Capital, in: Lazear, E.P (Ed) Education in the Twenty-First Century. Hoover Institution Press.

Becker, G.S., Murphy, K.M. and Tamura, R.F., (1990). Human Capital, Fertility and Economic Growth, Journal of Political Economy, Vol.98, No.2, pp12-37.

Benhabib, J., and Spiegel, M.M., (1994). The Role of Human Capital in Economic Development Evidence from Aggregate Cross-Country Data. Journal of Monetary Economics Vol.34 pp.143-173.

Benhabib, J., and Spiegel, M.M., (1997). Growth and Investment Across Countries: Are Primitives All that Matter? Working paper. New York University.

Björklund, A. and Kjellström, C., (2002). Estimating the Return to Investment in Education: How Useful is the Standard Mincer Equation? Economics of Education Review, Vol. 21, pp.195–210.

Björklund, A. and Lindahl, F, (2005). Education and Economic Development: What does Empirical Research Show about Casual Relationship? Swedish Institute of Social Research: Stockholm University.

Bloom, D., Canning, D., and Chan, K., (2006). Higher Education and Economic Development in Africa. Harvard University, Human Development Sector, Africa Region.

Boediono and McMahon, W.W. (1992). Universals Basic Education: An Overall Strategy of Investment Priorities for Economic Growth. Economics of Education Review, Vol. 11, No. 2. pp. 137-151.

Caballe, J., and Santos, M. S., (1993). Endogenous Growth with Physical and Human Capital, Journal of Political Economy. Vol.101 pp.1042–1067.

Dooley, D. (1984), Reviewing and Interpreting Research: Assessing Research and Interventions, in Human Resource Practice selected Readings. Distance Education Centre, Queensland.

Elu, J., (2000). Human Development in Sub-Saharan Africa: Analysis and Prospects for the Future. Journal of Third World Studies, Vol. XVII, No. 2

Fishlow, A., (1966). The Common School Revival: Fact or Fancy? In: Rosovsky Henry (ed.), Industrialization in Two Systems. New York, NY: Wiley.

Galor, O. And Weil, D.N., (2000). Population, Technology, and Growth: from Malthusian Stagnation to the Demographic Transition and beyond. American Economic Review, Vol.90, pp.806-828.

Gemmell, N., (1996). Evaluating the Impacts of Human Capital Stocks and accumulation on Economic Growth: Some New Evidence. Oxford Bulletin of Economics and Statistics, 58, 1 (1996) 0305-9049.

Glover, G. (1996), Epistemological and Methodological Considerations in Secondary Analysis. In Hantrais, L. and Mangen, S., Cross-national Research Methods in the Social Sciences, London and New York Pinter.

Goldin, C. And Katz, L.F., (2008). The Race Between Education and Technology. Harvard University Press Cambridge, Massachusetts, and London, England.

Graca, J., Saqib, J., and Philippopoulos, A, (1995). Interaction of Human and Physical Capital in a Model of Endogenous Growth, Economics of Planning. Vol.28 pp.93–118.

Greiner, A., (1999). Endogenous Growth Through Externalities of Investment: A Different Approach. Atlantic Economic Journal, Vol. 27 pp.86–90.

Grier, R., (2005). The Interaction of Human and Physical Capital Accumulation: Evidence from Sub-Saharan Africa. KYKLOS, Vol.58, No.2, pp. 195–211.

Griffiths, W.E., Hill, R.C. and Lim, G.C. (2008). Principles of Econometrics, Third Edition, John Wiley & Sons, Inc.

Hakim, Catherine, 2000, Research Design: successful design for social and economic research, 2nd Edition, Rutledge.

Hogg, V.R. and Tanis, A.E., (2006). Probability and Statistical Inference; International Edition, 7th Edition, Pearson Education International.

Hussey, J and Hussey, R (1997), Business Research: A Practical Guide for Undergraduate and Postgraduate Students, Macmillan, London.

Kendrick, J.W., (1976). The Formation and Stocks of Total Capital. New York: Columbia University for NBER.

Kuznets, S. (1966). Modern Economic Growth. New Haven, CT: Yale University Press.

Ljungberg, L., (2009). Did education pay? On the contribution of education to national income and living standards, Chapter for Education and economic change: history, theory and governance. Lund University.

Lucas, R., (1988). Mechanics of Economic Development. Journal of Monetary Economics, Vol.22, pp. 3-42.

Lucas, R.E., (1993). Making a Miracle. Econometrica. Vol. 61 pp.251–272.

Mankiw, N.G., Romer, D. and Weil, N.D., (1992). A Contribution to the Empirics of Economic Growth, the Quarterly Journal of Economics, Vol. 107, No: 2, pp. 407-437

McMahon, W.W., (1987). The Relation of Education and R&D to Productivity Growth in the Developing Countries of Africa. Economic of Education Review, Vol.6, No.2, pp.183-194.

McMahon, W.W., (1998). Recent Advances in Measuring the Social and Individual Benefits of Education. University of Illinois, Urbana-Champaign, IL, U.S.A.

Mitch, D., (1990). Education and Economic Growth: Another Axiom of Indispensability? From human Capital to Human Capabilities. In: Tortella, G (ed.), Education and Economic Development since the Industrial Revolution, Generalitat Valenciana, Valencia.

Mokyr, J. (2005). The Intellectual Origins of Modern Economic Growth. The Journal of Economic History, Vol. 65, No.2.

Nelson, R.R. and Phelps. E.S., (1966). Investment in Humans, Technological Diffusion, and Economic Growth. American Economic Review Vol.56 pp.69-75.

Psacharopoulos, G., (1985). Returns to Education; a Further International Updates and Implications. The Journal of Human Resources, Vol.20, No. 4, pp. 583-604.

Ram, R. And Schultz, T., (1979). Life Span, Health, and Productivity. Economic Development and Cultural Change, Vol.27, pp.399-421.

Romer, P. M. (1990). Endogenous Technological Change. Journal of Political Economy, 98(5), 71-102.

Romer, P., (1993). Idea Gaps and Object Gaps in Economic Development. Journal of Monetary Economics, Vol. 32 pp.: 543–573.

Smith, A., (1976). An Inquiry into the Nature and Causes of the Wealth of Nations, edited by Edwin Cannan, University of Chicago Press, Chicago.

Solow, R. M. (1956). A Contribution to Theory of Economic Growth. Quarterly Journal of Economics, 70, 65-94.

Stiglitz, J.E., (1975). The Theory of "Screening," Education, and the Distribution of Income. The American Economic Review; Vol.65, No. 3, pp. 283-300.

UNFPA: State of World Population 2009. Facing a Changing World: Women, Population and Climate.

Upadhyay, M.P., (1994). Accumulation of Human Capital in LDCs in the Presence of Unemployment. Economica, Vol.61 pp.355–378.

World Bank, (1998/99, 1991 and 2010). http://data.worldbank.org/data-catalog

VIII APPENDIX

```
. xtreg gdp hcp hcs, fe

Fixed-effects (within) regression          Number of obs      =          304
Group variable:   y                        Number of groups   =           38

R-sq:  within  =  0.0256                    Obs per group: min =            8
       between =  0.0649                                   avg =          8.0
       overall =  0.0268                                   max =            8

                                           F(2,264)           =         3.47
corr(u_i, Xb)  =  -0.2038                   Prob > F           =       0.0324

─────────────────────────────────────────────────────────────────────────────
       gdp │     Coef.    Std. Err.      t     P>|t|     [95% Conf. Interval]
───────────┼─────────────────────────────────────────────────────────────────
       hcp │   .0614148   .0246935     2.49    0.013     .0127937    .110036
       hcs │  -.0850388   .0419602    -2.03    0.044    -.167658   -.0024196
     _cons │   .8365931   1.630339     0.51    0.608    -2.373528   4.046715
───────────┼─────────────────────────────────────────────────────────────────
   sigma_u │  2.3801481
   sigma_e │  6.7430827
       rho │  .11078882   (fraction of variance due to u_i)
─────────────────────────────────────────────────────────────────────────────
F test that all u_i=0:     F(   37, 264) =     0.93          Prob > F =   0.5901
```

```
. xtreg fty hcp hcs, fe

Fixed-effects (within) regression          Number of obs      =          304
Group variable:   y                        Number of groups   =           38

R-sq:  within  =  0.5707                    Obs per group: min =            8
       between =  0.6399                                   avg =          8.0
       overall =  0.6132                                   max =            8

                                           F(2,264)           =       175.51
corr(u_i, Xb)  =  0.0148                    Prob > F           =       0.0000

─────────────────────────────────────────────────────────────────────────────
       fty │     Coef.    Std. Err.      t     P>|t|     [95% Conf. Interval]
───────────┼─────────────────────────────────────────────────────────────────
       hcp │  -.0060049   .0019467    -3.08    0.002    -.0098379   -.002172
       hcs │  -.0471835   .0033079   -14.26    0.000    -.0536966   -.0406704
     _cons │   7.450098   .1285248    57.97    0.000     7.197034   7.703162
───────────┼─────────────────────────────────────────────────────────────────
   sigma_u │  .58092621
   sigma_e │  .53157873
       rho │  .54426999   (fraction of variance due to u_i)
─────────────────────────────────────────────────────────────────────────────
F test that all u_i=0:     F(   37, 264) =     9.54          Prob > F =   0.0000
```

```
. xtreg leb hcp hcs, fe
```

```
Fixed-effects (within) regression          Number of obs      =          304
Group variable:    y                       Number of groups   =           38

R-sq:  within  =  0.2406                    Obs per group: min =            8
       between =  0.3307                                   avg =          8.0
       overall =  0.3006                                   max =            8

                                           F(2,264)           =        41.81
corr(u_i, Xb)  =  0.0788                    Prob > F           =       0.0000
```

leb	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
hcp	.09624	.0133978	7.18	0.000	.0698598	.1226202
hcs	.0264135	.0227661	1.16	0.247	-.0184128	.0712398
_cons	43.2657	.8845657	48.91	0.000	41.524	45.0074
sigma_u	4.75054					
sigma_e	3.6585647					
rho	.6277029	(fraction of variance due to u_i)				

```
F test that all u_i=0:    F(      37, 264) =     11.13          Prob > F =   0.0000
```

```
. xtreg mty hcp hcs, fe
```

```
Fixed-effects (within) regression          Number of obs      =          304
Group variable:    y                       Number of groups   =           38

R-sq:  within  =  0.5068                    Obs per group: min =            8
       between =  0.5697                                   avg =          8.0
       overall =  0.5473                                   max =            8

                                           F(2,264)           =       135.66
corr(u_i, Xb)  =  0.2153                    Prob > F           =       0.0000
```

mty	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
hcp	-.9640208	.091645	-10.52	0.000	-1.144469	-.7835726
hcs	-.8507964	.1557272	-5.46	0.000	-1.157422	-.5441711
_cons	262.5028	6.05069	43.38	0.000	250.5891	274.4166
sigma_u	41.278753					
sigma_e	25.02566					
rho	.73123401	(fraction of variance due to u_i)				

```
F test that all u_i=0:    F(      37, 264) =     19.74          Prob > F =   0.0000
```

. xtreg pga hcp hcs, fe

```
Fixed-effects (within) regression          Number of obs     =          304
Group variable:    y                       Number of groups  =           38

R-sq:  within  = 0.0772                     Obs per group: min =           8
       between = 0.0238                                    avg =         8.0
       overall = 0.0482                                    max =           8

                                           F(2,264)          =        11.05
corr(u_i, Xb)  = -0.2297                    Prob > F          =       0.0000
```

pga	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
hcp	.0107764	.0030107	3.58	0.000	.0048483	.0167045
hcs	-.0227865	.005116	-4.45	0.000	-.0328597	-.0127132
_cons	2.332309	.1987775	11.73	0.000	1.940918	2.7237
sigma_u	.53269797					
sigma_e	.82214377					
rho	.29568701	(fraction of variance due to u_i)				

F test that all u_i=0:   F(37, 264) =   2.96   Prob > F =   0.0000

. xtreg gdp ptrp ptrs, fe

```
Fixed-effects (within) regression          Number of obs     =          304
Group variable:    y                       Number of groups  =           38

R-sq:  within  = 0.0023                     Obs per group: min =           8
       between = 0.0052                                    avg =         8.0
       overall = 0.0000                                    max =           8

                                           F(2,264)          =         0.30
corr(u_i, Xb)  = -0.2602                    Prob > F          =       0.7414
```

gdp	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
ptrp	.0444536	.0603326	0.74	0.462	-.0743406	.1632478
ptrs	.0124155	.0800265	0.16	0.877	-.1451559	.1699869
_cons	1.389213	3.144946	0.44	0.659	-4.803157	7.581582
sigma_u	2.478148					
sigma_e	6.8234761					
rho	.11652934	(fraction of variance due to u_i)				

F test that all u_i=0:   F(37, 264) =   0.96   Prob > F =   0.5350

. xtreg gdp hcp hcs fty leb mty pga ptrp ptrs, fe

```
Fixed-effects (within) regression          Number of obs     =        304
Group variable:    y                       Number of groups  =         38

R-sq:  within  =  0.0895                    Obs per group: min =          8
       between =  0.0004                                   avg =        8.0
       overall =  0.0431                                   max =          8

                                           F(8,258)          =       3.17
corr(u_i, Xb)  =   -0.4180                  Prob > F          =     0.0019
```

gdp	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
hcp	.0604044	.0312323	1.93	0.054	-.0010984	.1219071
hcs	-.0682291	.0557281	-1.22	0.222	-.177969	.0415107
fty	-1.356355	.8686574	-1.56	0.120	-3.066916	.3542065
leb	-.1025758	.1689484	-0.61	0.544	-.4352692	.2301176
mty	.0232067	.0236085	0.98	0.327	-.0232831	.0696965
pga	2.267927	.5970494	3.80	0.000	1.092216	3.443637
ptrp	.029987	.0623113	0.48	0.631	-.0927165	.1526905
ptrs	-.0350937	.0872638	-0.40	0.688	-.2069338	.1367464
_cons	3.433443	12.45282	0.28	0.783	-21.08867	27.95556

sigma_u	2.9787233	
sigma_e	6.5936269	
rho	.16949401	(fraction of variance due to u_i)

F test that all u_i=0:   F(37, 258) =   1.03   Prob > F =   0.4354

. xtreg gdp fty leb mty pga ptrp ptrs, fe

```
Fixed-effects (within) regression          Number of obs     =        304
Group variable:    y                       Number of groups  =         38

R-sq:  within  =  0.0732                    Obs per group: min =          8
       between =  0.0135                                   avg =        8.0
       overall =  0.0277                                   max =          8

                                           F(6,260)          =       3.42
corr(u_i, Xb)  =   -0.3927                  Prob > F          =     0.0029
```

gdp	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
fty	-1.091048	.702962	-1.55	0.122	-2.475271	.293176
leb	-.1109588	.1696262	-0.65	0.514	-.4449748	.2230571
mty	.0108336	.0225626	0.48	0.632	-.0335952	.0552623
pga	2.476094	.5905167	4.19	0.000	1.31329	3.638899
ptrp	.0653491	.0602472	1.08	0.279	-.0532855	.1839838
ptrs	-.0150104	.0840059	-0.18	0.858	-.1804289	.1504082
_cons	4.890569	11.62686	0.42	0.674	-18.00422	27.78536

sigma_u	2.9522045	
sigma_e	6.6267702	
rho	.16560096	(fraction of variance due to u_i)

F test that all u_i=0:   F(37, 260) =   0.99   Prob > F =   0.4906