

**THE EFFECTS OF EDUCATION ON ECONOMIC GROWTH IN KENYA**

**BY**

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**A RESEARCH PROJECT SUBMITTED TO THE SCHOOL OF ECONOMICS,  
UNIVERSITY OF NAIROBI, IN PARTIAL FULFILMENT OF THE REQUIREMENT  
FOR THE DEGREE OF MASTER OF ARTS IN ECONOMICS.**

***DECLARATION***

This research paper is my original work and has not been presented for award of any degree to any other university in Kenya or any other country.

NAME.....SIGN.....DATE.....

This research paper has been submitted for examination with my approval as the university supervisor.

SIGN.....

DATE.....

**Prof. L. P Mureithi**

## ***DEDICATION***

This work is dedicated to my lovely wife Lydia and my beloved sons Leon and Jonathan, for having been there for me and for their love and support.

## ***ACKNOWLEDGEMENT***

First and foremost, I acknowledge the Almighty God for his mercies and blessing and for the greatest gift of life that he gave me. I realize that without God, this work would not even have started and because of his favor, the work has been done successfully.

I also extend my gratitude the University of Nairobi for having accorded me a chance to pursue my studies in the institution. I wish to express my sincere appreciation to my supervisor Prof. L. P Mureithi for his tireless support, positive criticism and general guidance and encouragement throughout the research period. Your tireless contributions brought me this far and I forever remain indebted to you.

I also acknowledge my beloved family for being understanding and for encouraging me as I undertook this research, my friends for their support and various contributions that made this work to be what it is.

## ***ABSTRACT***

The key reason for carrying out this research was to offer a response to the fundamental question as to whether education at different levels and economic growth in Kenya have a relationship and if so, how significant the relationship is.

Empirical evidence is not conclusive on this question and conflicting findings have been given by various empirical work. The research was motivated by the belief that is so deeply engrained in the Kenyan society that education contributes significantly not only to personal progress but also to national progress.

The emphasis is seen in the huge allocations of the national budget to the Ministry of Education. In the 2012/2013 budget, for instance, Ministry of Education got the second largest share of the budget at 21%, after energy, infrastructure and ICT which got 24% , but this was on account of the ongoing projects in the energy and roads sector. This paper uses time series technique to probe the relationship between real GDP growth rate in Kenya on one hand and primary school, secondary school and university enrolment on the other hand. The period of interest is the period 1980 to 2010.

The estimated co-coefficients depict the relationship between our variables of interest. The results show that there exists a favorable and significant connection between real GDP growth and the three independent variables namely primary school, secondary school and university enrolments. The co-efficient of regression for primary school, secondary school and university enrolments are 11.851, 1.267, and 1.463 respectively showing that increases in these variables will result into increases in real GDP growth rate.

The research therefore recommends that more investment should be put in education and that both the national and county governments should focus on the development of education at all levels.

***LIST OF ABBREVIATIONS***

|        |   |   |
|--------|---|---|
| GDP    | – | Gross Domestic Product                                  |
| ICT    | – | Information Communication Technology                    |
| KIPPRA | – | Kenya Institute for Public Policy Research and Analysis |
| OECD   | – | Organization for Economic Cooperation and Development   |
| OLS    | – | Ordinary Least Squares                                  |
| TFP    | – | Total Factor Productivity                               |
| USA    | – | United States of America                                |
| ADF    | – | Augmented Dickey-Fuller                                 |

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## **CHAPTER 1: INTRODUCTION**

Kenya, like most African countries, is a developing nation with a keen focus on economic growth. Among the key areas that the government has focused on in order to realize the much needed economic growth has been the education sector.

There is sufficient evidence to show that the belief in education as a major contributor to both personal and national progress is deeply entrenched in the Kenyan society. Our national budget allocates more funds to Ministry of Education than many other ministries. In 2012/2013 budget, for instance; energy, infrastructure and ICT sector got the lion's share of the budget at 24% allocation; education came second with a 21% allocation. It's worth noting that energy, infrastructure and ICT got the biggest share on account of the on-going roads and energy projects.

This emphasis on education has also seen universities open campuses in every small town and hamlet. The working class are back to school in droves and the politicians, albeit as a requirement to contest for some of the elective positions, have followed suit. This deliberate and persistent tendency in investing in education is what necessitates the question as to whether the investment in education is worthy for Kenya as a developing nation. Is education as a significant variable in so far as economic growth in Kenya is concerned?

At a micro level, generally and on average, educated individuals are believed to earn more, live longer and have a better life in so far as their health is concerned (Mincer, 1974). Based on this finding from Mincer, the benefits of education to an individual are obvious, as one of the finding was that extra year of education increased an individual's earning by 7%. The benefits of education are however not very clear when looking at it from the national level. A lot of uncertainty still hangs around the question as to whether

education can be a tool for economic growth and this is seen in the large division in empirical literature in the area of education and economic growth<sup>1</sup>

A great deal of confidence however can be drawn from lessons learnt from developed countries; when in 1957, the former United Soviet Socialist Republic propelled the universe's premier artificial satellite, the Sputnik, the American government learnt so fast from that and the result was an overhaul of their education system both in content and in curriculum delivery methodology. Ten years later, the U.S.A was able to land safely on the moon, and thirty years after, they won the cold yet no single bullet was fired. It is very obvious that the sprint to the moon in 1969 and the win in the cold war in 1989 were won not anywhere else but in the classroom, (Ed Wallace, 2005).<sup>2</sup>

Beyond these lessons, it is generally accepted, at least in theory, that education plays a major role towards promoting economic growth. Education is a major part of human capital development is accepted to play a critical in enhancing the productive ability of the masses. It, more so, at tertiary level, contributes significantly to growth in the economy and development by rendering laborers more productive and ultimately by enhancing the ability of the individuals to create of ideas and to become technologically innovative.

Education is also viewed as the only tool through which the society can be changed for the better. This transformation is achieved by providing human resources with expertise and competencies that will enable them to donate wholesomely to the development of the nation. It may also contribute to reduced poverty levels and a tool for enhancing equity, fairness and social justice thus improving income distribution and several aspects of development social, demographic and political fronts.

Contrary to popular belief as expressed above, empirical studies carried out on the area of education and economic growth have yielded mixed results as will be seen in the literature review section of this paper. The question, world over therefore remains: does

<sup>1</sup>Glewwe 2007, 'On education, some empirical studies find human capital to be positively correlated to growth of GDP, others find the linkage to be insignificant'

<sup>2</sup>Ed Wallace 2005, "The Backside of American History", Dallas Texas, unpublished.

education contribute to economic growth? This paper tackled this question extensively and offers some empirical evidences to address the concerns.

### **1.1 Statement of the Problem**

Empirical studies in areas of economic growth and education have had conflicting findings on the impact of education in fostering economic expansion. Whereas some studies hold that education promotes economic growth, others find that the relationship between the two does not exist or where it does, it is usually very weak.

Glewwe (2007), observes that disparities in the findings of these studies arise from a host of issues which Include: Varied proxies of education and varied meanings attached to the concept of human capital, limited data availability are among the issues that have cast significant suspicion on the dependability of growth regression on human capital pointers , the problem of parameter heterogeneity where most growth studies assume the impacts of explanatory variables to be the same in all countries yet in reality; countries vary widely in their characteristics especially developed and developing economies and endogeneity problems where it is assumed that it is always growth in the economies is caused by education.

The direction of causation between growth in the economies and education is still unclear, is it education that causes economic growth and vice versa? Another issue is that most of the studies in this area are also said to be cross sectional where both developed and developing economies are incorporated, little has been done on single countries (Risikat, 2009). The above cited problems can therefore be dealt with by carrying out single country studies.

This study seeks to be different from the rest by improving on these issues by way of carrying out a single country research and to get results that will be more meaningful to Kenya as a developing nation. This will be achieved by tackling the host of issues cited above which are seen to have contributed to mixed results in the previous studies.

## **1.2 Key Research Questions**

The key questions for this research were:

1. Does education cause economic growth?
2. Can Kenya as a nation bank on education as a major promoter for economic growth?

## **1.3 Objectives of the Study**

This study sought to answer the fundamental question of whether or not there is a connection between growth of the economy and education in Kenya.

The specific objectives can be stated as follows:

- a. To analyze the connection between economic growth and education in Kenya
- b. To propose policy recommendations, based on the research findings and to suggest a way forward.

## **1.4 Justification of the Study**

This study explores the apparatus through which education impacts on the growth of the economy by looking at the impacts of different levels of education on the expansion of real GDP. It exploits the time series information for a single country (Kenya); hence avoiding the common problem of parameter heterogeneity which is associated with cross country regressions.

The study makes use of a wide range of data, and a range of proxies for education so as to overcome the econometric problems associated with limitation of data and also to limit the problems of human capital measurement through the use of multiple proxies. The study is also expected to assist the government and other policy makers to determine which aspects of education to emphasize more on and the specific areas of education where more or less spending may be necessary based on the degree of contribution to economic growth. The study therefore has a broader aim of giving policy makers a new

perspective on Kenya's education goals and the most promising route towards economic growth.

## **CHAPTER 2: LITERATURE REVIEW**

### **2.1 Introduction**

This chapter analyses past studies on the theoretical connection between economic growth and education then reviews empirical works on the relationship as well. It is divided into 3 major sections namely theoretical literature, empirical literature, and an overview of lessons learnt from the studies. The empirical literature section is divided further into 3 subsections namely: studies done in countries outside Africa, studies done in Africa and then narrow down to studies done in Kenya.

### **2.2 Theoretical Literature**

It is agreed that economists generally have failed to agree precisely on how to foster economic development, however, it is common knowledge that economic development requires economic growth, a genuine expansion in income per capita coupled with growth in both political and social institutions that are essential to sustain the growth of the domestic economy. Moreover, it also needs citizenry that is able to labor in the industries with efficiency. Economic growth is achieved as the manufacture of goods and services increase at a rate greater than that at which the population is growing. In addition to the expansion of the per capita income, economic development also entails a significant change in the arrangement of the economy. The variations are seen in the growth of the industrial sector coupled with a decreasing contribution of agriculture to the share of GDP and also major deviations in up country to urban migration, population growth, and employment possibilities.

Over the years, much has been said by economists about what actually drives economic growth for an economy. In this section, we discuss the common models of economic growth as follows:

#### **2.2.1 Basic Economic Growth Model**

In this model, the chief factors of production are capital and labor. Output is therefore expressed as a function of these two factors. At a macro level, the model function can be represented by the formula:  $Y = F(K, L)$  ..... (1).

Where Y, K and L represents Income, capital and labor respectively.

Expansion of output (Y) is driven by increasing capital (K) by way of investing and depreciation, and increasing labor supply (L) made possible by increasing population.

The level of capital investment depends on savings and is computed by multiplying the mean rate of saving in an economy by output. Availability of labor is based on population. As labor and capital rise, output expands. The basic economic growth model can be presented graphically as in figure 1.

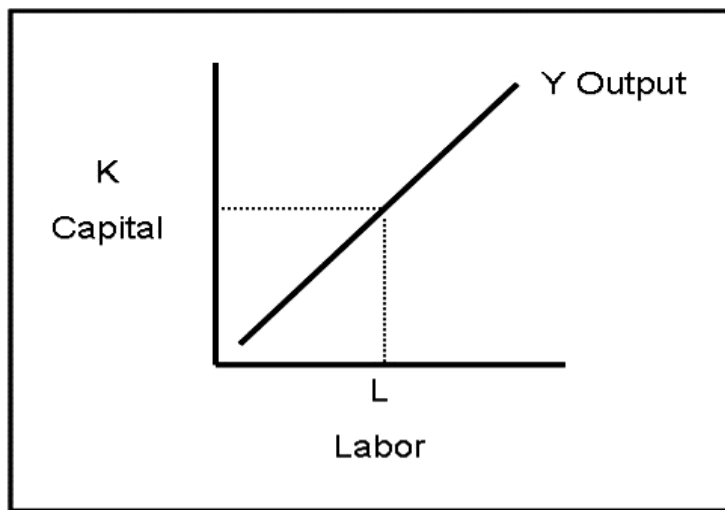


Fig 1: Basic Economic Growth Model

Source: Dwight H. Perkins 2006, “Economics of Development”, 6<sup>th</sup> Edition, Norton, W.W& Company

### 2.2.2 Harrod-Domar Growth Model

Evsey Domar and Roy Harrod, both economists, individually crafted an economic growth model founded on a fixed-coefficient in the early 1940’s. This function works on the premise that capital and labor are utilized in a constant ratio to each other to generate total output.

The model can be expressed as follows in equation

$$Y = K/v \dots\dots\dots (2)$$

Where  $v$  is a constant computed by dividing capital ( $K$ ) by output ( $Y$ ) and referred to as the capital-output ratio. It is essentially a degree of the yield of investment or capital. Figure 2 below is a graphical representation of the Harrod-Domar model.

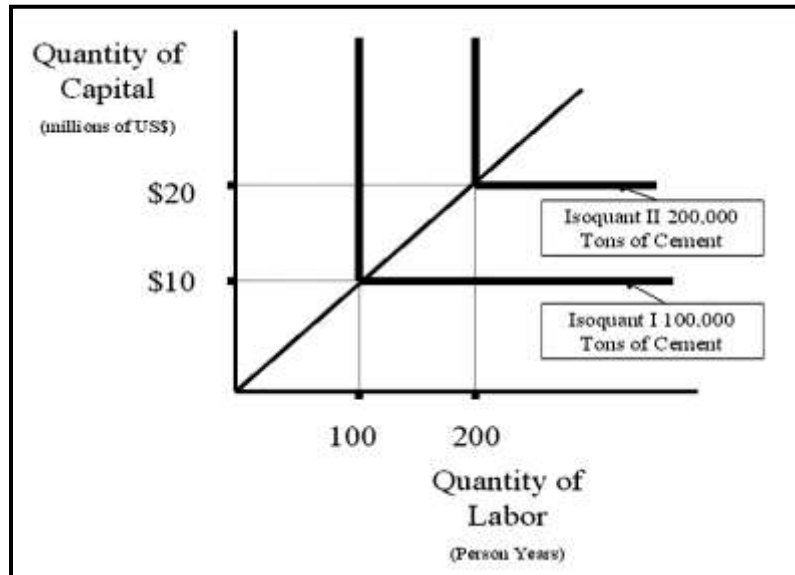


Fig 2: Harrod-Domar Growth Model

Source: Dwight H. Perkins et al 2006, 'Economics of Development', 6<sup>th</sup> edition, Norton, W.W& Company

From figure 2, outputs are isoquants. The model is built on the assumption that labor and capital are forever utilized in a constant percentage to generate equal amounts of output. Two important facets of growth that Harrod-Domar model focuses are the efficiency of capital is usage in investment and savings.

This model has an advantage of being able accurately forecast growth in the short run and has therefore been useful largely in developing economies to decide the “required” rate of investment or “financing gap” to be filled in so as to get a preferred growth rate. It is also a simple model is also simple hence requires comparatively small data and the function is simple to utilize. The model however, only remains in balance with full or optimal employment of factors of production namely: labor and capital. This results in inaccuracy of longer term economic forecasts hence failing to explain changes in



technology and efficiency gains that are otherwise necessary for sustained economic growth and development.

### **2.2.3 Solow Growth Model /Neoclassical Growth Model**

Robert Solow developed a fresh model of growth, in the 1950's, which addressed the shortcomings of Harrod-Domar model. Solow substituted the constant-coefficients production function with a production new function which exhibits the characteristics of constant returns to scale and seamless diminishing returns to each factor of production. In this model, switching between the factors is made possible so that the comparative composition of labor and capital can be reflected, a significant departure from the constant ratios envisaged by the Harrod-Domar model. This production function is curved as opposed to the L shaped isoquants hence allowing dynamism in employing varied proportion of capital and labor. Production in the model can be increased by increasing labor and capital in fixed quantities fixed or by increasing either in capital or labor.

The production function in this model depicted increasing knowledge or technology as labor complementing and expanding production. Solow's assumption is that technology increases autonomously from the model in two way: mechanical through upgraded machinery and related and human capital through improved health, education and worker skills. Major components of growth in the economy are technical change and population expansion.

### **2.2.4 Sources of Growth Analysis in Solow's Model**

Solow went ahead to brought to the fore the "growth accounting" or "sources of growth analysis", which focused straight on the impact of every variable in the production function. His motive was to measure the percentages of observed growth in the economy which could be attached to increase in capital labor force, and variations in total efficiency. The relationship is expressed as per equation 3

$$Y=F(K, L, A) \dots\dots\dots (3)$$

Where Y, K and L represents output, capital and labor respectively, and A is a factor that takes care of the effects of variables other than capital and labor supply that may impact on growth, for example worker skill levels, education, health, increasing technology, institutions many other factors. Parameter “A” is also referred to as total factor productivity. The residual A is sometimes described as an estimate of our ignorance on process of growth because it captures both efficiency gains and the net impacts of errors and omissions from economic data.

### **2.2.5 Endogenous or New Growth Theory**

This theory was developed in the 1980’s with the aim being to define more accurately the characteristics of economic growth. The driving force behind this theory was that Solow’s model though correct and sensible was incomplete and therefore there was need to develop a more complete theory (Cortright 2001).

This theory is described by Cortright (2001) as an assessment of the economy that encompasses two key points: first, it sees technological advancement as a result of economic activity and second, endogenous theory, he quips, holds that as opposed to physical objects, technology and knowledge are characterized by increasing returns which determine the process of economic growth.

New growth theory is premised on the notion that increases in efficiency can be tied directly to a quicker speed of innovation and additional investing in education. The supporters of the endogenous theory emphasizes the necessity for government and private sector institutions that successfully promotes innovation, and that provide the correct motivation for individuals and businesses to be inventive.

The most popular new growth model which is also the simplest has been the linear or AK model expressed as;

$$Y = C^{\alpha} H^{\beta} = AK.....(4)$$

In this model,  $K$  is a representation of a broad measure of aggregate capital made up of physical capital ( $C$ ) and human capital ( $H$ ), and  $A$  represents a given and fixed productivity parameter.

### **2.3 Empirical Literature**

Numerous empirical studies have examined the linkage between economic growth and education. Most of these work, however, have been cross sectional which includes developed and developing economies and there is limited literature on single country approach (Oladoyin 2010)

#### **2.3.1 Studies Done Outside Africa**

Among the studies carried out in countries which are outside the African continent and had varied conclusion and findings are as follows:

Self et al (2004), looked at how education affects economic growth in India. In this study, education was categorized into its various levels with the aim of finding out how each level had significance on the expansion of the economy. He further broke down the education variables by gender in order that he could carry out a further analysis to determine whether results would varied by gender. The findings were that education at primary level had a significant causal impact on growth in comparison to secondary level of education. He found that educating females at the various levels had the potential for causing growth of the economy while a causal impact on growth in males was only at primary level.

Abdul Latif et al (2007), employed standard co-integration technique and used time series data for Malaysia. The divided education into primary school, secondary school and tertiary education. The finding was that GDP is co-integrated with all educational variables indicating a positive relationship. In conclusion, they observed that Malaysian government should focus on educational development especially in the first stages in order to achieve highest possible enrolment rates and raising educational level for its labor force.

Ararat (2007), employed the use of endogenous growth model and a system of linear & log linear equations. He estimated the importance of different stages of education in triggering significant growth Russia and Ukrainian economies. His results indicated that there was negligible impact of educational achievements on economic growth. He however found that tertiary education has favorable results for income per capita growth in the long run.

Barro and Sala-i-Martin (1995), found that male education achievement specifically at secondary and tertiary stages had significant favorable growth effects. GDP, he found, increases by 1.1 percent with an increment in mean male secondary schooling of 0.68 years and that an increase in tertiary education of 0.09 years raises annual growth by 0.5 percentage. They also find a relationship between GDP and human capital, which is generally defined to include health and education, so that economies that remain behind tend to expand rapidly when they have high levels of human capital.

Barro (1992), employing the extended neo-classical growth model and considering mean growth rates and mean ratio of investment to gross domestic product over three decades ranging between 1965 to 1995 and using the three stage least squares found, in relation to education that growth was favorably connected to initial level of mean years of school attainment of grown up males at secondary and higher level. Growth, however, he found had insignificantly relationship to years of school attainment of females in secondary and higher levels, this however was observed to be a result of educated females not being utilized in the labor markets of majority of economies. Another contradictory result was that, growth was insignificantly connected to male schooling at primary level. That notwithstanding, this level being a pre-requisite for schooling at secondary; it would therefore impact on growth through this channel.

Jargerson and Frumeni (1992), using growth accounting methodology demonstrated that investing in both physical and human capital accounted for a very significant percentage of growth in both education and industrial sectors of the United States of America's economy. Growth in labor inputs, he found, accounted for in excess 0.6 of total

economic growth. Improvements in labor quality also explained 42% of this labor contribution.

According to Pancavel (1991), he showed how the contribution of the various stages of schooling namely primary, secondary and higher education can be arrived at from total measures of the schooling and efficiency. The results showed that even though the contribution of overall schooling increased to 23.41 from 14.78, the growth in tertiary education and its comparative contribution to economic growth in the US was much larger. Pancavel observes that the share of higher education to economic growth has increased greatly in 1990s.

Chen et al (2000), using a basic multi-variate statistical model and cross sectional data analyzed the source of cross provincial variations of economic growth in China. They found that among other things, higher education led to expansion of the economy in China.

In their conclusion, they observed that both levels of government i.e. local and central government should put emphasis on education in their provinces. They felt that a larger share of government spending should be on local educational facilities and teacher's remuneration and also have a labor system that rewards education.

### **2.3.2 Studies Done in Africa**

Wanjala and Belassi (2004), using time series data analyzed the effect of government spending on education on real GDP in Uganda in the years 1965 to 1999. They found that average expenditures on education per worker was positively correlated with economic growth. Their Likelihood test also showed that education expenditures in their model were also weakly exogenous leading to a conclusion that education expenditure drive economic growth in Uganda. They were however quick to point out that, for education expenditure to have the desired outcomes in full, it was necessary that there be competent administrators at the lower levels of government to formulate and execute the budget and also to allocate resources effectively to the education sector.

Oladoyin (2010), employing the growth accounting model and relying on co integration and error correction techniques, analyzed the effects of investing in education on economic growth in Nigeria. The conclusion was that investment in education contributed positively to economic growth in Nigeria and also had a strong and statistically significant impact.

Kwabena (2010), using panel data on educational attainment studied the impacts of education on a number development outcomes in African economies and concluded that, conditional on other factors, education has significant positive impact on numerous aspects of development i.e. growth in incomes, health outcomes, political stability and women participation in national politics.

Impacts of education on development outcomes is nonlinear, different stages of education affects development outcomes differently, and of importance to this study was his assertion that lower stages of learning have stronger effects on preventive health than higher education. Education decreases the probability and intensity of armed conflicts in the African region, everything held constant.

Bakare (2006), used vector autoregressive error correction model to investigate implications of growth in human capital in Nigeria. The finding was that there was substantial functional and institutional connection between the investment in human capital and the expansion of the economy in Nigeria. A percentage decrease in investment in human capital resulted in a 48% fall in growth rate of GDP between 1970 and 2000.

### **2.3.3 Studies Done in Kenya**

There is no empirical study that has been carried out in Kenya to show the effects of education on economic growth in Kenya to the best of my knowledge. However, there are some studies which though not focusing solely on the relationship between economic growth and education, have used education as one of the variables of interest in their work.

Mudaki and Masaviru (2012), analyzed the impacts of composition of public spending on economic growth. They looked at the connection between government expenditure on education and many other variables on economic growth. They concluded that spending on education was a very significant booster of economic growth. They therefore recommended increased expenditure on education as one of the key pillar/determinant of economic growth in Kenya.

In another study by Misati and Mgonda, on Kenya's social development agenda for industrialization and sustainable development, they concluded that education sector remains the single most important vehicle for propelling the country towards economic development and industrialization.

#### **2.3.4 Overview of Lessons Learnt from the Studies**

From theoretical literature, it is evident that early theories (neoclassical approaches) to growth theory had a number of weaknesses. For instance, the theories assumed that technological change was driven entirely by factors beyond our control i.e. exogenous factors hence it becomes harder to see the role that would be played by education in such models; later models (new growth theory) provide much more useful yardstick for thinking about the role that education plays in economic growth.

Whereas education is seen not to have a role in traditional neoclassical economic growth theories, the new growth theory explicitly puts the importance of education to the fore. In the new growth model, education is seen as contributing to expansion of the economy by increasing workers productivity and also by resulting in knowledge creation, ideas and innovation. Accumulation of knowledge is depicted as having a central role in determining economic growth.

There is a large division in empirical literature as to whether or not education leads to economic growth. Despite the widespread belief that indeed education causes economic growth, the evidence for this hypothesis has been generally weak. Most empirical work on this area are cross country regressions which groups both developing and developed economies together resulting in a considerable overlap in the data sets and specifications utilized by the various studies which could explain the mixed results in empirical work.

The empirical literature also shows a myriad of methodological shortcomings in the estimation of the impacts of education variables on economic growth which include problems of measurement of human capital, limited data availability hence the prevalence of cross country regressions, endogeneity bias (general assumption that it's indeed education that causes economic growth) and parameter heterogeneity also resulting from cross country regressions.

Away from the methodological issues, the literature review also indicates that earlier studies adopt a more conventional neo-classical approach whereas newer studies are based upon the endogenous growth theories. In the neo-classical tradition, one off permanent increases in human capital stock is linked to a one off increase in the productivity growth. The neoclassical theory emphasizes a higher rate of innovation that is generated by having more educated workers who are able to generate new ideas.



## CHAPTER 3: METHODOLOGY

### 3.1 Theoretical Framework

This research seeks to borrow heavily from the new growth theory because of its commonness and the important attention it has attracted in the recent studies.

### 3.2 Model Specification

#### 3.2.1 Theoretical Model

The model used in this paper is based on the following production function as used in Romer growth model.

Romer assumed that the total output of a country *i* at time *t* ( $Y_t$ ) is determined by three factors; total physical capital ( $K_t$ ), total human capital ( $H_t$ ) and total labor ( $L_t$ ). More specifically is the assumption that the production function assumes the form of a standard cobb-Douglas function as below:

$$Y_t = AK_t^{\beta_1} L_t^{\beta_2} H_t^{\beta_3} \dots\dots\dots(5)$$

Where  $Y_t$  .....is real income (real GDP),

$K_t$  .....is physical capital,

$L_t$  ..... is the number of workers,

$H_t$  ..... is total amount of human capital,

$A$  .....is technology parameter

$t$  .....is the observation subscript, and

$\beta_1, \beta_2, \beta_3$  .....are parameters to be estimated.

Human capital is defined as follows:

$$H_t = E_t L_t \dots\dots\dots(6)$$

Where  $E_t \dots\dots\dots$  is the average level of education per worker.

Substituting equation 6 into 5;

$$Y_t = AK_t^{\beta_1} L_t^{\beta_2} (E_t L_t)^{\beta_3} \dots\dots\dots(7)$$

$$Y_t = AK_t^{\beta_1} L_t^{\beta_2} L_t^{\beta_3} E_t^{\beta_3} \dots\dots\dots(8)$$

$$Y_t = AK_t^{\beta_1} L_t^{\alpha} E_t^{\beta_3} \dots\dots\dots(9)$$

Where  $\alpha = \beta_2 + \beta_3$  and hence  $L_t^{\beta_2} \cdot L_t^{\beta_3} = L_t^{\alpha}$

The model in equation 9 will enable us to relate real GDP to various education parameters namely primary education enrolment, secondary education enrolment and university enrolment.

Theoretically, a positive correlation is expected between economic growth on one hand and increases in capital stock, employment and education of workers on the other hand.

### 3.2.2 Econometric Specification

Using a logarithmic transformation of equation 9, the growth of real GDP is a function of capital, employment, primary school, secondary school and university enrolment.

The econometric model used in the empirical analysis is log linear form as follows:

The assumption for the purposes of modeling is that education causes economic growth.

$$\text{Log} Y_t = \beta_0 + \beta_1 \text{Log} K_t + \beta_2 \text{Log} L_t + \beta_3 \text{Log} X_{1t} + \beta_4 \text{Log} X_{2t} + \beta_5 \text{Log} X_{3t} + u_t \dots\dots\dots 10$$

A prior expectation is that  $\beta_0, \beta_1, \beta_2, \beta_3, \beta_4, \text{ and } \beta_5 > 0$  i.e. they have positive relationship to real GDP growth.

### 3.3 Definition of Variables

$LogY_t$  is the log of real GDP growth rate.

$LogL_t$  is the log of employment levels.

$LogK_t$  is the log of gross fixed capital formation.

$LogX_{1t}$  is the Log of Gross Primary school enrolment.

$LogX_{2t}$  is the log of Gross Secondary School Enrolment.

$LogX_{3t}$  is the log of Gross university enrolment.

$\beta_0, \beta_1, \beta_2, \beta_3, \beta_4, \text{ and } \beta_5$ , are the parameters to be estimated

$t$  Is the observation sub script

$u_t$  is the error term.

### 3.4 Estimation Techniques and Data Sources

#### 3.4.1 Data Sources

Data used for this research was obtained from Kenya statistical abstracts, various issues of economic surveys published by the Central Bureau of Statistics, various issues of Central Bank of Kenya bulletins and data from International Labor Organization. The data covered the period 1980-2010. This period was chosen since the data was readily available.

#### 3.4.2 Data Description

Real GDP: is gross GDP growth on an annual basis adjusted for inflation. Gross primary school enrollment; is the proportion of enrolment in its entirety not considering age, to

the population of the age group that corresponds to the level of education shown. Gross secondary school enrollment is the proportion of total secondary school enrollment, regardless of age, to the population of the age group that officially corresponds to the level of education shown. Gross university enrolment is the total number of students enrolled in both public and private universities in Kenya during the period in question.

Gross fixed capital formation is made up of outlays in additions to the fixed assets of the economy including net changes in the level of inventories.

### **3.5 Estimation Techniques**

#### **3.5.1 Unit Root Test**

Before estimating our equation number 10, characteristics of data will have to be analyzed. This will be achieved by carrying out a test of stationarity of economic time series. This test is major because typical econometric methodologies mostly assume that the time series is stationary when in actual sense this is not the case (Risikat Oladoyin 2010). The average statistical tests have low probability of being appropriate in making the inferences which may then be wrong and misleading. We tested for integration by applying the Augmented Dickey Fuller test and Philip Peron's unit root test.

#### **3.5.2 Co-integration Test**

Co-integration shows the presence of a linear combination of non-stationary variables that are otherwise stationary. The existence of co integration means that a stationary long run relationship between the series is present, absence of co integration on the other hand means that linear combination is not stationary and variable have no mean to which it returns. This tests was carried out by reduced rank procedure from Johansen.

#### **3.5.3 Test for Causality**

One of the problems that cause contradictions in the results of empirical research on economic expansion and growth is the correlation between the variables. This particular test usually carried out to determine whether a given time series is instrumental in

forecasting another. In this study, the test was carried out using the Granger Causality test.

## CHAPTER 4: DATA ANALYSIS & DISCUSSION OF RESULTS

### 4.1 Introduction

In this chapter, we carry out analysis of data, present and interpret results of the analysis.

### 4.2 Descriptive Statistics

| VARIABLE | MEAN   | STD DEVIATION |
|----------|--------|---------------|
| Log Y    | 0.0295 | 0.86          |
| Log X1   | 8.667  | 0.24          |
| Log X2   | 6.53   | 0.375         |
| Log X3   | 4.20   | 0.627         |
| Log K    | 2.97   | 0.16          |
| Log L    | 0.39   | 0.202         |

Source: Regression analysis

Table 1: Descriptive statistics

In table 1 above:

Log Y is the logarithm of real GDP growth rate,

Log X1 is the logarithm of gross primary school enrolment,

Log X2 is the logarithm of gross secondary school enrolment,

Log K is the logarithm of fixed capital formation and

Log L is the logarithm of employment levels

The mean and standard deviation of each variable is as shown in figure 3 above. The means show where the center of the data is located. They show the averages of the data sets. The standard deviations give us information about how close or far from the mean are the values of the statistical data sets i.e. how concentrated data are around the mean. From fig 3 above, the standard deviations are generally small indicating that the values in our data sets are close to the mean on average.

### **4.3 Stationarity Test/Unit Root Test**

Stationarity test was carried out using the ADF unit root test. The test was carried out on each of the variables namely real GDP growth rate, enrolments in both primary and secondary school and university enrolment, gross capital formation and real wage employment. The test results showed that real GDP growth rate was stationary at level, however, for the remaining variables, the test revealed that they were not stationary at level but after first differencing, they became stationary. The test results are shown in stata output in appendix 2.

### **4.4 Cointegration Test**

This test was to be carried out using the Johansen test for cointegration method. For this method to be used, it is required that all variables must be non-stationary at levels but they must be stationery when transformed to first difference. In the variables for this study, real GDP growth rate does not meet this requirement hence the test could not be carried out.

### **4.5 Tests for Causality**

The test for causality was executed using the Granger causality test method. This was done on stationary data since it's a requirement for this method to be used. We used 2 lags for this test. The results were as discussed below:

#### **a) Real GDP growth rate (LogY)**

Here, we are testing whether lagged variables of primary school, secondary school & university enrolment, and combined lagged variables of the entire causes real GDP growth rate.

*Lagged variables of primary school enrolment*

The hypothesis to be tested was as follows:

$H_0$ : Lagged variables of primary school enrolment does not cause real GDP growth rate.

$H_1$ : Lagged variables of primary school enrolment cause real GDP growth rate.

The observed probability value was **58%** which is greater than **5%** hence we cannot reject null hypothesis. We therefore accepted null hypothesis and concluded that lagged variables of primary school enrolment does not cause real GDP.

*Lagged variables of secondary school enrolment*

$H_0$ : Lagged variables of secondary school enrolment does not cause real GDP growth rate.

The observed probability value was 75% which is greater than 5% hence we cannot reject null hypothesis.

*Lagged variables of university enrolment*

$H_0$ : Lagged variables of university enrolment does not cause real GDP growth rate.

The observed probability value was 46% hence we cannot reject the null hypothesis.

*Lagged variables of primary school, secondary school and university enrolment*

$H_0$ : Lagged variables of primary school enrolment, secondary school enrolment and university enrolment does not cause real GDP growth rate.

The observed probability was 89.7%; hence we cannot reject null hypothesis

**b) Primary school enrolment (X1D1)**



The P-values of lagged variables for real GDP growth rate, secondary school enrolment, university enrolment and for all these variables combined was 81%, 51%, 86% and 84% respectively.

All these P-values are greater than 5% and hence we cannot reject null hypothesis. We therefore conclude that lagged variables of real GDP growth rate, secondary school enrolment, university enrolment and for the combined variables do not cause primary school enrolment.

**c) Secondary school enrolment (X2D1)**

The P-values of lagged variables for real GDP growth rate, primary school enrolment, university enrolment and for all these variables combined was 68%, 66%, 85% and 92 %respectively.

All these P-values are greater than 5% and hence we cannot reject null hypothesis.

We therefore conclude that lagged variables of real GDP growth rate, primary school enrolment, and university enrolment and for the combined variables do not cause secondary school enrolment.

**d) University enrolment (X3D1)**

The P-values of lagged variables for real GDP growth rate, primary school enrolment, secondary school enrolment and for all these variables combined was 98%, 11%, 84% and 41 %respectively.

All these P-values are greater than 5% and hence we cannot reject null hypothesis.

We therefore conclude that lagged variables of real GDP growth rate, primary school enrolment, and secondary school enrolment and for the combined variables do not cause university enrolment.

## 4.6 Regression Analysis

The regression analysis was carried out and the results were as per the stata output in appendix 4.

The  $R^2$  was 20% meaning that only 20% of the variance in the response variable real GDP growth rate was explained by the regression model.

### Significance Testing

#### Empirical results

| Log Y    | COFFICIENTS | STD ERROR | t-statistics | P-Value |
|----------|-------------|-----------|--------------|---------|
| Log X1D1 | 11.851      | 6.20      | 1.91         | 0.068   |
| Log X2D1 | 1.268       | 2.44      | 0.52         | 0.608   |
| Log X3D1 | 1.463       | 1.34      | 1.10         | 0.284   |
| Log KD1  | 0.999       | 1.386     | -0.72        | 0.478   |
| Log LD1  | 3.586       | 6.246     | -0.57        | 0.571   |
| Cons     | 0.569       | 0.281     | 2.02         | 0.054   |

Source: Regression analysis

Table 2: Empirical results

For the purposes of these tests, the null hypothesis was as follows:

$H_0$ ; There is a significant linear relationship between education and real GDP growth rate.

The test was carried out for each variable of primary interest controlling for the others. The variables of interest are primary school enrolment, secondary school enrolment and university enrolment. For primary school enrolment, the P value was 0.068, this value is not low testing at 95% significance levels and therefore there is no evidence to reject null hypothesis.

The test confirmed that there is a significant linear relationship between primary school enrolment and real GDP growth rate. For secondary school enrolment, the P value was 0.608, again this P value is not low hence there is no evidence to reject null hypothesis.

For university enrolment, the P value is 0.284, again the P value is not low and we cannot therefore reject the null hypothesis. The co-efficient also shows that the relationship between real GDP growth rate and different levels of education is positive.

More specifically, the results indicate that for every unit increase in primary school enrolment, secondary school enrolment and university enrolment, the real GDP growth rate increases by 11.851, 1.267 and 1.463 units respectively.

## **CHAPTER 5: CONCLUSION AND RECOMMENDATIONS**

### **5.1 Conclusion**

It is generally understood that the wealth and living standard of a nation is reflected in its GDP. It is no wonder that from the late 1980's a large proportion involvement of macro-economists have been directed to longer term issues especially the impacts of policies of government on economic growth in the long term. The emphasis indicates the realization that what separates affluence from poverty for an economy relies on the speed of the country's growth over the long run.

This study has confirmed that education at all levels is one of the positive contributors to growth of economy as measured by the growth in real GDP and therefore a determinant of the needed economic growth. In particular, primary school enrolment has been found to have a strong casual impact on economic growth as compared to secondary and university enrolment. It is therefore beyond doubt that the living standards of people can be made better by offering them an education and as a consequence, the economy will also grow.

### **5.2 Recommendations**

Given the results and discussions in the previous chapter, the following are the recommendations from the research:

The government must prioritize investment in education; more funds must be put in education at all levels. Increasingly, huge chunks of the budget have been consistently allocated to education sector and this is beneficial to the economy and therefore must be encouraged. The non-prioritization of our investment in education is one of the major obstacles that could be holding the country back from exploring the maximum benefits of education. Prioritization includes identifying courses that might be strategic in achieving economic growth and hence find the need to invest more in them rather.

There should be a keen focus on education at all levels by both the county and national governments. A lot of emphasis nowadays is on degrees, technical colleges are all being granted charters to become fully fledged universities in order to satisfy the big craving for degrees by Kenyans. What we do not seem to realize however, is that the advantage of other economies lies in the middle levels of education that lays emphasis on practicality. This should however not be construed to mean that degree level education is not important but rather that degree level of education puts more on emphasis on abstract theories that may either be outdated or have no use in practical world.

The government must formulate policies towards the establishment of a labor system that rewards education. If education is to remain a booster for economic progress, it must be well targeted, and realistic. It must be backed by our urge to be more productive and it also must be global in perspective. It's only then that the true meaning and benefits of education will be seen and felt in all areas of development.

The government should also focus on subsidizing of general education and workers training. This may make reward towards education better by effectively expecting employers to help workers in gaining human capital.

### **5.3 Suggested Further Research**

This study has used enrolment rates as proxies to education. A similar research can be conducted using different measures of educations which may include expenditures on education and also different education attainments. It will also be interesting to carry out a research to find out how pre-primary education, vocational trainings and middle level colleges are related to economic growth.

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## APPENDICES

### Appendix 1: Descriptive Statistics Results

| Variable | Obs | Mean     | Std. Dev. | Min       | Max      |
|----------|-----|----------|-----------|-----------|----------|
| logY     | 31  | 1.029523 | .8641057  | -1.609438 | 1.960095 |
| logX1    | 31  | 8.667892 | .2352946  | 8.266935  | 9.146335 |
| logX2    | 31  | 6.539409 | .3751011  | 5.988961  | 7.438384 |
| logX3    | 31  | 4.200769 | .6266844  | 3.039749  | 5.179534 |
| logK     | 31  | 2.972794 | .1631615  | 2.70805   | 3.236716 |
| logL     | 31  | .3862129 | .2023565  | .0059821  | .7012146 |

### Appendix 2: Adf Unit Root Test Results

```
. tsset YEAR, yearly
time variable: YEAR, 1980 to 2010
delta: 1 year
```

**.dfullerlogY, noconstant lags(0)**

Dickey-Fuller test for unit root                      Number of obs =    30

| Test<br>Statistic | ----- Interpolated Dickey-Fuller ----- |                      |                       |
|-------------------|--|----------------------|-----------------------|
|                   | 1% Critical<br>Value                   | 5% Critical<br>Value | 10% Critical<br>Value |
| Z(t)              | -1.963                                 | -2.652               | -1.602                |

```
. tsset YEAR, yearly
time variable: YEAR, 1980 to 2010
delta: 1 year
```

**.dfullerlogY, regress lags(0)**

Dickey-Fuller test for unit root                      Number of obs =    30

| Test<br>Statistic | ----- Interpolated Dickey-Fuller ----- |                      |                       |
|-------------------|--|----------------------|-----------------------|
|                   | 1% Critical<br>Value                   | 5% Critical<br>Value | 10% Critical<br>Value |
| Z(t)              | -3.299                                 | -3.716               | -2.624                |

Mackinnon approximate p-value for Z(t) = 0.0149

```

-----
D.logY |   Coef. Std. Err.   t  P>|t|   [95% Conf. Interval]
-----+-----
logY |
  L1. |  -.5595879  .1696429  -3.30  0.003  -.9070857  -.21209
      |
  _cons |  .5632181  .2240303   2.51  0.018   .1043128  1.022123
-----

```

```

. tsset YEAR, yearly
time variable: YEAR, 1980 to 2010
delta: 1 year

```

**dfuller logX1, regress lags(0)**

Dickey-Fuller test for unit root                      Number of obs =    30

| Test Statistic | ----- Interpolated Dickey-Fuller ----- |                   |                    |        |
|----------------|--|-------------------|--------------------|--------|
|                | 1% Critical Value                      | 5% Critical Value | 10% Critical Value |        |
| Z(t)           | 0.493                                  | -3.716            | -2.986             | -2.624 |

MacKinnon approximate p-value for Z(t) = 0.9847

```

-----
D.logX1 |   Coef. Std. Err.   t  P>|t|   [95% Conf. Interval]
-----+-----
logX1 |
  L1. |  .0137416  .0278789   0.49  0.626  -.0433656  .0708489
      |
  _cons | -.0895786  .2412828  -0.37  0.713  -.5838239  .4046668
-----

```

**dfuller logX1D1, regress lags(0)(First difference of Log X1)**

Dickey-Fuller test for unit root                      Number of obs =    29

| Test Statistic | ----- Interpolated Dickey-Fuller ----- |                   |                    |        |
|----------------|--|-------------------|--------------------|--------|
|                | 1% Critical Value                      | 5% Critical Value | 10% Critical Value |        |
| Z(t)           | -5.364                                 | -3.723            | -2.989             | -2.625 |

MacKinnon approximate p-value for Z(t) = 0.0000

```

-----
D.logX1D1 |   Coef. Std. Err.   t  P>|t|   [95% Conf. Interval]
-----+-----

```

```

-----+-----
logX1D1 |
  L1. | -1.047184 .1952398 -5.36 0.000 -1.447783 -.6465848
      |
  _cons | .0308858 .0083775 3.69 0.001 .0136966 .048075
-----+-----

```

**dfuller logX2, regress lags(0)**

Dickey-Fuller test for unit root                      Number of obs =    30

```

----- Interpolated Dickey-Fuller -----
      Test      1% Critical   5% Critical   10% Critical
      Statistic   Value         ValueValue
-----+-----+-----+-----+-----
Z(t)      1.316      -3.716      -2.986      -2.624
-----+-----+-----+-----+-----

```

MacKinnon approximate p-value for Z(t) = 0.9967

```

-----+-----
D.logX2 |  Coef. Std. Err.   t  P>|t|  [95% Conf. Interval]
-----+-----+-----+-----+-----
logX2 |
  L1. | .0529891 .0402588  1.32 0.199  -.0294774 .1354555
      |
  _cons | -.2966152 .2624113 -1.13 0.268  -.8341403 .2409099
-----+-----+-----+-----+-----

```

**dfuller logX2D1, regress lags(0) (First difference of Log X2)**

Dickey-Fuller test for unit root                      Number of obs =    29

```

----- Interpolated Dickey-Fuller -----
      Test      1% Critical   5% Critical   10% Critical
      Statistic   Value         ValueValue
-----+-----+-----+-----+-----
Z(t)      -5.195      -3.723      -2.989      -2.625
-----+-----+-----+-----+-----

```

MacKinnon approximate p-value for Z(t) = 0.0000

```

-----+-----
D.logX2D1 |  Coef. Std. Err.   t  P>|t|  [95% Conf. Interval]
-----+-----+-----+-----+-----
logX2D1 |
  L1. | -1.014522 .1952929 -5.19 0.000  -1.41523 -.6138142
      |
  _cons | .0496248 .0169768  2.92 0.007  .0147913 .0844582
-----+-----+-----+-----+-----

```

**. dfuller logX3, regress lags(0)**

Dickey-Fuller test for unit root                      Number of obs =    30

| ----- Interpolated Dickey-Fuller ----- |             |             |              |        |
|--|-------------|-------------|--------------|--------|
| Test                                   | 1% Critical | 5% Critical | 10% Critical |        |
| Statistic                              | Value       | Value       | Value        |        |
| Z(t)                                   | -1.076      | -3.716      | -2.986       | -2.624 |

MacKinnon approximate p-value for Z(t) = 0.7247

| D.logX3     | Coef.     | Std. Err. | t     | P> t  | [95% Conf. Interval] |
|-------------|-----------|-----------|-------|-------|----------------------|
| -----+----- |           |           |       |       |                      |
| logX3       |           |           |       |       |                      |
| L1.         | -.0492911 | .0458303  | -1.08 | 0.291 | -.1431703 .0445881   |
|             |           |           |       |       |                      |
| _cons       | .2767785  | .192995   | 1.43  | 0.163 | -.1185538 .6721108   |

**. dfuller LogX3D1, regress lags(0) (First difference of Log X3)**

Dickey-Fuller test for unit root                      Number of obs =    29

| ----- Interpolated Dickey-Fuller ----- |             |             |              |        |
|--|-------------|-------------|--------------|--------|
| Test                                   | 1% Critical | 5% Critical | 10% Critical |        |
| Statistic                              | Value       | Value       | Value        |        |
| Z(t)                                   | -5.168      | -3.723      | -2.989       | -2.625 |

MacKinnon approximate p-value for Z(t) = 0.0000

| D.LogX3D1   | Coef.     | Std. Err. | t     | P> t  | [95% Conf. Interval] |
|-------------|-----------|-----------|-------|-------|----------------------|
| -----+----- |           |           |       |       |                      |
| LogX3D1     |           |           |       |       |                      |
| L1.         | -.9974122 | .1929967  | -5.17 | 0.000 | -1.393409 -.6014156  |
|             |           |           |       |       |                      |
| _cons       | .0698464  | .0323252  | 2.16  | 0.040 | .0035205 .1361722    |

. After first differencing, Log x3 is stationery, we reject null hypothesis

**. dfullerlogK, regress lags(0)**

Dickey-Fuller test for unit root                      Number of obs =    30

| ----- Interpolated Dickey-Fuller ----- |             |             |              |        |
|--|-------------|-------------|--------------|--------|
| Test                                   | 1% Critical | 5% Critical | 10% Critical |        |
| Statistic                              | Value       | Value       | Value        |        |
| Z(t)                                   | -2.406      | -3.716      | -2.986       | -2.624 |

MacKinnon approximate p-value for Z(t) = 0.1402

| D.logK | Coef.     | Std. Err. | t     | P> t  | [95% Conf. Interval] |
|--------|-----------|-----------|-------|-------|----------------------|
| logK   |           |           |       |       |                      |
| L1.    | -.3055028 | .1269951  | -2.41 | 0.023 | -.5656405 - .0453651 |
| _cons  | .9009173  | .3780504  | 2.38  | 0.024 | .1265161 1.675318    |

**. dfuller LogKD1, regress lags(0) (First difference of log K)**

Dickey-Fuller test for unit root                      Number of obs =    29

| ----- Interpolated Dickey-Fuller ----- |             |             |              |        |
|--|-------------|-------------|--------------|--------|
| Test                                   | 1% Critical | 5% Critical | 10% Critical |        |
| Statistic                              | Value       | Value       | Value        |        |
| Z(t)                                   | -6.568      | -3.723      | -2.989       | -2.625 |

MacKinnon approximate p-value for Z(t) = 0.0000

| D.LogKD1 | Coef.     | Std. Err. | t     | P> t  | [95% Conf. Interval] |
|----------|-----------|-----------|-------|-------|----------------------|
| LogKD1   |           |           |       |       |                      |
| L1.      | -1.22577  | .1866242  | -6.57 | 0.000 | -1.608692 - .842849  |
| _cons    | -.0066934 | .0228985  | -0.29 | 0.772 | -.0536773 .0402905   |

**. dfullerlogL, regress lags(0)**

Dickey-Fuller test for unit root                      Number of obs =    30

| ----- Interpolated Dickey-Fuller ----- |             |             |              |        |
|--|-------------|-------------|--------------|--------|
| Test                                   | 1% Critical | 5% Critical | 10% Critical |        |
| Statistic                              | Value       | Value       | Value        |        |
| Z(t)                                   | -1.198      | -3.716      | -2.986       | -2.624 |

-----  
 MacKinnon approximate p-value for Z(t) = 0.6743  
 -----

| D.logL | Coef.     | Std. Err. | t     | P> t  | [95% Conf. Interval] |          |
|--------|-----------|-----------|-------|-------|----------------------|----------|
| logL   |           |           |       |       |                      |          |
| L1.    | -.0300914 | .0251117  | -1.20 | 0.241 | -.0815305            | .0213476 |
|        |           |           |       |       |                      |          |
| _cons  | .0344802  | .0106152  | 3.25  | 0.003 | .012736              | .0562244 |

-----

**. dfuller LogLD1, regress lags(0) (First difference of log L)**

Dickey-Fuller test for unit root                      Number of obs =    29

| Test Statistic | ----- Interpolated Dickey-Fuller ----- |                   |                    |
|----------------|--|-------------------|--------------------|
|                | 1% Critical Value                      | 5% Critical Value | 10% Critical Value |
| Z(t)           | -4.811                                 | -3.723            | -2.625             |

-----

MacKinnon approximate p-value for Z(t) = 0.0001  
 -----

| D.LogLD1 | Coef.     | Std. Err. | t     | P> t  | [95% Conf. Interval] |           |
|----------|-----------|-----------|-------|-------|----------------------|-----------|
| LogLD1   |           |           |       |       |                      |           |
| L1.      | -.9281375 | .1929095  | -4.81 | 0.000 | -1.323955            | -.5323199 |
|          |           |           |       |       |                      |           |
| _cons    | .0216592  | .0068855  | 3.15  | 0.004 | .0075312             | .0357872  |

-----

Appendix 3: Granger Causality Test Results

. tsset YEAR, yearly  
 time variable: YEAR, 1980 to 2010  
 delta: 1 year

. varlogY logX1D1 logX2D1 LogX3D1, lags(1/2)

Vector autoregression

|                           |              |           |
|---------------------------|--------------|-----------|
| Sample: 1983 - 2010       | No. of obs = | 28        |
| Log likelihood = 83.75621 | AIC =        | -3.411158 |
| FPE = 4.26e-07            | HQIC =       | -2.887527 |
| Det(Sigma_ml) = 2.96e-08  | SBIC =       | -1.698323 |

| Equation | Parms | RMSE    | R-sq   | chi2     | P>chi2 |
|----------|-------|---------|--------|----------|--------|
| logY     | 9     | .922279 | 0.2425 | 8.962333 | 0.3455 |
| logX1D1  | 9     | .03836  | 0.0921 | 2.841482 | 0.9439 |
| logX2D1  | 9     | .089363 | 0.0668 | 2.002743 | 0.9809 |
| LogX3D1  | 9     | .166161 | 0.1788 | 6.098298 | 0.6362 |

|             | Coef.     | Std. Err. | z     | P> z  | [95% Conf. Interval] |          |
|-------------|-----------|-----------|-------|-------|----------------------|----------|
| -----+----- |           |           |       |       |                      |          |
| logY        |           |           |       |       |                      |          |
| logY        |           |           |       |       |                      |          |
| L1.         | .3857855  | .2134536  | 1.81  | 0.071 | -.0325759            | .8041469 |
| L2.         | -.0514113 | .2055282  | -0.25 | 0.802 | -.454239             | .3514165 |
|             |           |           |       |       |                      |          |
| logX1D1     |           |           |       |       |                      |          |
| L1.         | 4.011425  | 5.569106  | 0.72  | 0.471 | -6.903821            | 14.92667 |
| L2.         | 4.192773  | 5.575327  | 0.75  | 0.452 | -6.734667            | 15.12021 |
|             |           |           |       |       |                      |          |
| logX2D1     |           |           |       |       |                      |          |
| L1.         | -1.64501  | 2.186094  | -0.75 | 0.452 | -5.929677            | 2.639656 |
| L2.         | -.2082682 | 2.209048  | -0.09 | 0.925 | -4.537922            | 4.121386 |
|             |           |           |       |       |                      |          |
| LogX3D1     |           |           |       |       |                      |          |
| L1.         | 1.096321  | 1.140304  | 0.96  | 0.336 | -1.138633            | 3.331275 |
| L2.         | .880057   | 1.237735  | 0.71  | 0.477 | -1.545859            | 3.305973 |
|             |           |           |       |       |                      |          |
| _cons       | .3658793  | .3039559  | 1.20  | 0.229 | -.2298633            | .9616219 |

|             |           |          |       |       |           |          |
|-------------|-----------|----------|-------|-------|-----------|----------|
| -----+----- |           |          |       |       |           |          |
| logX1D1     |           |          |       |       |           |          |
| logY        |           |          |       |       |           |          |
| L1.         | -.0048184 | .008878  | -0.54 | 0.587 | -.022219  | .0125821 |
| L2.         | -.0004858 | .0085483 | -0.06 | 0.955 | -.0172402 | .0162687 |
|             |           |          |       |       |           |          |
| logX1D1     |           |          |       |       |           |          |
| L1.         | .0453745  | .2316308 | 0.20  | 0.845 | -.4086135 | .4993625 |
| L2.         | -.0203763 | .2318896 | -0.09 | 0.930 | -.4748715 | .4341189 |
|             |           |          |       |       |           |          |
| logX2D1     |           |          |       |       |           |          |
| L1.         | -.0197034 | .0909243 | -0.22 | 0.828 | -.1979117 | .1585048 |
| L2.         | .1036811  | .0918789 | 1.13  | 0.259 | -.0763983 | .2837605 |
|             |           |          |       |       |           |          |
| LogX3D1     |           |          |       |       |           |          |
| L1.         | -.0024706 | .0474276 | -0.05 | 0.958 | -.095427  | .0904858 |
| L2.         | .0277331  | .05148   | 0.54  | 0.590 | -.0731659 | .128632  |
|             |           |          |       |       |           |          |

```

      _cons | .0281339 .0126422  2.23 0.026  .0033557  .052912
-----+-----
logX2D1 |
logY |
  L1. | -.0092926 .0206823 -0.45 0.653  -.0498292  .0312441
  L2. | .017351 .0199144  0.87 0.384  -.0216805  .0563825
      |
logX1D1 |
  L1. | .2675404 .5396118  0.50 0.620  -.7900793  1.32516
  L2. | .4162828 .5402147  0.77 0.441  -.6425185  1.475084
      |
logX2D1 |
  L1. | -.0180442 .211819 -0.09 0.932  -.4332018  .3971135
  L2. | -.0744974 .214043 -0.35 0.728  -.4940141  .3450193
      |
LogX3D1 |
  L1. | -.0106181 .1104884 -0.10 0.923  -.2271713  .2059351
  L2. | .068713 .1199288  0.57 0.567  -.1663432  .3037692
      |
      _cons | .0215118 .0294514  0.73 0.465  -.036212  .0792355
-----+-----
LogX3D1 |
logY |
  L1. | -.0001934 .0384566 -0.01 0.996  -.075567  .0751801
  L2. | .005413 .0370287  0.15 0.884  -.0671619  .0779879
      |
logX1D1 |
  L1. | .8346693 1.003351  0.83 0.405  -1.131862  2.8012
  L2. | 1.897099 1.004471  1.89 0.059  -.0716285  3.865827
      |
logX2D1 |
  L1. | .2012271 .3938548  0.51 0.609  -.5707142  .9731684
  L2. | -.110101 .3979902 -0.28 0.782  -.8901474  .6699454
      |
LogX3D1 |
  L1. | -.0278908 .2054413 -0.14 0.892  -.4305483  .3747668
  L2. | .2234052 .2229949  1.00 0.316  -.2136567  .6604672
      |
      _cons | -.0239072 .0547618 -0.44 0.662  -.1312384  .083424
-----+-----

```

#### Appendix 4: Regression Analysis Results

```

. regress logY logX1D1 logX2D1 LogX3D1 LogKD1 LogLD1
variable logX2D1 LogX3D1 not found
r(111);

```



. regresslogY logX1D1 logX2D1 LogX3D1 LogKD1 LogLD1

| Source      | SS         | df | MS         | Number of obs = | 30       |
|-------------|------------|----|------------|-----------------|----------|
| -----+----- |            |    |            | F( 5, 24) =     | 1.27     |
| Model       | 4.58434772 | 5  | .916869544 | Prob> F         | = 0.3090 |
| Residual    | 17.3265604 | 24 | .721940017 | R-squared       | = 0.2092 |
| -----+----- |            |    |            | Adj R-squared = | 0.0445   |
| Total       | 21.9109081 | 29 | .755548556 | Root MSE        | = .84967 |

| logY        | Coef.     | Std. Err. | t     | P> t  | [95% Conf. Interval] |          |
|-------------|-----------|-----------|-------|-------|----------------------|----------|
| -----+----- |           |           |       |       |                      |          |
| logX1D1     | 11.8512   | 6.201252  | 1.91  | 0.068 | -9.475527            | 24.64996 |
| logX2D1     | 1.267911  | 2.440026  | 0.52  | 0.608 | -3.768055            | 6.303877 |
| LogX3D1     | 1.463384  | 1.335677  | 1.10  | 0.284 | -1.293318            | 4.220085 |
| LogKD1      | -.999021  | 1.386443  | -0.72 | 0.478 | -3.860499            | 1.862457 |
| LogLD1      | -3.586032 | 6.246105  | -0.57 | 0.571 | -16.47736            | 9.305294 |
| _cons       | .5694956  | .2815144  | 2.02  | 0.054 | -.0115216            | 1.150513 |

## Appendix 5: Variables Description

describelogY logX1D1 logX2D1 LogX3D1 LogKD1 LogLD1

| variable name | type  | format | label | variable label   |
|---------------|-------|--------|-------|--|
| -----+-----   |       |        |       |  |
| logY          | float | %9.0g  |       | LOG OF REAL GDP GROWTH RATE                              |
| logX1D1       | float | %9.0g  |       | FIRST DIFFERENCE OF LOG OF PRIMARY SCHOOL ENROLMENT      |
| logX2D1       | float | %9.0g  |       | FIRST DIFFERENCE OF LOG OF SECONDARY SCHOOL ENROLMENT    |
| LogX3D1       | float | %9.0g  |       | FIRST DIFFERENCE OF LOG OF UNIVERSITY ENROLMENT          |
| LogKD1        | float | %9.0g  |       | FIRST DIFFERENCE OF LOG OF GROSS FIXED CAPITAL FORMATION |
| LogLD1        | float | %9.0g  |       | FIRST DIFFERENCE OF LOG OF WAGE EMPLOYMENT               |

### Appendix 6: Regression Data

| YEAR | GDP<br>Kshs<br>(Millions) | Y<br>(Percentage) | X1<br>(Thousands) | X2<br>(Thousands) | X3<br>(Thousands) | K<br>(Percentage) | L<br>(Millions) |
|------|---------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-----------------|
| 1980 | 2,632                     | 5.572             | 3893              | 399               | 20.9              | 24.51             | 1.006           |
| 1981 | 3,039                     | 4.1               | 3981              | 411               | 23.3              | 22.91             | 1.024           |
| 1982 | 3,377                     | 5.052             | 4184              | 438               | 21.7              | 21.86             | 1.038           |
| 1983 | 3,842                     | 1.593             | 4324              | 494               | 24                | 20.93             | 1.093           |
| 1984 | 4,294                     | 1.6               | 4380              | 498               | 24.2              | 19.81             | 1.115           |
| 1985 | 5,037                     | 4.073             | 4700              | 437               | 29                | 25.32             | 1.19            |
| 1986 | 5,874                     | 4.8               | 4843              | 459               | 33                | 21.77             | 1.227           |
| 1987 | 6,523                     | 5.5               | 5031              | 522               | 40                | 24.29             | 1.274           |
| 1988 | 7,560                     | 4.9               | 5124              | 540               | 41                | 25.45             | 1.327           |
| 1989 | 8,643                     | 5.1               | 5389              | 641               | 63                | 24.86             | 1.369           |
| 1990 | 9,939                     | 5                 | 5392              | 618               | 79                | 24.16             | 1.409           |
| 1991 | 11,316                    | 4.3               | 5456              | 614               | 82                | 20.97             | 1.442           |
| 1992 | 13,224                    | 2.3               | 5530              | 629               | 83                | 16.92             | 1.462           |
| 1993 | 16,681                    | 0.4               | 5429              | 531               | 80                | 17.61             | 1.475           |
| 1994 | 20,036                    | 0.3               | 5557              | 620               | 82                | 19.29             | 1.505           |
| 1995 | 22,785                    | 4.8               | 5536              | 632               | 85                | 21.82             | 1.557           |
| 1996 | 25,896                    | 4.6               | 5598              | 658               | 86                | 15                | 1.607           |
| 1997 | 623,235                   | 2.4               | 5677.3            | 687.5             | 89                | 15.14             | 1.462           |
| 1998 | 690,910                   | 1.8               | 5919.6            | 700.5             | 76                | 16.69             | 1.475           |
| 1999 | 742,136                   | 1.4               | 6064.3            | 713.3             | 77                | 15.52             | 1.505           |
| 2000 | 795,793                   | 0.2               | 6155.5            | 759               | 90.4              | 17.41             | 1.557           |
| 2001 | 895,279                   | 1.2               | 6127              | 818.2             | 111.4             | 18.79             | 1.607           |
| 2002 | 967,800                   | 0.5               | 6100              | 819               | 123               | 15.14             | 1.722           |
| 2003 | 1,141,800                 | 2.9               | 7100              | 863               | 82.1              | 16.48             | 1.75            |
| 2004 | 1,109,338                 | 5.1               | 7400              | 898.5             | 91.5              | 16.96             | 1.7637          |
| 2005 | 1,172,784                 | 5.7               | 7590              | 934               | 92.3              | 17.65             | 1.8077          |
| 2006 | 1,244,445                 | 6.1               | 7630              | 1030              | 112.2             | 18.49             | 1.8685          |
| 2007 | 1,814,243                 | 7.1               | 8330              | 1180              | 118.2             | 19.11             | 1.9073          |
| 2008 | 690,910                   | 1.8               | 8560              | 1330              | 122.8             | 19.24             | 1.9439          |
| 2009 | 768,955                   | 2.645             | 8830              | 1510              | 177.5             | 19.93             | 2               |
| 2010 | 1,111,425                 | 5.552             | 9380              | 1700              | 177.6             | 19.77             | 2.0162          |

Source: Various issues of economic surveys published by the Central Bureau of Statistics, various issues of Central Bank of Kenya bulletins and data from International Labor Organization.

Variables definition: Y is real GDP growth rate, X1 is the gross primary school enrolment, X2 is the gross secondary school enrolment, X3 is university enrolment, K is fixed capital formation and L is employment levels.