UNIVERSITY OF NAIROBI

SOURCES OF GROWTH IN KENYA BETWEEN 1965-2005

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Declaration

This is my original work and has not been presented for any degree award in any other university.

Signed .....EMate..................... Date .....05 SEPTEMBER 2008....

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Approval

This research paper has been submitted with our approval as university supervisors;

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Signed .... Date .....12/11/08.......

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ABBREVIATIONS

GDP	Gross Domestic Product
IMF	International Monetary Fund
KNBS	Kenya National Bureau of Statistics
PIM	Perpetual Inventory Method
R&D	Research and Development
SSA	Sub-Saharan Africa
TFP	Total Factor Productivity
UON	University of Nairobi
USD	United States Dollar

CHAPTER ONE

1.0.0 INTRODUCTION

1.1.0 BACKGROUND INFORMATION

The International Monetary Foundation (IMF) in the dawning of the new millennium assessed Kenya's economic and financial performance to have deteriorated significantly in the 1990s because of stop-go macroeconomic policies, slow structural reform, and pervasive governance problems that resulted in bouts of financial instability, a rapid buildup of short-term debt, and high real interest rates. Kenya's economic performance weakened over the last decade because of the failure to sustain prudent macroeconomic policies, the slow pace of structural reform, and the persistence of governance problems. The often slack fiscal policy led to a rapid build up of short-term government debt which, in combination with declines in the saving rate, translated into lending rates in excess of 20 percent in real terms.

This, together with other high costs of doing business in Kenya depressed investment and its effectiveness, and as a consequence economic growth. To expound on this, it is expected that GDP being a measure of economic growth is by and large encouraged by capital formation. Capital formation would mean the accumulation of returns from investments, and thus if investors find it expensive to invest, the volume of GDP reduces and thus affecting economic growth negatively. Kenya has barely achieved fiscal adjustment against the difficult backdrop of worsening terms of trade, a scarcity of external financing, and adverse weather conditions. In this context, investor confidence has remained weak, and growth continued to decline. The 1980s and 1990s were characterized by persistently slow growth and limited economic transformation, despite the fact that the country maintained a large measure of political stability and pursued a fairly consistent development strategy.

The cross-country endogenous growth literature has been useful in identifying uniformities across countries over time and has helped to detect important associations in growth performance of countries. However, studies on the strength of these results typically find they have limited predictive power (Serquin and Kenny, 1999). This lack of strength is partly attributed to the adoption of the wrong assumption that growth processes across countries and over time are similar, while growth processes differ across countries and over time. We therefore supplement the cross-country endogenous growth methodology with Kenya-specific analysis, with a focus on the factors influencing growth using a model that states that besides capital and labor, increases in output can be achieved by increases in Total Factor Productivity (TFP).

Capital and labour can be mostly categorized as an expansion of the economy. That is, if the economy increases its capital stock and its labour by 2 percent, then aggregate output will expand by 2 percent as well. However, the people (as measured by the amount of labour) will still have the same income per capita. Their standard of living remains unchanged. The more difficult task is increasing the total factor productivity, which will raise the standard of living of the country's population. Increasing TFP takes a longer time horizon because it involves increasing the technological level, transforming institutions, deregulating the economy, and improving education. For example, if these factors improve by 1 percent, then an increase in capital stock and labour of 2 percent will instead result in a 3 percent growth of the economy.

1.2.0 STATEMENT OF THE PROBLEM

Identifying the key factors essential for sustained growth is vital for designing economic policies that lead to higher standards of living. The major players in sustaining growth have been thought to be accumulation of physical and human capital as well as technology. Economists dispute on the degree of contribution of each of these factors toward nurturing growth. The neoclassical growth model for instance assumes diminishing returns to physical capital with each subsequent increase, and thus its ability to sustain growth is limited. This leaves the impression that productivity would probably play the vital role of growth sustenance. Such a prediction laid the ground with the emergence of the modern growth theories that emphasize the role of knowledge and technology transfer.

The remarkable growth of the East Asian economies has provided an important basis for analyzing sources of growth. Many researchers have hypothesized that the rapid growth resulted from the effective adoption of advanced technology coupled with accumulation of inputs. Recent studies in endogenous growth like Romer (1986) postulated that research & development (R&D) activities are associated with externalities which affect the stock of knowledge available to all firms. A firm's production function is defined by firm–specific variables (capital, labour and R&D inputs) and a shift term (index of technology) which is a function of the stock of knowledge available to all firms, defined as the public characteristics of knowledge-generating activities.

Numerous studies on growth in the SSA have been carried out in an attempt to design growth-oriented policies since these countries are highly prone to volatility in economic activity. Kenya experiences a slow growth pattern which is believed to be inextricably linked to several characteristics of most of the countries in the region notably, their heavy dependence on agriculture which is still under-developed; weak economic base, high population growth and unemployment rates; low rates of returns on investment in physical and human capital: low level of integration in the world economy and under-development of market institutions. There is hardly any incongruity about the necessity for Kenya to rely on less erratic sources of growth that would insulate the country from adverse external developments as well as stimulate sustained growth and it is therefore crucial to identify its sources of growth.

This paper aims to use the basic growth accounting principle to identify those factors that have determined the economic performance of Kenya for the last forty years. Though many studies have addressed the issue of growth in Kenya both from an international and regional perspective, this study contributes uniquely to this literature in that few studies have addressed Kenya's growth in isolation by paying attention to its country-specific properties, distinct from analysis that is often conducted within a large sample of countries using factors that vary greatly across countries.

1.3.0 OBJECTIVE OF STUDY

This study assumes a particular parametric form of a Cobb-Douglas production function for the Kenyan economy and estimates the production function by running a regression. The output elasticities will be constructed using the parameter estimates and TFP growth is calculated as a residual. Since data on the growth of output, physical capital stock and labour are available, the contributions of physical capital, labour and TFP growth rates for all the years under study will be calculated. It is expected that at the end of the study, we would be able to produce empirical estimates of the contributions of TFP and factor accumulation to economic growth over the years. Thus, the engine driving the growth process over the years can be identified. This will equip policy makers with the relevant information for the design of appropriate policies that will result in higher and sustainable growth rates for the whole economy.

The main objective of the study is to investigate the sources of economic growth in Kenya during the 1965 - 2005 periods using the growth accounting method. Specifically the study involves;

• Estimation of TFP growth and contributions of physical and human capital inputs to economic growth from 1965-2005.

• To analyse the contributions of factor accumulation and TFP growth to economic growth.

1.4.0 JUSTIFICATION OF STUDY

Economic growth is one of the primary goals of National Economic Policy in SSA. This goal has however been very difficult to achieve in the past four decades. The last four decades was difficult for SSA countries in terms of both economic growth and stability. Many of the SSA countries did not only suffer slow growth that began in the 1970s, but also had several years of negative growth in the subsequent period. The growth record of Kenya has been one of irregularity since the post-independence period. With a reasonably high growth rate in the 1960s and 1970s, the Kenyan economy began to experience a slow down in growth in the 1980s and 1990s. Kenya is a country rich in both human and natural resources. Most importantly, its population is still among the best educated in Africa. Kenya is also fairly well endowed with land although of varying quality. Yet, under-utilisation, unequal and insecure access to land as well as poor quality of much of the land rather than absolute shortage of land, are arguably the main reasons behind the present inability of much of the agricultural population to achieve a satisfactory income.

In sharp contrast to many of its neighbours Kenya has a favourable geographic location and unhindered access to the sea. It has also by and large been spared violent conflict, unlike many other countries in SSA. Yet, Kenya has become one of the poorest countries in Africa, with a per capita income of about 400 USD that is little more than a dollar per day. The relevance of this study stems from the fact that Kenya is in dire need of policy measures aimed at raising the growth rate of income per capita so as to meet her development targets, in an effort to address the growing concern for poverty reduction in the country. In view of this, a wide range of sectoral reforms have been implemented in Kenya, just like in many SSA countries since early 1980s as a result of the World Bank's and IMF's initiative to accelerate the slow growth of African economies experienced in the 1970s.

In order to achieve sustained economic growth, increased production and productivity must be at the centre of an economic recovery strategy. In order to formulate strategies for achieving sustained increased production and the rapid growth necessary for poverty reduction, relevant information is absolutely necessary. It is therefore important to study some factors that tend to or are expected to affect Kenya's economic growth, so as to gain a better understanding of those factors that have produced differences in growth rates within the study period, and thus which can be altered to determine better growth in the future. Out of this concern, it is extremely necessary that effective policies be developed and put into place in order to harness her potential for development which has been demonstrated in the last four years, with real GDP growth for 2005 exceeding 3.5 percent according to figures published by the Central Bank in 2005. Effective policies can only stem from a fore understanding of the sources that brought about growth in the past and which can be efficiently formulated to promote the desired long-term growth.

CHAPTER TWO

2.0.0 LITERATURE REVIEW

2.1.0 THEORETICAL BACKGROUND

The growth accounting approach formally introduced by Solow (1957) explains the growth in an economy by breaking down the aggregate output (Y or GDP) into contributions of growth inputs (labor, capital, and technology). That is, the model explains how much of the growth in an economy is explained by changes in the amount of labour or by changes in the amount of output. While the Solow model is widely used as a baseline model of economic growth, it is still considered by many to be unsatisfactory as a description of the process leading to economic growth. This is because the model views improvements in total factor productivity to be the ultimate source of growth in output per worker, but does not provide an explanation as to where these improvements come from. In the language of economists, long-run growth is determined by something that is exogenous in the model. Consequently, the recent Endogenous Growth models have been developed to tackle this limitation. There are two meanings of the phrase endogenous growth: one, Long-run growth is not driven by some exogenous process, like exogenous technological progress. Instead the long-run growth rate depends on the economic decisions of economic agents (households and firms) and two, Public policy is potentially capable of affecting the long-run growth rate.

Growth accounting develops from an aggregate production function that expresses the relationship between inputs and output. The general model is described by the following formula:

$$Y_{(t)} = A_{(t)} \times L_{(t)}^{\alpha} \times K_{(t)}^{1-\alpha} \qquad (1)$$

Theoretically, total factor productivity (TFP) growth reflects all the effects on output growth that cannot be attributed to the inputs into production. Current analyses use the value added in TFP estimates, implying the existence of a value added function, which efficiently combines the primary inputs of labour and capital. Under the assumptions of competitive product and factor markets, as well as constant returns to scale, market prices measure marginal costs and rentals/wages measure the value of marginal product.

Production theory shows that in discrete time, the growth of output is equal to the sum of share-weighted growth of inputs and TFP growth:

$$\Delta \ln Y_{(t)} = \alpha_{(t)} \Delta \ln L_{(t)} + (1-\alpha_{(t)}) \Delta \ln K_{(t)} + \Delta \ln A_{(t)} \qquad (2)$$

where $\alpha_{(t)}$ is the labour share of nominal value added. In a more realistic AK model, the key here that does distinguish this model from the Solow Model is that the effect of labour input is determined by the stock of what is termed as human capital.

Researchers have long acknowledged the significance of human capital in explaining economic growth. A more skilled individual will be assumed to produce more output than an unskilled individual, and the total stock of such 'skills' is what is called human capital. Crucially, human capital can be accumulated through education. Thus both physical and human types of capital can be accumulated. It can be shown that the estimated share for labour is the labour input elasticity of output; one minus this share gives the capital elasticity of output. Equation (2) decomposes output growth into the contributions made by inputs and by TFP growth, which can be calculated as a residual. Rearranging equation (2) and including human capital enables us to present results in terms of labour productivity growth:

$$\Delta \ln\left[\frac{Y_{(t)}}{H_{(t)}}\right] = \left[1-\alpha_{(t)}\right]\Delta \ln\left[\frac{K_{(t)}}{H_{(t)}}\right] + \alpha_{(t)}\Delta \ln\left[\frac{L_{(t)}}{H_{(t)}}\right] + \Delta \ln A_{(t)} \qquad (3)$$

Since our interest is in human capital, we could rearrange the equation as:

$$\Delta \ln\left[\frac{Y_{(t)}}{H_{(t)}}\right] = \left[1-\alpha_{(t)}\right]\Delta \ln\left[\frac{K_{(t)}}{H_{(t)}}\right] + \alpha_{(t)}\left[\Delta \ln L_{(t)} - \Delta \ln H_{(t)}\right] + \Delta \ln A_{(t)} \qquad (4)$$

where $L_{(t)}$ and $H_{(t)}$ denote unadjusted and quality-adjusted total labour respectively. The former treats labour as homogeneous across worker type, while the latter explicitly distinguishes between worker characteristics, i.e. education attainment in this paper.

In practice, it is not possible to differentiate capital and labour sufficiently, and inevitably TFP growth also includes some of the changes in the quality of labour and capital. Moreover, if the underlying elasticities of the production relation are not well approximated by the respective factor income shares, and the different inputs are not growing at the same rates, then there will be errors in assessing the relative contributions of labour and capital to output growth. Factors other than technical change, which will also be captured by the TFP residual, include adjustment costs, economies of scale, cyclical effects and the contribution of omitted inputs.

2.2.0 SOME EMPIRICAL STUDIES

The admirable performance of a number of Asian economies has been the premise for a large and diverged literature, much of which looks into reasons for the persistently high growth, and draws lessons for other countries that would like to follow suit. The growth in those countries not only radically changed people's lives, but also raised issues such as what had been the contributing factors, and whether the experience was applicable elsewhere. While some assessments of the sources of growth literature have questioned the approach and its theoretical basis, it remains true that empirical studies have been more numerous and influential. Notwithstanding many differences in data and analytical methodologies, most of the studies have the tendency to share one common feature in analyzing the relative role of input accumulation and TFP change; they relied heavily on a growth accounting approach.

Only a few empirical studies have dealt with individual countries in the SSA mostly due to luck of data. While a huge empirical literature testifies to the increasing supply of similar cross-country data on economic growth, most case study teams will find major gaps in the results due to missing observations. However as data became more available for more countries of the SSA region, some researchers have addressed these countries in the context of a larger sample. In a study done by Abu-Qarn and Abu-Bader (2007 cited Nehru and Dhareshwar, 1993) being among the early studies to estimate physical capital stocks and analyse the sources of growth. They used the Perpetual Inventory Method (PIM) to estimate physical capital from the flow of investments assuming a depreciation rate of 4 percent. In their analysis, they overlooked human capital and assumed an identical arbitrary share of capital in income of 0.4 for all countries.

Barro (1999) has extensively studied the factors influencing growth. His studies are geared toward finding measurable variables which help explain growth rates in an economy. Barro's data from 35 African countries regressed on actual and long-run levels of democracy in mid-1970s and in mid-1990s, found that a few African countries still had below-target levels of democracy in the mid-1990s. Prominent among them were Rwanda, Sudan, Nigeria, Somalia and Swaziland. Results predicted a sluggish economic growth rate of real per capita GDP, and the changes in growth rates also had dramatic effects on the standards of living in Africa. The strength of these cross-country studies, as pointed out by Barro is that they provide an understanding required to assess government policies and other determinants of long-term economic growth, Barro (1999). The results of his regression model which uses per capita growth rate as the dependent variable include education, life expectancy, male schooling, fertility, government of law index, government consumption, terms of trade index, democracy index and inflation.

Another comprehensive study was conducted by (Collins and Bosworth, 1996). They adopted the (Nehru and Dareshwar, 1993) data and extended it 1994 using PIM. Aware of the significance of human capital, they included an index of labour quality as an input in the production function, (Abu-Qarn and Abu-Bader, 2007).

In his study on the role of structural change as a source of economic growth in China, Chow (1993) estimated production functions and marginal returns to capital and labor for five sectors of the Chinese economy, carefully constructing capital stock data for each sector. He found that there was a declining difference in returns to capital, and an increasing difference in returns to labor, among sectors for the period of 1952-1985. Chow (1993 cited Borensztein and Ostry, 1996) also suggest that the large gain in TFP was caused by labor relocation from rural to industrial and urban sectors, rather than pure technical progress.

In more recent studies done by World Bank on determinants of growth in Arab countries using cross-country regressions, it was commonly found that the quality of institutions and factor endowment tended to affect negatively the relative growth performance of the Arab countries in comparison with three comparator regions. More specifically, the investment ratio and human capital explain the low growth performance of the Arab countries relative to the high performing East Asian group. Human capital, on the other hand, is the factor that explains the lower performance of the Arab countries relative to Latin America. It has been found that it is the quality of physical and human capital rather than their quantity that explains the relatively lower Arab growth performance. Their examination of the relative contribution of factor accumulation and TFP to economic growth for a sample of 92 countries indicated that factor accumulation accounted for most of the growth performance for the period 1960-1997. While TFP contributed positively to the growth performance of the East Asian countries, it was not an important source of growth in the Arab region. The quality of institutions and human capital accounted for the lower performance of the Arab countries in terms of TFP and in comparison with the other regions of the world.

A study done in Kenya by (Bollinger *et al.* 1999) showed that HIV/AIDS has the potential to create severe economic impacts. It is different from most other diseases because it strikes people in the most productive age groups and is essentially 100 percent fatal. The major economic effect is a reduction in the labor supply and increased costs, whereby the loss of young adults in their most productive years will affect overall economic output. They also found that although Kenya's economy is somewhat diversified in terms of GDP, agriculture is the predominant economic activity. The sector accounts for about 25 percent of GDP and 70 percent of export earnings. In the 1970s and 1980s, about 80 percent of all Kenyans lived in the rural areas and of these, 90 percent earned their livelihood from agriculture. This may still be the case though there has been a high rural-urban movement in the 1990s to date in search of better income generating activities. Whether or not this should affect output from the rural agricultural sector should be considered on the basis of human capital. It is obvious that GDP in Kenya has generally not increased in tandem with increase in population. This means that there is more to skill than just labor supply. Although GDP grew at about 2.5 percent between 1990 and 1997, the population grew at 2.6 percent, so that per capita income decreased over that time period. This explains that unless productivity is increased in this area, TFP will only decline and as a result overall growth. Policy analysts suggest that if Kenya's potential just in agriculture alone were to be efficiently harnessed, overall output would improve by close to 50 percent. But if this has to happen, it must be ensured that output of labour is much higher than the cost of attaining and maintaining it.

2.3.0 AN OVERVIEW

While a huge empirical literature testifies to the growing supply of comparable cross-country data on economic growth, most case study teams will find major gaps in the results due to missing observations. An early priority should be filling these gaps where possible. But large gaps remain for many variables unless national-level sources are available to fill these gaps. Missing data pose another general problem, which is that the regression panels are unbalanced and differ from regression to regression. This creates a problem in defining a meaningful benchmark for individual-country experience. With the country composition of regions differing over time and across regressions, one cannot unambiguously compare, say, Kenya's performance over time with that of SSA or East Asia, (Ndulu and O'Connell, 2000). Another issue is that data for a particular variable may be reported differently in different periods due to timely variations, probably due to incorporation of new data that was availed late or due to better computation methods. This creates inconsistency in the data used.

As far as the growth accounting method, which was adopted by the previous and present studies to measure the sources of a country or a group of countries' economic growth and its attributes, is concerned, it is still the work of empirical growth analysis. For all its flaws, be it real or imagined as discussed in many measurement issues, many researchers have used it to gain valuable insights into the process of economic growth. Not only thousands of research papers have been published but also the residual (TFP) has consistently become a closely watched government statistics. Thus applying it in our study as the basis for our analysis would ensure a clever theoretical framework that has been proven more than once to work.

CHAPTER THREE

3.0.0 METHODOLOGY

3.1.0 EMPIRICAL MODEL

Our growth accounting exercise is intended to break down the growth of output into the growth of the factors of production (capital and labor) and the growth of the efficiency in the utilization of these factors. The measure of this efficiency is usually referred to as Total Factor Productivity. For policy purposes it may matter whether output growth stems from factor accumulation or from increases in TFP.

We will assume a Cobb-Douglas production function of the form

$$Y = A\,K_t^{\alpha} L_t^{1-\alpha} \qquad 0<\alpha<1 \tag{5}$$

where Y is output, K is capital input, L is labour input and A is TFP, a parameter that governs the relationship between the inputs and output. Taking natural logarithms and differentiating both sides of (5) with respect to time t, then dividing through by labour input (L) gives the following expression,

$$\dot{y} = \dot{A} + \alpha\dot{k} \tag{6}$$

where lower case letters denote quantities per unit of labour input, so that y expresses labour productivity or output per unit of labour input while k denotes the level of capital intensity or the capital–labour ratio. The dots indicate the growth rates of each variable. Equation (6) implies that the rate of growth of labour productivity ($\dot{y}$) is equal to the rate of growth of TFP ($\dot{A}$) plus α multiplied by the rate of growth of capital intensity ($\dot{k}$).

A large body of empirical work has used the Cobb-Douglas version of production function which incorporates both physical and human capital. In a study carried out on the relationship between financial development and sources of growth (Levine *et al.* 1999), a positive correlation was found between credit finance and economic growth, and so was direct foreign investment. Natural resources are a fixed factor of production and hence, almost by definition, impose a restriction on economic growth potential. This restriction may depending on the nature of the production technology cause a growing labour force and a growing stock of capital to run into diminishing returns.

$$Y_t = A_t K_t^{\alpha} H_t^{\beta} F_t^{f} I_t^{i} L_t^{l} e^{u} \tag{7}$$

Y_t is output (GDP), A_t is the Total Factor Productivity, K_t is a measure of physical capital, H_t is the amount of human capital augmented labour used in production, F_t is finance, I_t is direct foreign investment, L_t is land being a proxy for natural resource and u_t is the error term. By extending the basic Solow model to include human capital, equation (7) ensures that the A_t term is all factors other than measurable inputs.

We assume that labour L is homogenous within Kenya and that each unit of labour has been trained with E years of schooling (Hall and Jones, 1999). Human capital-augmented labour is given by a function of the form:

$$H_t = e^{\varphi(E_t)} L_t \tag{8}$$

Where E is the number of years of education of workers in the labour force. In this specification, the function $\varphi(E_t)$ reflects the efficiency of a unit of labour with E years of schooling relative to one with no schooling ($\varphi(0_t) = 0$). The derivative $\varphi'(E_t)$ is the return to schooling estimated in a Mincerian wage regression. An additional year of schooling raises a worker's efficiency proportionally by $\varphi'(E_t)$ (Bils and Klenow, 1996). Widely advanced at the macro level where studies have been done across countries is the argument that education cannot explain the large differences in productivity across countries. Our hypothesis is to determine whether this argument holds in Kenya. Two assumptions provide the empirical basis for this argument, one is that the returns to human capital are concave so that with higher levels of human capital the return falls, and two is that the Mincerian returns to education are the same across countries. These assumptions warrant that as human capital expands, the return falls. The study by Hall and Jones that we follow from above imposes a common function $\varphi(E_t)$, which does not allow for the empirical investigation of these issues. In our study, we allow for this investigation and estimate the returns to education in the country and do not restrict these to be concave or predetermined.

Our basic measure of economic performance is the level of output per worker acquired by diving equation (7) by L, where lower case letters denote quantities per unit of labour input. $h=H/L$ is human capital per worker.

$$y_t = k^{\alpha}_{t}\, h^{\beta}_{t} f^{\delta}_{t}\, i^{\gamma}_{t}\, l^{\rho}_{t} A_t e^{u} \qquad (9)$$

tion theory shows that in discrete time, the growth of output is equal to the sum of weighted growth of inputs and TFP growth using chain indices. This decomposes growth into the contributions made by inputs and by TFP growth calculated as a l. Thus we can present our equation in terms of input productivity growth.

$$) = \Delta\, ln(A_t) + \alpha\, \Delta\, ln(k_t) + \beta\, \Delta\, ln(h_t) + \delta\, \Delta\, ln(f_t) + \gamma\, \Delta\, ln(i_t) + \rho\, \Delta\, ln(l_t) + u_t \qquad (10)$$

Δx_i denote a unit increase in factor x_i, then the marginal product of that factor is i.e. the change in output arising from an increase in factor i by a unit. This us to express the marginal product of the factor x_i as the first partial derivative of duction function with respect to that factor, thus the marginal product of the ith s simply $\partial y/\partial x_i = f_i$. In our case, we hypothesis then that human capital causes in output with expansion in education, in which case is specified as marginal ivity of human capital. From our results, we should be able to tell if policy makers pay more attention to education as an important component of economic growth it pay more to concentrate on other factors that are yoked up in TFP.

CHAPTER FOUR

4.0.0 REGRESSION ANALYSIS

The Pearson's R correlation coefficient and the R^2 coefficient of determination are measures of association for evaluating the relationship between an independent variable and dependent variable. These statistics are components of a broader set of statistical techniques for evaluating the relationship between variables, called regression analysis (sometimes referred to in combination as correlation and regression analysis). The purpose of regression analysis is to answer three questions that have been identified as requirements for understanding the relationships between variables, that is, is there a relationship between the variables?, how strong is the relationship?, and what is the direction of the relationship? The goal of our regression analysis is to determine the values of parameters for our function that best fits our data set, in which we use linear regression.

This chapter evaluates the empirical relation between the dependent variable (output per worker) and the explanatory variables (capital intensity, human capital, finance, direct foreign investment, land and total factor productivity growth). We briefly observe the trends in these variables by plotting them so as to have an idea of the trendline for these variables since 1965 to 2005. This chapter also attempts to describe the basic requirements for data, giving simple summaries about the sample and the measures. Together with simple graphics analysis, they form the basis of our quantitative analysis of the data used. We then use a hypothesis test to see if there is a relationship between the variables in the population represented by our sample data.

In addition, we test for problems that occur in regression analysis when a function specified has multiple independent variables that are highly correlated. The common interpretation of the computed regression parameters as measuring the change in the expected value of the dependent variable when the corresponding independent variable is varied while all other independent variables are held constant is not fully applicable when a high degree of correlation exists. This is due to the fact that with highly correlated independent variables it is difficult to attribute changes in the dependent variable to one of the independent variables rather than another.

Later in the chapter, we shall have inferential statistics. We test for significance of the variables as well as the explained variance for the function using Least Squares. These results should help us meet our objective of forecasting, that is, try to infer from the sample data what the trend of the dependent variable in the near future is likely to be, and thus come up with a guide on the appropriate policies. With inferential statistics, we will be trying to reach conclusions that extend beyond the immediate data alone. In our analysis, we use the usual elements of regression analysis which are one, evaluate regression and correlation using the scatterplots and the regression equation, and two, examine the statistical evidence to determine whether or not, the relationships found in our sample data are applicable to the population represented by the sample using a hypothesis test.

4.1.0 TRENDS IN THE VARIABLES: SCATTER PLOTS

We obtain our scatter diagrams below using our regression programme and the trendline or regression line is the straight line on the charts. The overall pattern of the dots, or data points, concisely summarizes the nature of the relationship between the variables. In our case, we have plotted every independent variable against the dependent variable separately for clarity. The clarity of the pattern formed by the dots can be enhanced by drawing a straight line through the cluster such that the line touches every dot or comes as close to doing so as possible. This summarizing line is called the "regression line." The pattern of the points on the scatterplot gives us information about the relationship between the independent and dependent variables. The regression line makes it easier for us to understand the scatterplot.

Fig 1: Output per Worker (Y) Vs Capital Intensity (K)

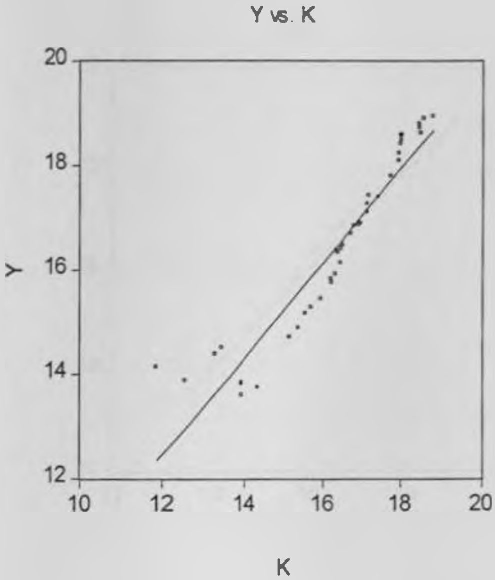


Fig 2: Output per Worker (Y) Vs Secondary Education (S)

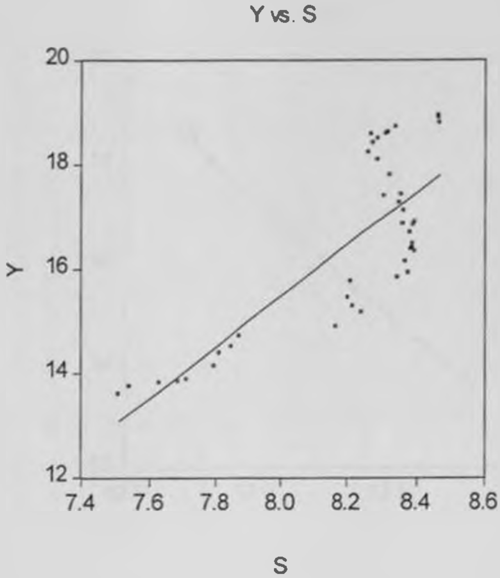


Fig 3: Output per Worker (Y) Vs Higher Education (U)

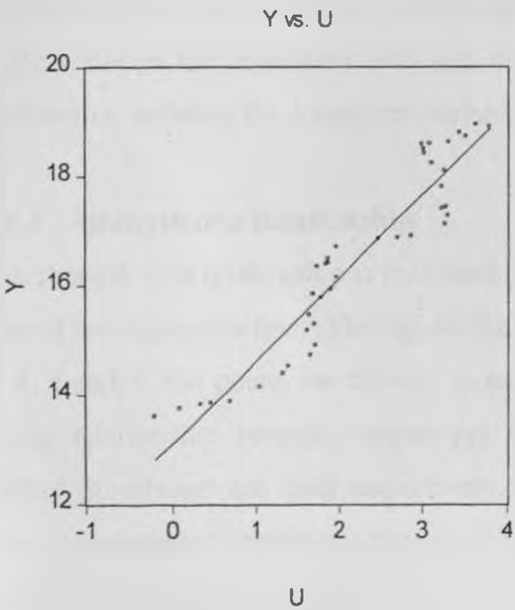


Fig 4: Output per Worker (Y) Vs Finance (F)

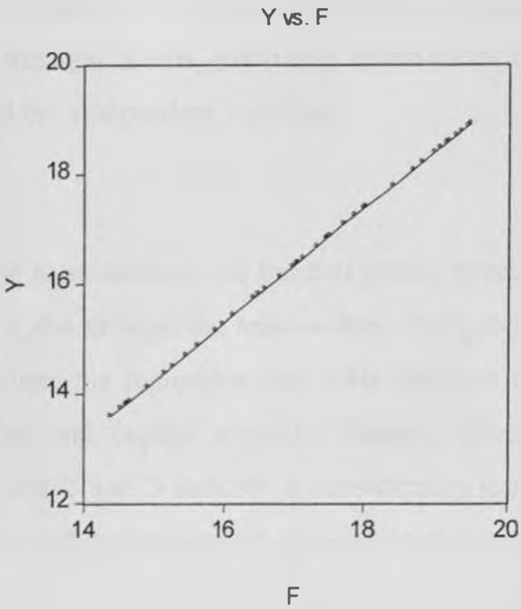


Fig 5: **Output per Worker (Y) Vs Foreign Investment (I)**

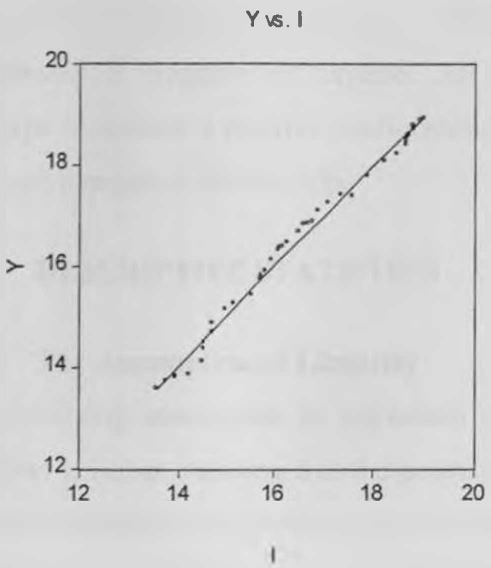
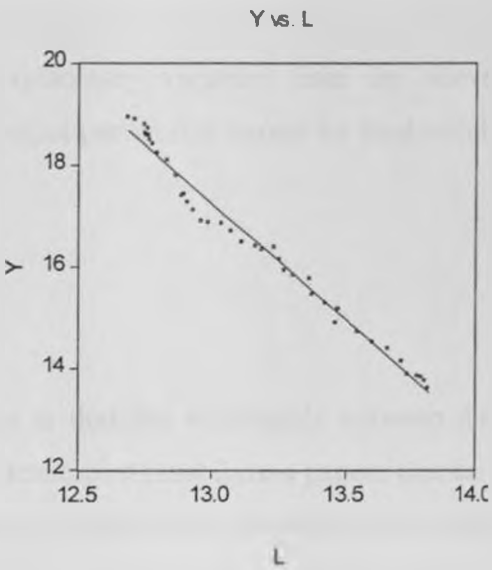


Fig 6: **Output per Worker (Y) Vs Land (L)**



4.1.1 Evidence of a Relationship

When there is no relationship between two variables, the regression line is parallel to the horizontal axis. Observing from our diagrams above, all the regression lines are at an angle between the regression line and the horizontal x-axis, providing evidence of a relationship between the dependent variable and the independent variables.

4.1.2 Strength of a Relationship

The strength of a relationship is indicated by the narrowness of the band of points spread around the regression line. The tighter the band, the stronger the relationship. In figures 1, 4, 5 and 6, the points are closely spread around the regression line. This indicates a strong relationship between output per worker and capital intensity, finance, direct foreign investment and land respectively. Figures 2 and 3 indicate a considerably less strong relationship between output per worker and human capital attained in form of secondary and higher education.

4.1.3 Direction of Relationship

When the regression line slopes upward to the right, there is a positive or direct relationship between the variables. When the regression line slopes downward, the relationship is negative or inverse. All the explanatory variables from the above scatterplots indicate a positive relationship with output per worker except for land which indicates a negative relationship.

4.2.0 DESCRIPTIVE STATISTICS

4.2.1 The Assumption of Linearity

An underlying assumption of regression analysis is that the relationship between the variables is linear, meaning that the points in the scatterplot must form a pattern that can be approximated with a straight line. We could test the assumption of linearity with a test of statistical significance of the correlation coefficient, while making a visual assess to the scatterplots. The correlation matrix is an important indicator that tests for linear relationship between the explanatory variables and the dependent variable. The matrix also helps to determine the strength of the variables in the model in that if their correlation coefficient values exceed the threshold value which corresponds to the 0.05 significance level, then the effect of all factors combined is significant. Table 2 below presents our correlation matrix. The absolute value of the correlation coefficient will be in the range 0 to 1. A value of 0 indicates that there is no relationship whereas a value of 1 indicates that there is a perfect correlation and the two variables vary together. We assume a Null Hypothesis of no correlation, that is, the factors of production used in this case have no effect on the dependent variable (output per worker).

Table 1: Correlation Matrix

	Output per Worker	Capital Intensity	Average Secondary Education	Average Higher Education	Finance	Direct Foreign Investment	Land
Output per Worker	1.000000						
Capital Intensity	0.062072	1.000000					
Average Secondary Education	-0.303794	-0.098796	1.000000				
Average Higher Education	-0.381639	0.069458	-0.032848	1.000000			
Finance	0.106553	0.264380	0.023215	0.065413	1.000000		
Direct Foreign Investment	0.442272	-0.132446	-0.304316	-0.047194	0.528015	1.000000	
Land	-0.081051	-0.209781	-0.262518	-0.062837	-0.000632	0.098031	1.000000

All absolute values of correlation coefficients of the explanatory variables against output per worker lie beyond the threshold level of 0.05, thus reject H_0: *of no correlation*

The results indicate presence of correlation between the explanatory variables and the dependent variable, though the low absolute values point out a relatively weak relationship. This means that the effect of the explanatory variables will be felt though may not have significant consequential influence on the dependent variable.

4.2.2 The Assumption of Normality

Normality is critical in many statistical methods though in many cases it is assumed instead of being tested. When this assumption is violated, interpretation and inference may not be reliable or valid because a single outlier can make the test worthless. Many statistical tests have been proposed to find out whether a sample is drawn from a normal distribution or not. Here we use the Jarque-Bera test which is based on the classical measures of skewness and kurtosis. The normality test uses the Null Hypothesis of normality against the alternative hypothesis of non-normality. If the probability value is less than Jarque-Bera chi-square under 5% level of significance, the null hypothesis is not rejected. Table 2 below gives the summary of the descriptive statistics of the data used in this study.

Table 2: Summary of Descriptive Statistics

	Output per Worker	Capital Intensity	Average Secondary Education	Average Higher Education	Finance	Direct Foreign Investment	Land
Mean	0.104475	0.121259	0.023829	0.095616	0.127351	0.135549	-0.028329
Median	0.089863	0.097095	0.012012	0.075306	0.113975	0.113571	-0.024251
Maximum	0.351419	1.736771	0.292776	0.525001	0.383142	0.391296	0.010853
Minimum	0.012651	-1.389895	-0.047153	-0.157118	-0.048646	-0.024096	-0.081799
Std. Dev.	0.065775	0.454012	0.059442	0.166167	0.095459	0.108618	0.020172
Skewness	1.892039	0.639016	2.602137	0.488860	0.470718	0.399737	-0.387744
Kurtosis	7.274529	9.457179	11.81017	2.573046	2.858126	2.223936	2.881176
Jarque-Bera	54.31807	72.21422	174.5060	1.897043	1.510718	2.069058	1.025833
Probability	0.000000	0.000000	0.000000	0.387313	0.469842	0.355394	0.598747
Observations	40	40	40	40	40	40	40

*Note: *Not Reject hypothesis of normality under 5% level of significance*

The results present probability values lower than the Jarque-Bera statistic for all variables, an indication that the data has a normality trait.

4.2.3 The Assumption of Stationarity

Stationarity in a time series is achived when the mean value of the series remains constant over the time series. Frequently, differencing is needed to achieve stationarity. Non-stationarity of time series data has often been regarded as a problem in empirical analysis. The stationarity or otherwise of a series can strongly influence its behaviour and properties, for instance persistence of shocks will be infinite for a non-stationary series. Working with non-stationary variables leads to spurious regression where if two variables are trending over time, a regression of one on the other could have a high R^2 even if the two are totally unrelated making inference from these results meaningless. It is therefore important to test for stationarity of the variables. Augmented Dickey-Fuller (ADF) tests were used to test for stationarity of the series. The results of the tests are presented in Table 3.

Table 3: Summary of ADF Tests

VARIABLE	ADF (2)	CRITICAL VALUE 1%	CRITICAL VALUE 5%	CRITICAL VALUE 10%	ORDER OF INTEGRATION
Output per worker	-9.819944	-2.6243	-1.9498	-1.6204	I(1)
Capital Intensity	-5.489586	-2.6227	-1.9495	-1.6202	I(0)
Average Secondary Education	-5.099472	-3.6067	-2.9378	-2.6069	I(0)
Average Higher Education	-4.103807	-2.6227	-1.9495	-1.6202	I(0)
Finance	-8.831530	-2.6243	-1.9498	-1.6204	I(1)
Direct Foreign Investment	-9.358712	-2.6243	-1.9498	-1.6204	I(1)
Land	-10.77664	-2.6243	-1.9498	-1.6204	I(1)

H_0: $f=0$, H_1: $f<0$. Reject the null hypothesis of Non-Stationarity under 5% significance level

If we first difference a trend-stationary series, it would "remove" the non-stationarity. If a non-stationary series, y_t must be differenced *n* times before it becomes stationary, then it is said to be integrated of order *n* written as *I(n)*. An *I(0)* series is a stationary series. An *I(1)* series contains one unit root. The majority of economic and financial series contain a single unit root, although some are stationary. From our results, capital intensity and both secondary and higher education variables were stationary while the rest had to be differenced once to make them stationary. The computed ADF test-statistic for all variables thus becomes smaller than the critical values under 1%, 5% and 10% significance levels respectively, therefore we can reject the Null Hypothesis of non-stationarity. The more the ADF statistic moves towards negativity, the stronger the rejection of the hypothesis that there is a unit root problem.

4.3.0 THE REGRESSION EQUATION

The regression equation is the algebraic formula for the regression line, which states the mathematical relationship between the independent and the dependent variables. We can use the regression line to estimate the value of the dependent variable for any value of the independent variable. The stronger the relationship between the independent and dependent variables, the closer these estimates will come to the actual score that each case has on the dependent variable. The results of our regression analysis will be useful in predicting values of the dependent variable beyond the time period in which the model is estimated.

Following Romer (1990), final output is a function of human capital used in production, the amount of labor, and total physical capital. We propose to retain the Cobb-Douglas form of the production function but to use our data on labour quality to measure human capital directly using the same specification as that of Hall and Jones (1999) and Bils and Klenow (2000). In contrast to their approach, which imposes human capital productivity from other sources, we allow the micro data to assess the productivity of educated labour. This has the advantage of allowing the data to determine if the returns to skills are higher with increase in education. To estimate our regression model for y, we use data over the period 1965 to 2005.

The model specification is:

$$\Delta \ln(y_t) = \beta_0 + \beta_1 \Delta \ln(k_t) + \beta_2 \Delta \ln(s_t) + \beta_3 \Delta \ln(u_t) + \beta_4 \Delta \ln(f_t) + \beta_5 \Delta \ln(i_t) + \beta_6 \Delta \ln(l_t) + \varepsilon_t$$

where ln(y) is the natural logarithm of output per worker, ln(k) is the natural logarithm of capital intensity, ln(s) is the natural logarithm of average human capital attained in secondary and training level while ln(u) is that of human capital attained in higher education. Ln(f) is the natural logarithm of finance, ln(i) is natural logarithm of direct foreign investment, ln(l) is natural logarithm of land and ε is the error term. Note we take natural logarithm of the data before differencing since capital intensity is exponentially trending, and then all variables are regressed in their first order derivatives to give the elasticities for each variable. The results are presented in table 4.

Table 4: Estimation Results

DEPENDENT VARIABLE: Output per Worker				
VARIABLE	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
Constant	0.079413	0.020831	3.812249	0.0006
Capital Intensity	0.019714	0.022707	0.868202	0.3916
Average Secondary Education	-0.220160	0.172594	-1.275594	0.2110
Average Higher Education	-0.148794	0.053015	-2.806636	0.0083
Finance	-0.106165	0.124917	-0.849887	0.4015
Direct Foreign Investment	0.291018	0.112345	2.590388	0.0142
Land	-0.572467	0.465799	-1.229000	0.2278
R-squared	0.422705	Mean dependent var		0.104475
Adjusted R-squared	0.317742	S.D. dependent var		0.065775
S.E. of regression	0.054329	Akaike info criterion		-2.829879
Sum squared resid	0.097405	Schwarz criterion		-2.534325
Log likelihood	63.59757	F-statistic		4.027187
Durbin-Watson stat	2.503219	Prob(F-statistic)		0.003905

Table 4 above presents results of our regression in elasticities for all variables. We only interpret the t values for the predictor variables ignoring that for the constant. The explanatory variables that turned out to be statistically significant under 5% level of significance are average higher education and direct foreign investment. The rest of the explanatory variables were found not to be statistically significant. Next we look at the signs of the coefficients for the explanatory variables: all are negative except those of direct foreign investment and capital intensity. An additional unit of capital intensity will cause a 2% increase in output per worker, while a unit increase in direct foreign investment will cause a 29% increase in output per worker. The rest of the negative signs depict negative marginal productivity of the variables. The co-efficient of determination, $R^2 = 0.42$. This statistic gives the ratio of explained variation to total variation, converting the 0.42 to a percentage we can interpret this as saying that approximately 42% of the variation in output per worker can be explained by capital intensity, average secondary and higher education, finance, direct foreign investment and land. The unexplained variance of 58% is attributed to Total Factor Productivity.

The Durbin-Watson coefficient is a test for autocorrelation, that is, it tests the time series assumption that error terms are uncorrelated. The Durbin-Watson coefficient tests only first-order autocorrelation (lag t-1). The value of Durbin-Watson coefficient ranges from 0 to 4. A value of 2 indicates no autocorrelation; 0 indicates positive autocorrelation; and 4 indicates negative autocorrelation. Our Durbin-Watson coefficient of 2.5 from our results is not conclusive though it leans toward absence of autocorrelation. It therefore makes it necessary to make a follow up on this further in the chapter using the Breusch-Godfrey LM Test of Serial Correlation. Finally in the interpretation of this output, we put together the regression coefficients and the constant term to write the equation of the line of regression as:

Δ ln(Output per Worker) = 0.08 + 0.02 Δ ln(Capital Intensity) - 0.22 Δ ln(Average Secondary Education) - 0.15 Δ ln(Average Higher Education) - 0.11 Δ ln(Finance) + 0.29 Δ ln(Direct Foreign Investment) - 0.57Δ ln(Land)

4.4.0 HYPOTHESIS TESTS

The assumptions required for utilizing a regression equation are the same as the assumptions for the test of significance of a correlation coefficient. The variables should be normally distributed, the relationship between the dependent and independent variables is linear, and that the variance of the values of the dependent variable is uniform for all values of the independent variables (equality of variance).

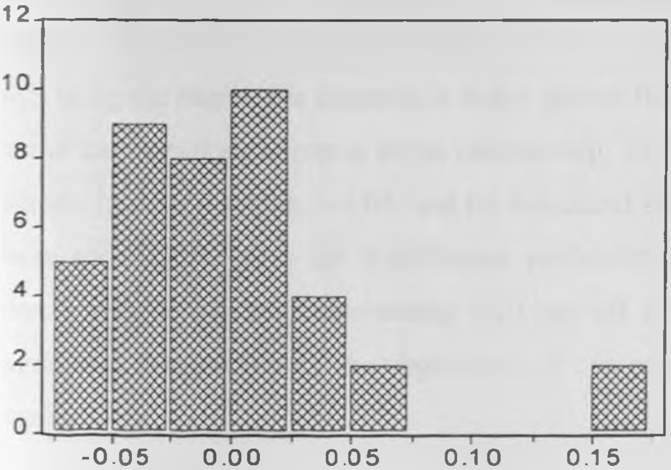
4.4.1 Test of Linearity

The test of linearity is a diagnostic statistical test of the null hypothesis that the linear model is an appropriate fit for the data points. The desired outcome for this test is to fail to reject the null hypothesis. If the probability for the test of statistic is less than or equal to the level of significance for the problem, we reject the null hypothesis, concluding that the data is not linear and the regression analysis is not appropriate for the relationship between the dependent and independent variables. For this, we refer back to table 1 and observe the correlation coefficient which is also a test of linearity statistic. The coefficient is greater than the level of significance of 0.05 for all independent variables, thus we fail to reject the null hypothesis and conclude that we satisfy the assumption of linearity.

4.4.2 Test of Normality

The test requires that the combined distribution of both the dependent and independent variables be normally distributed. It is usually assumed that the variables are normal if each variable is normally distributed, so this assumption is tested by either checking the normality of each variable or normality of residuals. From figure 2 below, the probability that the distribution of the variables is non-normal is nil and lower than the Jarque-Bera statistic, thus the conclusion that the null hypothesis of normality should not be rejected. It also shows that the distribution is skewed to the right.

Figure 8: Histogram-Normality Test



Series: Residuals	
Sample 1966 2005	
Observations 40	
Mean	1.73E-17
Median	-0.009521
Maximum	0.169479
Minimum	-0.073981
Std. Dev.	0.049976
Skewness	1.578137
Kurtosis	6.463083
Jarque-Bera	36.59168
Probability	0.000000

*Note: *Not Reject the Null Hypothesis of Normality under 5% level of significance*

4.4.3 Test of Homoskedasticity

Homoskedasticity (equality of variances) means that the points are evenly dispersed on either side of the regression line for the linear relationship. The null hypothesis is that the variance (dispersion) is equal or is homoskedastic. When the variance of the disturbance is not constant, then heteroskedasticity occurs. Heteroskedasticity will bias the variance of the estimated parameters and as a result, the t-values for our estimated coefficients cannot be trusted. We use the white's heteroskedasticity test. If the probability of the test statistic is greater than 0.05, we do not reject the null hypothesis and conclude that the variances are equal. This is the desired outcome. If the probability of the test statistic is less than or equal to 0.05, we conclude the variances are different and the regression analysis is not the best fit for the relationship between the dependent and independent variables.

Table 6: White Heteroskedasticity Test

F-statistic	1.160138	Probability	0.353553
Obs*R-squared	9.216333	Probability	0.324376

$nR^2 > \chi^2$; reject alternative hypothesis of heteroskedasticity

4.4.4 Hypothesis Test of R^2

The purpose of the hypothesis test of R^2 is a test of the applicability of our findings to the population represented by the sample. The hypothesis test of R^2 is a test of whether or not R^2 is larger than zero in the population. We interpret the coefficient of determination R^2 as the reduction in error attributable to the relationship between the variables. The test statistic is an ANOVA F-test which tests whether or not the reduction in error associated with using the regression equation is really greater than zero. The ANOVA table gives a test of the overall significance of the relationship. To interpret the table we refer to the F statistic in table 4 which is 4.03, and its associated significance probability 0.004 which more specifically gives the significance probability of the regression. This figure is clearly well below the conventional 0.05 cut off significance level. Thus we have a significant relationship in the regression of our explanatory variables on output per worker.

4.4.5 Partial Test of Statistical Significance

Our hypothesis in chapter three was to determine whether education significantly explains variances in output per worker. Our coefficients of interest from the estimated equation are those measuring human capital productivity, which are β_2 and β_3. We use the Wald test to test the Null Hypothesis that the two coefficients are equal to zero; hence test H_0: $\beta_2=0$ and $\beta_3=0$.

Table 5: The Wald Test

Null Hypothesis:	$\beta_2=0$		
	$\beta_3=0$		
F-statistic	5.733800	Probability	0.007016
Chi-square	11.46760	Probability	0.003235

NB: reject the null hypothesis of zero value

The probability values fall below the 0.05 significance level thus indicating that it would be wrong to reject the null hypothesis that our variables of interest can assume a zero value. This backs up the estimation results in table 4 that show marginal productivity of human capital in Kenya is negative.

4.4.6 Breusch-Godfrey LM Test of Serial Correlation

Autocorrelation is the serial correlation of error terms for estimates of a time series variable, resulting from the fact that the value of a datum in time t in the series is dependent on the value of that datum in time t-1 or some higher lag. Autocorrelation can be detected visually by examining a regression line scatterplot. Distances from the regression line to the actual values represent error. The Durbin-Watson Statistic reported in table 4 above casts doubts on whether serial correlation is there or not in the residuals of the estimated equation. If uncorrected, serial correlation in the residuals would lead to incorrect estimates of the standard errors and invalid statistical inference for the coefficients of the equation. We therefore perform a Breusch-Godfrey test for serial correlation in the residuals and the results are presented in table 7.

Table 7: Breusch-Godfrey Serial Correlation LM Test

F-statistic	5.11E+28	Probability	0.000000
Obs*R-squared	40.00000	Probability	0.000000

NB: Not reject the null hypothesis of no serial correlation

"Obs*R-squared" is the LM test for the null hypothesis of no serial correlation. A high probability value signifies presence of a strong serial correlation in the residuals while a low probability value signifies weak serial correlation. From our results above, the probability of serial correlation presence is nil thus we do not reject the null hypothesis of no serial correlation.

CHAPTER FIVE

5.0.0 CONCLUSION

In the recent past, the phenomenal growth and increased activity in the Kenyan economy have generated greater interest among researchers, government agencies and the general public. Among issues of much interest have been the effects of macroeconomic variables on upward growth rate of GDP. This paper uses a model derived from endogenous growth theory to estimate the role of human capital among other sources of growth. The empirical model specifies output per worker as a function of human capital per worker, capital intensity, finance, direct foreign investment, land and total factor productivity growth. Choosing and finding available proxies for human capital constitutes a serious obstacle for research in testing the endogenous growth model for Kenya. The study employed the OLS estimation technique to estimate a single equation with output per worker as the dependent variable and explanatory variables as capital intensity, human capital, finance, direct foreign investment, land and total factor productivity growth.

The results of the estimation indicate that the endogenous growth model does not predict well in that output per worker was found to be negatively correlated to the growth in human capital (level of skill) employed per worker. Also, the values of the coefficients are quite low denoting a relatively weak correlation between output per worker and human capital. Also, Kenya's output per worker is relatively more responsive to increase in human capital attained through higher education than through secondary education, and is highly responsive to increase in direct foreign investment compared to all other explanatory variables. However, these results generally show negative per worker labor productivity. Therefore, labor training and general education of the workforce is not an effective way to increase productivity in the economy.

5.1.0 Policy Implications

The results of the analysis show that output per worker growth in Kenya during 1965-2005 was driven primarily by Total Factor Productivity with less role of factor accumulation. The pickup in growth in the late 1990s to early 2000s was made possible by an improvement in TFP growth mainly resulting from adjustment of IMF-supported programs to be on track. In addition, investment to GDP ratio in Kenya remains low and would need to be boosted. The other issue is that of high population growth rate that is negatively impacting on natural resources which are not only limited but also under-utilised. Using the results of other studies as a guide, we argue that the factors that can positively influence TFP growth in Kenya include human capital development, trade liberalization to boost direct foreign investment and a favourable macroeconomic policy environment.

Our results show that higher education makes a significant contribution toward output growth. Regarding the role of government policy in today's economy, targeting outputs in the production process other than targeting selected inputs seems to be a definite dimension especially in the developed world. Besides targeting relative certainty regarding markets and products in the Kenyan economy, the appropriate government policy response is to target outputs. Industries and firms could be promoted through government programs as it is with Japan. It is also important to base the economy less on the traditional inputs of land, labor and capital and to focus more on the input of knowledge. This would result in decreased demand for less skilled workers while at the same time increasing demand for skilled workers capable of dealing with uncertainty in the market. This calls for a policy that creates an environment facilitating the creation and commercialization of knowledge.

5.2.0 Areas for Further Research

Results from this study are robust to various changes in the modeling framework although more extreme variations in methods of measurement could be tested. Given the present activity of other researchers in the area of measuring and valuing human capital stocks, there is optimism that some consensus about the value of the human capital stock may soon emerge. Because the composition and structure of the Kenyan economy has different sectors, it would be appropriate to do a similar study for specific sectors and see the response to output resulting from increased level of skill, as well as contributions of other variables. For instance, the composition and structure of output of domestic manufacturing may increase in value added due to high level of human capital of the manufacturing sector which will eventually increase the value added from export of processed goods. It is, however, difficult to conclude that an increase in the level of human capital alone will guarantee the expansion of export of products such as roasted coffee, chocolate, wine and spices. It would also add knowledge if a similar study was analysed for different periods depending on the theme of each period. For instance, a study to find out contributions of sources of growth in the post-independence vs pre-independence periods, or periods under different regimes, or even break up the study into decades.

5.3.0 Limitations of the Study

A major limitation of the study is the problem concerning the data in the Kenyan economy which lacks categorical reliability. By using different sources for data used, it was apparent that different values would be presented for the same variable. To maintain consistency, we relied on data published by the Government agencies. Another was limitation of time being the fact that this study can be very wide, but due to constrictions on academic timing would not be exhaustive.

Bosworth and Collins (1996) have argued that the growth accounting framework is a useful tool to understand growth experiences in countries. The same authors have, however, noted the limitations of this methodology. A key weakness relates to the interpretation that the measured residual from the growth accounting exercise represents TFP growth. In practice, in addition to providing a measure of gains in economic efficiency, the residual may also reflect a number of other factors, including political disturbances and conflicts, institutional changes, droughts, external shocks, changes in government policies, and measurement errors. This limitation is particularly important for sub-Saharan African countries which include Kenya, caught up in conflicts and subject to significant drought-related and external shocks. Another problem with the growth accounting framework is that it does not decompose properly growth stemming from the exploitation of natural resources. If a new oil field or diamond mine comes on stream it will tend to show up more as a boost in TFP than factor accumulation.

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