Issue 6
November 2012

Analysis of Economic Growth in Kenya: Growth Accounting and Total Factor Productivity

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Growth in output per worker has traditionally been modelled as being driven by physical capital accumulation while assuming that technological progress is exogenous. However, this factor has been unable to explain growth sufficiently and as such, recent thinking on growth gives prominence to other factors such as technological advancement, human capital and, research and development. This has led to the new growth models which demonstrate how long-run growth can be generated without overemphasis on exogenous technological changes. This paper, therefore, zeroes in on the contribution of the classical factors and technological advancement to output by carrying out growth accounting analysis. The baseline/theoretical framework for the study is the neoclassical production function from which the residual is calculated. Growth accounting analysis of the Kenyan scenario shows accumulation of the classical inputs, capital and labour, to be more important than total factor productivity growth with contributions of 71.4%, 25% and 3.6% respectively. The paper also shows that total factor productivity is influenced by openness of the economy as well institutions and terms of trade with elasticities being 0.3136, -0.3822 and -0.3352 respectively. From this analysis, it can be concluded that the Kenyan economy is propelled by factor accumulation and at the current level of development, the economy should concentrate more on policies that raise factor supplies for enhanced output.

Keywords: *Total Factor Productivity, Growth Accounting*

Introduction

Different countries experience acute differences in their productive capacities overtime with some having high economic growth and others not growing at all or even deteriorating. With this scenario, policy makers' intention is to promote rapid and sustainable economic growth. Various theoretical and empirical models have come up to explain the growth rate of a country's per capita real GDP but disagreements still exist on the determinants and channels of economic growth.

Traditionally, explanation of growth has been narrow as it has only considered physical capital accumulation as the principal factor and then effective labour, with technological progress being viewed as exogenous. In the Solow (1956) model, a rise in savings will decrease technological progress leading to a steady state growth (convergence) hence a temporary growth effect. This implies that the traditional growth model emphasizes capital accumulation as well as diminishing returns. However, the gap between the poor and the rich countries has widened over time hence this neoclassical growth model, when empiricised, shows that capital accumulation cannot account for an enormous part of long-run growth. This has led researchers to concentrate on the concept of residual (which is synonymous to TFP or technological advancement).

Theoretical postulations and empirical studies have vividly suggested that sustained output growth dictates need for routine growth in TFP thereby underscoring the importance of TFP in growth analysis. In support of this view, Bruton (1995) indicates that countries that are rich today are those in which TFP growth has been in place for a century or more. He points out that growth strategy must, therefore, put in place and maintain a policy environment that ensures continued increase in productivity in many sections of the economy.

Different economists have attempted to explain growth using different approaches, either by accumulation of inputs, TFP growth or factor interaction/efficiency enhancement. In 1950s, economists attributed almost all the change in output per hour worked to technological change, for instance Schmookler (1952) and Abramovitz (1956). Abramovitz (1956) in a study of the US growth finds that only 10 percent of the USA output growth from 1869-1978 and 1944-1953 could be attributed to factor growth. Therefore, 90 percent of the US productivity growth was TFP driven. He comments as: "This result is surprising…since we know little about the causes of productivity increase, the indicated importance of this element may be taken to be some sort of measure of our ignorance about the causes of economic growth (Abramovitz, 1956, P. 11)". Similarly, Solow (1957) finds that the accumulation of physical capital accounts for only about 12 percent of output growth per hour worked in the US for the 1900-1949 period and the remaining 88 percent is attributed to TFP growth. In a similar study on the US, Easterly and Levine (2001) conducted growth accounting and found that on average, TFP accounts for around 60 percent of output per worker growth in the US.

In a study on developing countries, Elias (1990) carries out growth accounting analysis for several Latin American countries and shows that TFP growth accounts for around 30 percent. King and Levin (1994) growth accounting analysis for 100 countries finds that capital per person accounts for 40 percent of the growth of output per person while the rest is accounted for by TFP.

Amin (2002) investigates Cameroon and observes that the contribution of factor input is greater than the contribution of TFP with capital input contributing more than labour but the contribution depended on the period under consideration. Tahari et al. (2004) study average real GDP growth in the SSA between 1960 and 2002 and argue that growth was low in the 1990s and was mainly driven by factor accumulation but not TFP.

The analysis of TFP, therefore, is important especially in the LDCs because the share of TFP in GDP growth varies a lot and at times accounts for 33 - 50 percent and this share has grown over time for countries with high or moderate GDP growth (Nehru and Dhareshwar, 1993). Prescott (1998) says that a greater portion of cross-country per capita differences has to do with TFP. This paper, as such, examines growth accounting in Kenya in order to see if the channel of growth is accumulation of factors or it is technological advancement. It also goes further to examine the determinants of TFP.

Methodology

Theoretical Framework

Generally, there are two approaches used in measuring TFP. The first one involves the use of an aggregate production function for econometric analysis while the second one is the income/growth accounting approach (Ritter, 1988; Elias, 1990 and Barro, 1998).

The basis of this paper is the Solow (1956) model. The Solow model assumes that the rate of saving, *s*, population growth, *n*, and technological progress, *g*, are exogenously determined. The implication of this is that the number of effective units of labour, $A(t)L(t)$, grows at rate n + g. In this model, the inputs are paid their marginal products hence constant returns to scale (henceforth CRS). The model, it only considers two inputs, capital and labour. Assuming a Cobb-Douglas production function as

$$Y(t) = K(t)^{\alpha} \left(A(t)L(t)\right)^{1-\alpha} \text{, with } 0 < \alpha < 1 \tag{2.1}$$

where *Y* is output, *K* is physical capital stock, *L* is labour and *A* is the level of technology. *L* and *A* are assumed to grow exogenously at rates *n* and *g* respectively. For the labour force growth, the following exponential function is used

$$L(t) = L(0)e^{nt} \tag{2.2}$$

Taking natural logarithm of (2.2) and differentiating it with respect to time, labour grows according to

$$\frac{dL(t)}{dt} = \frac{dlnL(t)}{dt} = \frac{\dot{L}(t)}{L(t)} = \frac{nL(0)e^{nt}}{L(0)e^{nt}} = n \tag{2.3}$$

For the growth of technology, one uses the exponential model below

$$A(t) = A(0)e^{gt} \tag{2.4}$$

Similarly, taking natural logarithm of (2.4), which is the technological growth function, and differentiating with respect to time, technology grows according to

$$\frac{dA(t)}{dt} = \frac{dlnA(t)}{dt} = \frac{\dot{A}(t)}{A(t)} = \frac{gA(0)e^{gt}}{A(0)e^{gt}} = g \tag{2.5}$$

This means that the number of effective units of labour, $A(t)L(t)$ grows at rate *n* + *g*. Assuming equation (2.1) is of a general form $\left[Y(t) = F\left(K(t), A(t)L(t)\right)\right]$, the assumption of CRS enables one to get the intensive form model as

$$\frac{Y(t)}{A(t)L(t)} = F\left(\frac{K(t)}{A(t)L(t)},1\right)$$ hence,

$$y = f(k) \tag{2.6}$$

where k is the stock of capital per effective unit of labour ($k = K/AL$) and y is the level of output per effective unit of labour ($y = Y/AL$).

Turning back to the specific function as in (2.1) and dividing through by $A(t)L(t)$ gives

$$\frac{Y(t)}{A(t)L(t)} = \left(\frac{K(t)}{A(t)L(t)}\right)^{\alpha}\left(\frac{A(t)L(t)}{A(t)L(t)}\right)^{1-\alpha} = k^{\alpha} \tag{2.7}$$

The model further assumes that a constant proportion of output, s, is invested. With $k = K/AL$, differentiating this k function with respect to time and using the quotient rule gives the evolution of k as

$$\frac{dk}{dt} = \dot{k} = \frac{AL\frac{dK}{dt} - K\left(L\frac{dA}{dt} + A\frac{dL}{dt}\right)}{(AL)^2}$$

$$\dot{k} = \frac{AL\dot{K} - KL\dot{A} - KA\dot{L}}{(AL)^2}$$

$$\dot{k} = \frac{AL\dot{K}}{ALAL} - \frac{KL\dot{A}}{ALAL} - \frac{KA\dot{L}}{ALAL}$$

$$\dot{k} = \frac{\dot{K}}{AL} - \frac{\dot{A}}{A}\frac{K}{AL} - \frac{\dot{L}}{L}\frac{K}{AL}$$

Letting $\frac{\dot{A}}{A} = g$, $\frac{\dot{L}}{L} = n$ and $\dot{K} = sY - \delta K$, with δ being the depreciation rate

$$\dot{k} = \frac{sY}{AL} - \frac{\delta K}{AL} - \frac{\dot{A}}{A}\frac{K}{AL} - \frac{\dot{L}}{L}\frac{K}{AL}$$

$$\dot{k} = sy - \delta k - gk - nk = sy - \left(n + g + \delta\right)k$$

As shown earlier, $y = f\left(k\right)$ hence

$$dk/dt = \dot{k}(t) = sy(t) - (n + g + \delta)k(t)$$ where $y = Y/AL$

or $dk/dt = \dot{k}(t) = sf(k) - (n + g + \delta)k$ (2.8)

The model takes *s, n, g* and δ to be exogenously determined.

The $\dot{k}$ equation states that the rate of change of the capital stock per unit of effective labour is the difference between actual investment per unit of effective labour ($\left[sf(k)\right]$), that is, the fraction of output invested *(s)* and *(δ + g + n) k* which is the break-even investment (the amount of investment that must be done just to keep k at its existing level). *AL* is growing and so *k* must also grow at *n + g* to hold *k* steady because if $sf\left(k\right) > \left(\delta + g + n\right)$, then *k* is rising. The reverse is true if the inequality is changed. As long as the production function is well behaved, the economy approaches a steady state over time where $dk/dt = \dot{k} = 0$. Therefore equation (2.8) implies that *k* converges to a steady-state value k^*. Substituting (2.7) into (2.8), one gets

$sk^{*\alpha} = (n + g + \delta)k^*$, *or* $k^* = \left(\frac{s}{n + g + \delta}\right)^{1/(1-\alpha)}$ (2.9)

In the steady state, income per efficiency unit, $y^* = f(k^*)$, is constant.

As conventionally expected, the steady-state capital-labour ratio is related positively to the rate of saving and negatively to the rate of population growth. Substituting (2.9) into the production function and taking logs, the steady-state income per capita is

$$ln\left[\frac{Y(t)}{L(t)}\right] = lnA(0) + gt + \frac{\alpha}{1-\alpha}ln(s) - \frac{\alpha}{1-\alpha}ln(n+g+\delta). \quad (2.10)$$

$A(0)$ reflects technology as well as resource endowments, climate, institutions (initial technology) and therefore may vary significantly across countries. gt represents the exogenous growth in technology and it varies with time. Hence

$$lnA(0) = a + \varepsilon \quad (2.11)$$

where a is a constant and ε is a country-specific shock. Thus, log income per capita at time zero is

$$ln\left[\frac{Y}{L}\right] = a + \frac{\alpha}{1-\alpha}ln(s) - \frac{\alpha}{1-\alpha}ln(n+g+\delta) + \varepsilon \quad (2.12)$$

It is assumed that the rates of saving and population growth are independent of country specific factors (ε) shifting the production function.

In order to calculate the residual, an expression/framework for the growth rate of output in terms of the growth rates of capital and labour inputs is used. Assuming a neoclassical production function to be

$$Y = F(K, L, t) \quad (2.13)$$

where *Y* is output, *K* is capital, *L* is labour and *t* is time.
Taking the logarithm of the function and differentiating it with respect to time

$$\frac{dY/dt}{Y} = \frac{(dF/dK)(dK/dt)}{F} + \frac{(dF/dL)(dL/dt)}{F} + \frac{dF/dt}{F} \quad (2.14)$$

Multiplying the capital and labour components on the right hand side of equation (2.14) with K/K and L/L respectively

$$\frac{\dot{Y}}{Y} = \frac{(dF/dK)}{F}\frac{K}{K}\dot{K} + \frac{(dF/dL)}{F}\frac{L}{L}\dot{L} + \frac{dF/dt}{F} \quad (2.15)$$

In equation (2.15), $\left(dF/dt\right)/F$ represents the shift of the production function and is therefore the TFP or technical progress. Using the conventional notation A to represent this shift component yields

$$\frac{\dot{Y}}{Y} = \frac{(dF/dK)K}{F}\frac{\dot{K}}{K} + \frac{(dF/dL)L}{F}\frac{\dot{L}}{L} + \frac{\dot{A}}{A} \qquad (2.16)$$

Rearranging equation (2.16), the residual is given as

$$\frac{\dot{A}}{A} = \frac{\dot{Y}}{Y} - \left(\frac{(dF/dK)K}{F}\frac{\dot{K}}{K} + \frac{(dF/dL)L}{F}\frac{\dot{L}}{L}\right) \qquad (2.17)$$

where $\left[\left(dF/dK\right)K\right]/F$ and $\left[\left(dF/dL\right)L\right]/F$ are conventionally the shares or elasticities of the respective inputs in total output and can be represented by βK and βL respectively. As such, TFP is given as

$$\text{TFP} = \frac{\dot{A}}{A} = \left[\frac{\dot{Y}}{Y} - \left(\beta_K \frac{\dot{K}}{K} + \beta_L \frac{\dot{L}}{L}\right)\right] \qquad (2.18)$$

$\dot{Y}/Y$ is the rate of change in output, $\dot{K}/K$ is the rate of change of real gross fixed capital and L/L is the rate of change of labour.

On the TFP econometric approach, this study is based on a model used by Upadhyay and Miller (2000) to study the effects of openness, trade orientation and human capital on TFP growth for pooled DCs and LDCs. They point out that treating all the determinants of output as inputs may be inaccurate because many determinants affect output implicitly by influencing TFP growth. They calculate TFP and estimate its determinants as

$$lntfp_t = \beta_1 + \beta_2 lnH_{it} + \beta_3 lnx_{it} + \beta_4 lntot_{it} + \beta_5 lnpd_{it} + \beta_6 ln(1+\pi)_{it}$$
$$+\beta_7 ln\sigma tot_{it} + \beta_8 ln\sigma x_{it} + \beta_9 \sigma pd_{it} + \beta_{10}\sigma\pi_{it} + \sum \beta_{10+i} time + u_t \qquad (2.19)$$

where

i and *t* subscripts stand for cross-sectional and time series aspects of the analysis.

tfp = total factor productivity

x = ratio of exports to GDP

tot = terms of trade
pd = local price deviation from ppp (trade orientation)
π = inflation rate
σ = standard deviations over the five periods
time = time dummy to capture fixed effects over time
ut = normally distributed stochastic variable

The Models

The existence of Solow residuals portray the fact that capital and labour accumulation do not fully explain output growth despite the neoclassical model emphasizing factor accumulation and neglecting differences in productivity growth and technological change captured by the residual. Assuming the following Cobb-Douglas production function

$$Y_t = A_t K_t^{\alpha} L_t^{1-\alpha} \tag{2.20}$$

where Y_t denotes real GDP, A_t is TFP, K_t is total capital and L_t is total labour used in the production process. Applying the rules for deriving proportional changes on equation (2.20) yields

$$\frac{\Delta Y_t}{Y_t} = \alpha \frac{\Delta K_t}{K_t} + (1-\alpha)\frac{\Delta L_t}{L_t} + \frac{\Delta A_t}{A_t} \tag{2.21}$$

Equation (2.21) is the key equation in growth accounting and it says that the percentage change in output is the sum of a fraction *(α)* of a percentage change in capital, a fraction *(1-α)* of a percentage change in labour and a percentage change in TFP. Specifically, the parameters *α* and *(1-α)* in (2.21) are input shares/elasticities and α is obtained as

$$\alpha = \left(\Delta Y_t / \Delta K_t\right)\left(K_t / Y_t\right) \tag{2.22}$$

The study also examines the factors behind TFP since some view is that some variables affect growth through it. Nelson and Phelps (1966) point out that treating human capital simply as another factor in growth may mis-specify its role hence its effect may as well be captured through technological advancement. This view is also shared by Benhabib and Spiegel (1994) and, Upadhyay and Miller (2000). TFP is calculated as a residual and the estimation model is

$$lnTFP_t = \beta_0 + \beta_1 lnED_t + \beta_2 lnOPE_t + \beta_3 FDIED_t + \beta_4 lnTOT_t + \beta_5 lnINST_t + u_t, \quad (2.23)$$

where

TFP = total factor productivity
ED = human capital (secondary school enrolment)
OPE = openness [(exports + imports)/*GDP*]
FDIED = *FDI*/*GDP* interacted with *ED* (technology spillover proxy)
TOT = terms of trade
INST = world country freedom ratings (proxy for institutions)

Variable, Measurement and Data Sources

Real Gross Domestic Product (RGDP) - This paper uses real GDP and real GDP per worker and the data on real GDP is obtained from the International Finance Statistics (IFS) Year Book published yearly by the International Monetary Fund (IMF).

Physical Capital (TKKIP) - As necessitated by the calculation of TFP, this study requires and uses gross fixed capital stock as opposed to investment-GDP (I/GDP) ratio used in many studies. Capital is measured as real total capital stock but for more specific analysis, it is also disaggregated into private and public capital stock. The data are sourced from an Analytical Data Compendium by Ryan, KIPPRA, 2002.

Wage Employment (WE) - This study uses workforce/wage employment because the study uses a production function and therefore workforce becomes more appropriate (Hoeffler, 2002). The data are sourced from the Statistical Abstracts published annually by the Government of Kenya.

Total Factor Productivity (TFP) - TFP analysis is necessary because of the large portion of output that is not explained by the classical inputs (capital and labour). Normally, TFP is not readily available as compared to variables such as Y_t, K_t, and L_t. Accordingly, TFP is normally obtained as a residual.

Openness (OPE) - This variable is measured as the ratio of imports plus exports to GDP $\left[(M+X)/GDP\right]$ although many studies have shown no significant variation when *X*/*GDP* or *M*/*GDP* is used. The data series is acquired from the IFS Year Book published annually by the IMF.

Human Capital (ED) - In the absence of sufficient average education data, this study uses gross secondary school enrolment ratio and the data originated from the World Development Indicators (WDI) published yearly by the World Bank.

Terms of Trade (TOT) - Terms of trade refers to the price index of a country's exports relative to the price index of its imports $\left(TOT = P_X / P_M\right)$. Terms of trade affect output because a rise in the TOT means that PX has gone up relative to PM. With the same physical quantity of exports, the country can now import more goods. Kenya has traditionally faced deteriorating terms of trade because it mainly exports the lowly priced primary products but imports the expensive manufactured goods and oil. The data on terms of trade index were sought from the World Tables.

Technology Spillovers (FDIED) – Countries manifest a lot of interdependence by extensive exchange of goods, capital and ideas. As such, high technology products from the DCs can be improved or imitated in the LDCs. This spill-over effect is captured by the interaction between FDI and human capital which may be taken to indicate inflow of technology, since FDI inflows create potential spill-overs of knowledge to the local labour force, while the level of human capital determines the ability to absorb the potential spill-over benefits. FDI data were acquired from the WDI and measured as ratio of GDP.

Institutions (INST) - Kenya is ranked amongst the most corrupt countries in the world and this, as an institution, is bound to affect growth because resources face leakages. Investigations find that better institutions bolster transitional growth (Grier and Tullock, 1989; and Sachs and Warner, 1997). This variable is captured by the Annual Freedom in the World Country Scores which provides indices for political rights (PR) and civil liberties (CL) and then uses a scale of one to seven to determine the status of a country with one representing the highest degree of freedom and seven the lowest. This study uses the average of PR and CL for each year to proxy the institutions' variable since political freedoms, civil liberties and the economic progress are inseparable and move together. The data are sourced from the Freedom in the World Book and the Journal of Freedom at Issue (1972-2003).

Analysis Techniques

Total factor productivity, as indicated earlier, is not readily available as

Journal of Business Management and Applied Economics
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compared to variables such as Y_t, K_t, and L_t. Accordingly, TFP is conventionally obtained as a residual in the following form

$$\frac{\Delta A_t}{A_t} = \frac{\Delta Y_t}{Y_t} - \alpha \frac{\Delta K_t}{K_t} - (1-\alpha)\frac{\Delta L_t}{L_t} \quad \text{and} \quad \alpha = \left(\Delta Y_t / \Delta K_t\right)\left(K_t / Y_t\right) \tag{2.24}$$

The growth accounting procedure is commonly implemented using the spreadsheet. Having obtained data on Y_t, K_t, and L_t, one then computes the series for ΔY_t and ΔK_t and uses equation (2.24) to obtain the time series for α_t. The next step is to compute the annual average of α_t to obtain α which is consequently used to determine the contribution of each factor to output (growth accounting). The other step is to compute the time series for $\Delta Y_t / Y$, $\Delta K_t / K_t$ and $\Delta L_t / L_t$ and their annual averages after which these annual averages are plugged into equation (2.24) to obtain the $\Delta A_t / A_t$ (TFP).

On the other hand, the TFP model is composed of variables which are tested for stationarity (determined using the ADF and Zivon Andrews tests) after which the non-stationary variables are differenced so as to have a balanced equation and then OLS estimation is applied.

Empirical Analysis and Presentation of Results

Growth accounting

Growth accounting is a very important analysis because it gives a clear picture on what part each input plays in explaining output there by giving policy makers a basis for policy prescription and conquently a tool for economic management. Using the last column of Table 1, capital accumulation accounts for 71.4 percent of output growth during the 1970-2003 period while work force accounts for 25 percent and TFP growth accounts for only 3.6 percent of output.

Following a common practice by many researchers, such as by Bigsten and Durevall (2006), this study also involves calculation of the contribution of TFP growth assuming CRS and using various combinations of elasticities (0.5, 0.5), (0.3, 0.7) and (0.2, 0.8) for capital stock and workforce respectively. Kenya, being a less developed country and labour abundant, the last two combinations could be expected to make more empirical sense but in the final analysis, the three combinations of elasticities produced TFP growth of 4.4, 4.7 and 4.9 percent respectively for the 1970-2003 period. The overall exercise, therefore, points to the fact that factor accumulation was the channel of growth for Kenya for the duration considered.

The results for disaggregated capital stock in Table 2 show that private capital accounts for 36.2 percent of the output that is explained by total capital [i.e {((0.070/0.138)*0.060)/0.084}*100] while public capital accounts for 35.2 percent of output explained by aggregate capital [i.e {((0.068/0.138)* 0.060)/0.084}*100]. It is important to note that the magnitudes of the average elasticities from growth accounting do not support the assumption of CRS and TFP growth was almost zero over the 1971-2003 period. Individually, this disaggregated analysis in Table 2 shows that private and public capital as well as workforce play a crucial role in determining output in the Kenyan economy with contributions of 83.3, 80.9 and 25 percent respectively but private capital emerges as most important of the inputs while TFP plays no role.

Table 3 gives results from a more detailed analysis of growth accounting whereby the study period is broken down into decades so as to distinctively see the channel(s) of growth for each period. During the 1971-1980 and 2001-2003 periods, growth was mainly explained by capital accumulation and TFP but not workforce accumulation. In the 1981-1990 and 1991-2000 periods, on the other hand, factor accumulation took the centre stage in explaining output but not TFP. For the 2001-2003 period, capital accumulation and TFP explained growth.

Table 4 shows the results of even a deeper analysis of growth accounting where the aggregate capital stock is split into private and public capital stock besides the entire study period being split into four periods. In all the periods, factor accumulation, especially of both types of capital, plays a more important role in determining output while TFP growth has no significant effect.

In conclusion, these results where accumulation of factors is the growth channel are consistent with former findings by Ritter (1988), Elias (1990), Mankiw et al. (1992), Amin (2002), Baier et al. (2002), Onjala (2002), Limam and Miller (2004), Tahari et al. (2004) and, Bigsten and Durevall (2006).

Econometric Analysis of TFP

Analysis of TFP is important because it shows the factors that explain the portion of output that is not accounted for by the classical inputs. Table 5 presents findings from econometric analysis of the TFP models. Following the conventional practice, the results in this table have been generated after the econometric problems are corrected for. The TFP model is composed of both stationary and non stationary variables (determined using the ADF test). Unfortunately, the non-stationary variables have no theory that suggests cointegration. In order to ascertain whether the non-stationarity could have been caused by structural breaks, these variables were once again tested for unit root using the Zivon Andrews test which caters for structural breaks. However, the variables remain non-stationary despite taking care of structural breaks. Therefore, the non-stationary variables are differenced so as to have a balanced equation.

The Ordinary Least Squares analysis is then carried out and the results are presented in Table 5. This table shows that TFP is affected negatively by the terms of trade and institutions. The results indicate that openness affects TFP positively while terms of trade, foreign direct investment and institution have a negative effect.

Some of these findings are consistent with economic theory. Expansion of international trade is expected to boost technological advancement out of either the direct or indirect benefits of trade such as increased consumption, availability of raw materials/intermediate inputs some of which enhance productivity. This finding is supported by former findings by Upadhyay and Miller (2000). On the other hand, deteriorating terms of trade are expected to diminish productivity. This is because most of the country's exports are primary goods and experience poor terms of trade relative to the capital goods from the DCs.

It is interesting to note that the much hyped technological spillover effect (proxied by the interaction between foreign direct investment and human capital) has a negative effect on TFP but this may be understood from the fact that the negative effects of FDI have tended to overwhelm the benefits especially in the LDCs. Most of the FDIs involve inappropriate technology for the LDCs, come with conditions attached such as tax rebates and excessive requirements for profit repatriation. In addition, the technology does not significantly spill to the local workforce since these FDIs come with their expatriates.

Institutions variable's results are as expected because poor institutions in the LDCs lead to poor governance thereby influencing economic performance negatively. This finding is supported by former studies, for instance, Grier and Tullock (1989) find an inverse relationship between GDP growth and political repression in Africa. In another study, Sachs and Warner (1995) investigate the sources of long-run growth and find that better institutions bolster transitional growth. However, human capital and technological spillover have no influence.

Conclusions and Policy Implications

Every nation attempts to raise the welfare of its citizens and this objective cannot be achieved without sufficient economic growth. Kenya, like many LDCs, lacks sufficient resources for the implementation of her projects and as such needs prudent and specific policy prescription for optimal utilization of the resources at hand for enhanced output growth. Considering the outcome of the growth accounting exercise, aggregate capital accumulation is the most important individual factor in explaining output growth (71.4%) followed by workforce accumulation (25%) while TFP accounts for meagre 3.6 percent.

When capital is disaggregated, private capital is most important in accounting for output change followed by public capital and then workforce but TFP has no effect. The results from periodic analysis of TFP lead to different conclusions depending on the period considered except for capital accumulation which is crucial in all periods. Considering factor accumulation vis a vis TFP, accumulation of inputs emerges as more crucial in accounting for output growth and as such the accumulation channel is more important than the productivity channel for the Kenyan economy. The implication here is that policies for investment improvement, both in private and public capital, are crucial for the economy but should be complemented with policies that promote productivity of the labour force/employment.

The results from periodic analysis of TFP lead to different conclusions depending on the period considered except for capital accumulation which is crucial in all periods. Considering factor accumulation vis a vis TFP, accumulation of inputs emerges as more crucial in accounting for output growth and as such the accumulation channel is more important than the productivity channel for the Kenyan economy. The implication here is that policies for investment improvement (capital formation) are crucial for the economy but should be complemented with policies that promote labour force/employment. In conclusion, the results indicating accumulation of factors as the growth channel are consistent with former findings by Ritter (1988), Elias (1990), Mankiw et al. (1992), Amin (2002), Baier et al. (2002), Onjala (2002), Limam and Miller (2004), Tahari et al. (2004) and, Bigsten and Durevall (2006).

Turning to the TFP growth analysis, it is a traditional observation that TFP growth (residual) enlarges with development and cannot be ignored in the long-run. The paper shows that total factor productivity is influenced by openness of the economy as well institutions and terms of trade with elasticities being 0.3136, -0.3822 and -0.3352 respectively. In order to cater for the TFP growth, however meagre it is for Kenya, the results show that the government should enhance economic openness, add value to our exports (to improve terms of trade) and bolster institutions for enhanced TFP growth.

Weaknesses of the Study and Areas of Further Research

The use of workforce has its limitations because it excludes the informal sector whose employment series does not exist. If labour force is used, one also lands into problems because this data set includes the unemployed lot who are searching for employment and therefore they may not be contributing to output in any way.

The study is also at the aggregated/macro level, an aspect which is crucial for externalities. However, it could be complemented by a study at the firm level and if possible a panel data study. Lastly, the study is based on the neoclassical model which is weak because of the unrealistic assumptions upon which it is derived.

APPENDIX

Table 1: Growth Accounting for Kenya Over the Period 1970-2003

Source of Growth (or Input Type)	Input Shares (Average)	Input Growth (Average)	Components	Contribution to Output Growth	Contribu-tion to Output (%)
Total Capital (TKKIP)	*α_3 = 1.28*	*ΔTKKIP/TKKIP = 0.05*	*α3(ΔTKKIP/TKKIP)*	*0.060 (= 1.28 x 0.05)*	*71.4*
Wage Employment (WE)	*α_4 = 0.71*	*ΔWE/WE = 0.03*	*α4(ΔWE/WE)*	*0.021 (= 0.71 x 0.03)*	*25*
TFP			*ΔRGDP/RGDP-α3(ΔTKKIP/TKKIP)-α4(ΔWE/WE)*	*0.003 (= 0.084-0.060-0.021)*	*3.6*
Total Output		*ΔRGDP/RGDP=0.084*			

Table 2: Growth Accounting with Disaggregated Capital for Kenya Over the Period 1970-2003

Source of Growth (or Input Type)	Input Shares (Average)	Input Growth (Average)	Components	Contribution to Output Growth	Contribution to Output (%)
Private Capital (PKKIP)	*α_1 = 1.69*	*ΔPKKIP/PKKIP = 0.04*	*α1(ΔPKKIP/PKKKIP)*	*0.070 (= 1.69 x 0.04)*	*83.3*
Public Capital (PUKKIP)	*α_2 = 0.97*	*ΔPUKKIP/PUKKIP = 0.07*	*α2(ΔPUKKIP/PUKKIP)*	*0.068 (= 0.97 x 0.07)*	*80.9*
Wage Employment (WE)	*α_3 = 0.71*	*ΔWE/WE = 0.03*	*α3(ΔWE/WE)*	*0.021 (= 0.71 x 0.03)*	*25*
TFP			*ΔRGDP/RGDP-α1(ΔPKKIP/PKKIP)-α2(ΔPUKKIP/PUKKIP)-α3(ΔWE/WE)*	*-0.075 (= 0.084-0.070-0.068-0.021)*	*-89.3*
Total Output		*ΔRGDP/RGDP=0.084*			

Table 3: Growth Accounting for Aggregated Capital for Kenya During Different Period

Periods	Source of Growth (or Input Type)	Input Shares (Average)	Input Growth (Average)	Components	Contribution to Output Growth	Output Growth	Contribution to Output (%)	TFP Growth
Period 1 1971-1980	Total Capital (TKKIP) Wage Employment (WE)	α_{1K1} = 1.34972 α_{1L} = -1.2011	ΔTKKIP/TKKIP = 0.085811 ΔWE/WE = 0.045863	α_{1K}(ΔTKKIP/TKKIP) α_{1L}(ΔWE/WE)	0.115821 -0.055086	0.187047	61.9 -29.5	67.5
Period 2 1981-1990	Total Capital (TKKIP) Wage Employment (WE)	α_{2K} = 2.213796 α_{2L} = 1.773167	ΔTKKIP/TKKIP = 0.033752 ΔWE/WE = 0.034479	α_{2K}(ΔTKKIP/TKKIP) α_{2L}(ΔWE/WE)	0.074720 0.061137	0.064554	115.7 94.7	-110.5
Period 3 1991-2000	Total Capital (TKKIP) Wage Employment (WE)	α_{3K} = 0.566621 α_{3L} = 1.994955	ΔTKKIP/TKKIP = 0.031055 ΔWE/WE = 0.01866	α_{3K}(ΔTKKIP/TKKIP) α_{3L}(ΔWE/WE)	0.017596 0.037226	0.018926	93 196.7	-189.7

Period 4 2001-2003	Total Capital (TKKIP) Wage Employment (WE)	α_{4K} = 0.298084 α_{4L} = -0.70266	ΔTKKIP/TKKIP = 0.0502 ΔWE/WE = 0.006307	α_{4K}(ΔTKKIP/TKKIP) α_{4L}(ΔWE/WE)	0.014964 -0.004432	0.021212	70.5 -20.9	50.3

1. The subscript number and letter correspond to the period and the variable input respectively.

Table 4: Growth Accounting for Disggregated Capital for Kenya During Different Periods

Periods	Source of Growth (or Input Type)	Input Shares (Average)	Input Growth (Average)	Components	Contribution to Output Growth	Output Growth	Contri-bution to Output (%)	TFP Growth
Period 1 1971-1980	Private Capital (PKKIP) Public Capital (PUKKIP) Wage Employment (WE)	α1PK = 1.724201 α1PUK = 0.970378 α1L = -1.2011	ΔPKKIP/PKKIP = 0.066096 ΔPUKKIP/PUKKIP = 0.130721 ΔWE/WE = 0.045863	α1PK(ΔPKKIP/PKKIP) α1PUK(ΔPUKKIP/PUKKIP) α1L(ΔWE/WE)	0.113963 0.126849 -0.055086	0.187047	60.9 67.8 -29.5	0.7
Period 2 1981-1990	Private Capital (PKKIP) Public Capital (PUKKIP) Wage Employment (WE)	α2PK = 3.117773 α2PUK = 1.60978 α2L = 1.773167	ΔPKKIP/PKKIP = 0.02537 ΔPUKKIP/PUKKIP = 0.046368 ΔWE/WE = 0.034479	A2PK(ΔPKKIP/PKKIP) α2PUK(ΔPUKKIP/PUKKIP) α2L(ΔWE/WE)	0.079098 0.074642 0.061137	0.064554	122.5 115.6 94.7	-232.9
Period 3 1991-2000	Private Capital (PKKIP) Public Capital (PUKKIP) Wage Employment (WE)	α3PK = 0.661829 α3PUK = 0.525054 α3L = 1.994955	ΔPKKIP/PKKIP = 0.026889 ΔPUKKIP/PUKKIP = 0.036479 ΔWE/WE = 0.01866	A3PK(ΔPKKIP/PKKIP) α3PUK(ΔPUKKIP/PUKKIP) α3L(ΔWE/WE)	0.017796 0.019153 0.037226	0.018926	94 101.2 196.7	-291.9
Period 4 2001-2003	Private Capital (PKKIP) Public Capital (PUKKIP) Wage Employment (WE)	α4PK = 0.298085 α4PUK = 0.298092 α4L = -0.70266	ΔPKKIP/PKKIP = 0.0502 ΔPUKKIP/PUKKIP = 0.0502 ΔWE/WE = 0.006307	A4PK(ΔPKKIP/PKKIP) α4PUK(ΔPUKKIP/PUKKIP) α4L(ΔWE/WE)	0.014964 0.014964 -0.004432	0.021212	70.5 70.5 -20.9	-20.2

1. The subscript number and letters correspond to the period and the variable inputs respectively.

Table 5: Results of the TFP Model

	Model
Variables	Coefficients
Constant	-0.059694**
	(-2.049391)
ΔlnED	0.129232
	(0.423186)
ΔlnTOT	-0.335195**
	(-2.662671)
ΔlnOPE	0.313646**
	(2.189433)
FDIED	-0.005618
	(-1.140183)
ΔlnINST	-0.382205*
	(-1.930108)
Adjusted R^2	0.215
F statistic	2.751434
Prob (F stat)	(0.039102)
Durbin-Watson	2.453079

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