# Economic Policy and Total Factor Productivity in Kenya

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## *Abstract*

*Policy makers and development experts in many countries have had to deal with a decision on exactly what sources of economic growth they must target to achieve higher growth rates. Most development practitioners and policy makers continue to target physical capital accumulation as the major source of economic growth. Several studies have argued that economic growth does not always come from factor accumulation but total factor productivity (TFP). Due to lack of knowledge on its strong links to economic growth, policy makers in many countries ignore to focus on TFP growth in the policy making and implementation process. If TFP growth is a major source of economic growth in a country, then economic policies must be geared towards encouraging and not restricting TFP growth in order to achieve higher economic growth. In the case of Kenya, however, it is not clear whether economic policy has encouraged or discouraged TFP growth. Economic policies aimed at raising economic growth in Kenya, to a large extent, tend to emphasize too much on factor accumulation than TFP growth. This somewhat leads to a less than optimal growth rates in output.*

*This study aims at determining the place of TFP as a source of economic growth in Kenya with a view to arguing for a re-focus of policy towards TFP growth as one of the major factors that drive economic growth and competitiveness of the economy than just concentrating policy efforts on factor accumulation. The findings show that TFP growth is a significant source of GDP growth in Kenya. The findings further show that government policies on Foreign Direct Investments (FDI), education, trade policy and government policies on infrastructural development significantly contribute to TFP growth in Kenya. While government expenditures on infrastructure and access to credit (monetary and financial policy) increases TFP growth, government expenditures on education (education policy), openness of the economy to trade (trade policy) and FDI flows (investment policy) have all not improved TFP growth. The other policies, including government policy on research and development, represented in the study by government expenditures on research and development, financial market policies represented by interest rate margins and macro policies represented by inflation rates are found to have no significant effects on TFP growth. The findings are an indicator of the policy areas that the government needs to put more efforts on in order to raise TFP growth and hence GDP growth. These policy areas include: the need to invest more on research and innovation through increased funding to research institutions, need for the government to put in place policies that will increase the quality of education, efficiency of education, and policies to limit brain drain. Other policy measures suggested in this study include measures to encourage domestic production through subsidies and tax holidays to local producers.*

## Abbreviations and Acronyms

| | |
|---|---|
| AIC | Akaike Information Criteria |
| COMESA | Common Market for Eastern and Southern Africa |
| EAC | East African Community |
| FDI | Foreign Direct Investment |
| FP | Final Prediction Error |
| GDP | Gross Domestic Product |
| ICT | Information Communication Technology |
| IFS | International Financial Statistics |
| ILO | International Labour Organization |
| KARI | Kenya Agricultural Research Institute |
| KEFRI | Kenya Forest Research Institute |
| KEMFRI | Kenya Marine Fisheries Research Institute |
| KIRDI | Kenya Industrial Research and Development Institute |
| KNBS | Kenya National Bureau of Statistics |
| OECD | Organization for Economic Cooperation and Development |
| PCK | Productivity Centre of Kenya |
| R&D | Research and Development |
| TFP | Total Factor Productivity |
| UNCTAD | United Nations Conference on Trade and Development |
| VAR | Vector Autoregression |

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# 1. Introduction

Policy makers and development experts in many countries have had to deal with a decision on what sources of growth to target in order to achieve high growth rates. Most development practitioners and policy makers continue to target physical capital accumulation as the major source of economic growth. Capital accumulation is believed to be the driving force for any economy to grow faster. This view is supported by, among others, the findings of Ghani and Suri (1999) that capital accumulation accounted for 50 per cent of Malaysia's economic growth between 1971 and 1997. While this view could be true for some countries and over a given time period, capital accumulation is not always the main driving force of economic growth in all countries and at all times. This is the position taken by Easterly and Levine (2000) and Rodriguez-Claire (1997) who argue that the major contribution to economic growth does not always come from factor accumulation but total factor productivity (TFP). Krugman (1994) argues that the growth in the East Asian Economies was unsustainable largely because it was driven by capital accumulation and labour quality, rather than improving gains in TFP. Solow (1957) defines TFP growth as the rate of growth of real output not accounted for by the growth of factor inputs. Solow associated TFP with a shift in technology.

Due to lack of knowledge on its strong links to economic growth, policy makers in many countries ignore focussing on TFP growth in the policy making and implementation process. In light of the evidence from literature on the importance of TFP growth as a major source of economic growth, identifying and focusing policy on the exact sources of a country's economic growth is very vital for sustainable long-term economic prospects of the country (Nachega and Fontaines, 2006). If TFP growth is a major source of economic growth in a country, then economic policies must be geared towards encouraging and not restricting TFP growth in order to achieve higher economic growth. In the case of Kenya, however, it is not clear whether economic policy has encouraged or discouraged TFP growth. Economic policies aimed at raising economic growth in Kenya, to a large extent, tend to emphasize too much on factor accumulation than TFP growth. This somewhat leads to a less than optimal growth rate in output. It is not surprising therefore, that Njuguna *et al.* (2003) found out that Kenya's actual output growth has been way below its potential output growth. The trends in TFP growth in Kenya have not been encouraging either. Kimuyu (1998) documents that between 1961 and 1996, TFP growth was erratic, with a mean average of

about -0.2. Similar results are reported by Gerdin (1997) as quoted by Kimenyi, Mbaku and Mwaniki (2003) that TFP growth between 1964 and 1994 was generally negative except for the coffee-boom period (1976 to 1978). While trying to reverse this trend, the Kenyan government in 2004 established the Productivity Centre of Kenya (PCK) under the Ministry of Labour and Human Resource Development. PCK is mandated to mainstream productivity improvement in the national development planning process.

This study determines the place of TFP as a source of economic growth in Kenya, with a view to arguing for a re-focus of policy towards TFP growth as one of the major factors that drive economic growth and competitiveness of the economy than just concentrating policy efforts on factor accumulation. This study poses the question: "How has economic policy impacted on TFP in Kenya?". The study attempts to determine whether the policies that have been in place in Kenya have enhanced or restricted improvements in TFP, and in turn undermined economic growth and national competitiveness.

## 1.1 Organization of the Paper

The study is organized as follows. Section two discusses the determinants of total factor productivity, section three the different measures of TFP, and section four details the empirical framework adopted. While section five gives the empirical results, section six discusses the summary, conclusions and the policy recommendations.

## 2. Measurement of Total Factor Productivity

There are various approaches to the measurement of total factor productivity growth. Key among them being: Growth Accounting, the Index Number Approach, Input-Output Analysis (IO), and Data Envelopment Analysis (DEA). The growth accounting approach is discussed in detail, while the other approaches are briefly discussed.

### 2.1 Growth Accounting

Solow (1957) defines TFP as the rate of growth of the real output not accounted for by the growth of factor inputs. He considers any shift in the production function that is not accounted for by the growth of factor inputs as TFP, and calls it technical change (efficiency in the utilization of factor inputs). Growth in output is decomposed into growth in factors of production (capital and labour), and growth in efficiency in the utilization of these factors.

Solow considered a simple model with two factors of production and labour-augmenting technology over time. A production of this form is given by a Cobb-Douglas production function of the form:

$$Y(t) = [K(t)]^{\alpha} [A(t)L(t)]^{1-\alpha} \tag{2.1}$$

where $Y(t)$ represents the total output in the economy in time $t$, $K(t)$ represents capital stock in the economy in time $t$, $L(t)$ represents the total labour force in the economy in time $t$ and $A(t)$ represents labour efficiency in the economy in time $t$.

To measure the change in output, equation (2.1) is differentiated with respect to time so that:

$$\frac{\partial Y}{\partial t} = \frac{\partial Y}{\partial K}\frac{\partial K}{\partial t} + \frac{\partial Y}{\partial L}\frac{\partial L}{\partial t} + \frac{\partial Y}{\partial A}\frac{\partial A}{\partial t} \tag{2.2}$$

It is important to note from equation 2.1 that:

$$\frac{\partial Y}{\partial K} = \alpha[K(t)]^{\alpha-1}[A(t)K(t)]^{1-\alpha} = \frac{\alpha Y}{[K(t)]}, \quad \frac{\partial Y}{\partial L} = \frac{(1-\alpha)Y}{[L(t)]} \text{ and } \frac{\partial Y}{\partial A} = \frac{(1-\alpha)Y}{[A(t)]}$$

Therefore,

$$\frac{\partial Y}{\partial t} = \frac{\alpha Y}{[K(t)]}\cdot\frac{\partial K}{\partial t} + \frac{(1-\alpha)Y}{[L(t)]}\cdot\frac{\partial L}{\partial t} + \frac{(1-\alpha)Y}{[A(t)]}\frac{\partial A}{\partial t} \tag{2.3}$$

The growth factor in the economy is a proportion of the output in the previous period obtained by dividing both sides of equation (2.3) by $Y$ so that:

$$\begin{aligned}\frac{\frac{\partial Y}{\partial t}}{Y} &= \frac{\frac{\alpha Y}{[K(t)]}\cdot\frac{\partial K}{\partial t}}{Y} + \frac{\frac{(1-\alpha)Y}{[L(t)]}\cdot\frac{\partial L}{\partial t}}{Y} + \frac{\frac{(1-\alpha)Y}{[A(t)]}\frac{\partial A}{\partial t}}{Y} \\ \Rightarrow \frac{\partial Y/\partial t}{Y} &= \alpha\frac{\partial K/\partial t}{[K(t)]} + (1-\alpha)\frac{\partial L/\partial t}{[L(t)]} + (1-\alpha)\frac{\partial A/\partial t}{[A(t)]}\end{aligned} \tag{2.4}$$

The term on the left of equation (2.4) is the proportional change in output. The first two terms on the right are the proportional change in capital stock and labour, respectively. The remaining term on the right is the Solow residual and gives the effects of productivity improvements on GDP. This implies that:

$$(1-\alpha)\frac{\partial A/\partial t}{[A(t)]} = \frac{\partial Y/\partial t}{Y} - \alpha\frac{\partial K/\partial t}{[K(t)]} + (1-\alpha)\frac{\partial L/\partial t}{[L(t)]} \tag{2.5}$$

Equation (3.5) gives change in technical progress, and is the Solow residual. With available data on $\alpha$, $(1-\alpha)$ and the growth rates for output, physical capital and labour, TFP growth can be computed from (2.5) as the residual. The Solow residual is that part of output growth as can be seen from (2.5), which cannot be attributed to the accumulation of capital and labour. Other approaches that have been proposed in the literature for calculating TFP are discussed below.

## 2.2 Divisia-Based Index Numbers

In the case where there are multiple inputs and outputs, the Solow residual is inappropriate. In this case, several index numbers have been developed to estimate the TFP. The index numbers are nothing more than a generalization of the Solow residual. With several outputs, the production possibilities in time $t$ is given as:

$$P^t(x) = \{y : G(y,t) \leq F(K,L,t)\} \tag{2.6}$$

where $G(y,t)$ is the output correspondence and is assumed to exhibit constant returns to scale. Letting $\varphi(K,L,t) = [G(y,t) - F(K,L,t)]$, the production possibility set is then given as:

$$\Rightarrow P^t(x) = \{y : \varphi(K,L,t) \leq 0\} \tag{2.7}$$

Taking the vector of inputs to be represented by $x$ and $a$ to represent the relative input shares, the input growth rate is given as $\sum a_i \frac{\partial x_i / \partial t}{x_i}$ where $a_i \equiv \alpha = rK/y$ when input $i$ is capital and $a_i \equiv \alpha = rK/y$ when input $i$ is labour with $r = \partial y / \partial K$ being the marginal product of capital and $w = \partial y / \partial L$ the marginal product of labour. Taking $\omega$ to be a vector of the relative input shares of the various factors of production, and assuming perfect competition, $\frac{b_j}{\omega_i} = -\frac{\partial \varphi / \partial y_j}{\partial \varphi / \partial x_i}$, TFP is therefore defined as the difference between the Divisia indices of the output and inputs given as:

This is the Divisia-based TFP growth, and it measures the shifts in

$$\frac{\partial A / \partial t}{A} = \sum \frac{b_j y_j}{by} \frac{\partial y_j / \partial t}{y_j} - \sum \frac{\omega_i x_i}{\omega x} \frac{\partial x_j / \partial t}{x_j} \equiv -\frac{\partial \varphi / \partial t}{\sum \left( \partial \varphi / \partial y_j \right) y_j} = \frac{\partial \varphi / \partial t}{\sum \left( \partial \varphi / \partial x_i \right)} \tag{2.8}$$

the production possibility frontier. The Divisia indices of the output and input growth rates that are used to get the difference are approximated in discrete time. The common approximation methods are the Tönquivist and Fisher ideal index. The difference between the two hinges is on how they apportion weights to the different outputs and inputs used.

Before calculating the index, one has to deal with how to calculate the growth in capital stock between period *(t+1)* and period *t*. Tönquivist or Translog productivity index uses $\ln K^{t+1} - \ln K^t$ to calculate the growth rate of capital. With this approximation of capital stock growth rates, the Tönquivist productivity index is given as:

$$\frac{\partial A / \partial t}{A} = \sum_j \frac{1}{2} \left( \left( \frac{b_j^t y_j^t}{b^t y^t} + \frac{b_j^{t+1} y_j^{t+1}}{b^{t+1} y^{t+1}} \right) \left( \ln y_j^{t+1} - \ln y_j^t \right) \right) - \sum_i \frac{1}{2} \left( \left( \frac{\omega_i^t x_i^t}{\omega^t x^t} + \frac{\omega_i^{t+1} x_i^{t+1}}{\omega^{t+1} x^{t+1}} \right) \left( \ln x_i^{t+1} - \ln x_i^t \right) \right) \tag{2.9}$$

where $\frac{b_j^t y_j^t}{b^t y^t}$ and $\frac{\omega_i^t x_i^t}{\omega^t x^t}$ are the weights and $r^t = \omega_i^t$ and $r^{t+1} = \omega_i^{t+1}$ for $i$ is the capital input. The Fisher ideal index, on the other hand, is approximated in almost the same procedure but with $K^{t+1} - K^t$ (see

Diewert, 1987, for more details). The two indices are not substantially different. In our case, it is not appropriate to use the index numbers approach, since we only have two inputs.

The other approach used in literature in calculating TFP is the Malmquist index. The Malmquist index is defined using distance functions. Distance functions measure the relative distance between output and the production possibility frontier. They allow one to describe a multi-input and multi-output production technology without the need to specify a behavioural objective (such as cost minimization or profit maximization). An input distance function characterizes the production technology by looking at a minimal proportional contraction of the input vector, given an output vector. An output distance function considers a maximal proportional expansion of the output vector, given an input vector. An output distance of 0.75 shows that output is only 75 per cent of where it could be given the inputs employed.

Some studies have also used the data enveloping analysis (DEA) to estimate TFP growth. The basic difference between the DEA and the other measures of TFP illustrated above is that it accounts for changes in the utilization of factor inputs. DEA is a linear-programming methodology, which uses data on the input and output quantities to construct a piece-wise linear surface over the data points. This frontier surface is constructed by the solution of a sequence of linear programming problems. The degree of technical inefficiency (the distance between the observed data point and the frontier) is produced as a by-product of the frontier construction method. DEA can be either input-orientated or output-orientated. While in the input-orientated case, the DEA method defines the frontier by seeking the maximum possible proportional reduction in input usage, with output levels held constant, in the output-orientated case, the DEA method seeks the maximum proportional increase in output production, with input levels held fixed. The two measures provide the same technical efficiency scores when a constant returns to scale (CRS) technology is assumed. Before proceeding to calculate TFP growth, it is important to calculate the stock of physical capital.

## 2.3 Capital Stock

To calculate the capital stock, the study uses the perpetual inventory method, which argues that the stock of capital is the accumulation of the stream of past investments:

$$K_t = I_t + (1-\delta)K_0 \tag{2.10}$$

Using the concept of initial capital stock $K_0$, the study follows Nehru and Dhareshwar (1993) in the construction of the capital stock series:

$$K_t = (1-\delta)^t K_0 + \sum_{i=0}^{t-1} I_{t-i}(1-\delta)^i \tag{2.11}$$

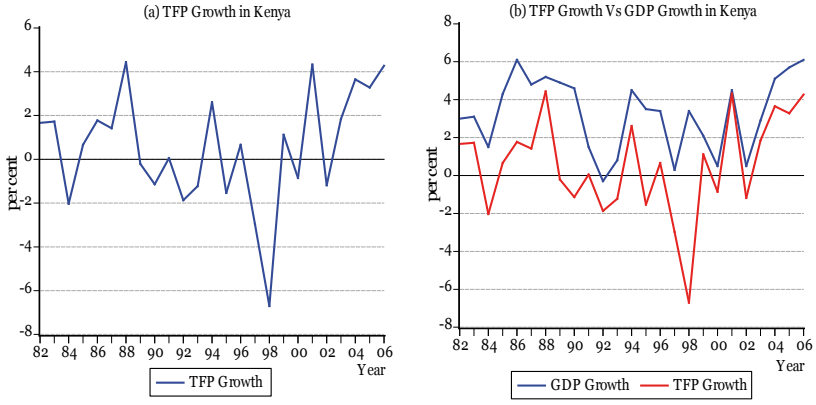
where $\delta$ is the rate of depreciation of capital and $K_0$ is the initial capital in period zero. The study choses 4 per cent as the depreciation rate in line with Nehru and Dhareshwar (1993). In addition, a modified Harberger (1978) method to calculate initial capital $K_0$ at 1982 is used. The calculation is done by estimating the value of investment in the first period, using a linear regression of the log of investments against time. The fitted value of initial investment is used to calculate initial capital using the formula given by Park (1995) as:

$$K_0 = \frac{I_0(1+g)}{g+\delta}$$

where $g$ is the historical average of the growth rate of investments.

The plot in Figure 2.1 shows the evolution of capital stock in Kenya since 1982. The figure shows that the growth of capital in Kenya has over the years followed a steady positive trend, except for a short period around the year 2000. However, the positive trend resumed shortly after a year or so.

**Figure 2.1: Evolution of capital stock in Kenya (1982-2006)**



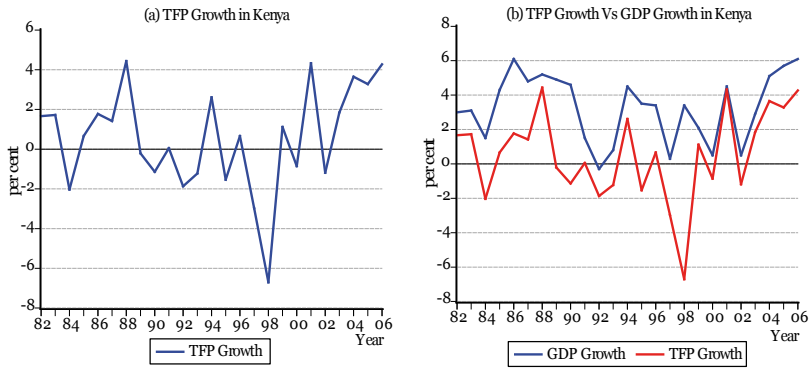
# 3. Growth Accounting in Kenya

The study uses growth accounting approach (the Solow residual) to calculate TFP trends in Kenya between 1982 and 2006. The calculated TFP series is then used to assess how several policy variables impacted on TFP growth over the sample period. The study also seeks to determine whether it was factor accumulation or TFP growth that was the major source of economic growth in Kenya. To do this, a vector error correction model and variance decomposition to apportion the variation in GDP growth to factor accumulation and TFP growth over the sample period is used. Data on capital stock is calculated using perpetual inventory method applied on data from Kenya. Capital stock share, $\alpha$ , is estimated from the Kenya National Income Accounts as 0.6. This is the average share of non-wage income in total output. Labour input is taken as the total workforce; data is obtained from Economic Surveys. Trends in estimated TFP and growth in GDP are given in Figure 3.1. The Figure shows that, compared to GDP growth, the growth in TFP was more erratic over the sample period.

## 3.1 Sources of Growth in Kenya

This section decomposes GDP into its component parts in order to determine the contribution of capital growth, labour growth and TFP growth on economic growth. This will determine whether or not TFP growth is an important source of economic growth in Kenya. If it is not, then analyzing government policy effects on it will not add value to policy making. If it is found to be an important source of growth, an analysis of how policy has influenced its growth will be done. To do this, the study regresses GDP growth on capital growth, labour growth and TFP growth.

**Figure 3.1: TFP growth and GDP growth in Kenya**



The regression is given as:

$$\tilde{y}_t = \alpha\tilde{k}_t + (1-\alpha)\tilde{l}_t + \tilde{a}_t \tag{3.1}$$

Stationarity results on the variables show that capital growth is I(1), labour growth is I(0) and TFP growth is I(1), while GDP growth is I(1). It is important that all variables that are I(1) are made stationary before commencing estimations to avoid spurious results. Therefore, the study differentiates GDP growth, capital growth and TFP growth to make them stationary before using the differenced series in the estimations. The model to be estimated therefore is of the form:

$$\Delta\tilde{y}_t = \alpha\Delta\tilde{k}_t + (1-\alpha)\tilde{l}_t + \Delta\tilde{a}_t \tag{3.2}$$

where $\Delta$ is the first difference operator

Since the variables are not integrated in the same order, they will not be cointegrated. The I(0) variables cannot be cointegrated with the I(1) variables. Enders (2004) notes that estimation of equation (3.2) is only appropriate when the variables in the model are not cointegrated. If the variables are cointegrated, then the estimation of (3.2) leads to misspecification, since it will not include the long-run relationship contained in the error correction term. Engle and Granger (1987) in the Granger Representation theorem show that if the variables are cointegrated, then they can be represented by an error correction model. The error correction model and cointegration are therefore equivalent representations of the model. If variables are not cointegrated (like in our case), the variables cannot be represented by an error correction model. Therefore, one should estimate a simple vector autoregression (VAR) model instead of an error correction model.

Let $x_t$ denote the vector of endogenous variables in the model, i.e $x_t = \left[\Delta\tilde{y}_t, \Delta\tilde{k}_t, \tilde{l}_t, \Delta\tilde{a}_t\right]$. The study postulates that all the variables are endogenous in the model. Assuming the model has *p* lags, it can be represented by a multivariate *p*-order AR process of the form:

$$x_t = B_1 x_{t-1} + B_2 x_{t-2} + \ldots + B_{p-2} x_{t-p+2} + B_{p-1} x_{t-p+1} + B_p x_{t-p} + \varepsilon_t \tag{3.3}$$

where $x_t$ is a $n \times 1$ vector of model variables, $\varepsilon_t$ is an independently and identically distributed vector with zero mean and constant variance, $\varepsilon_t \sim iid(0,\Omega)$ and $B$ is a matrix of parameters to be estimated. From

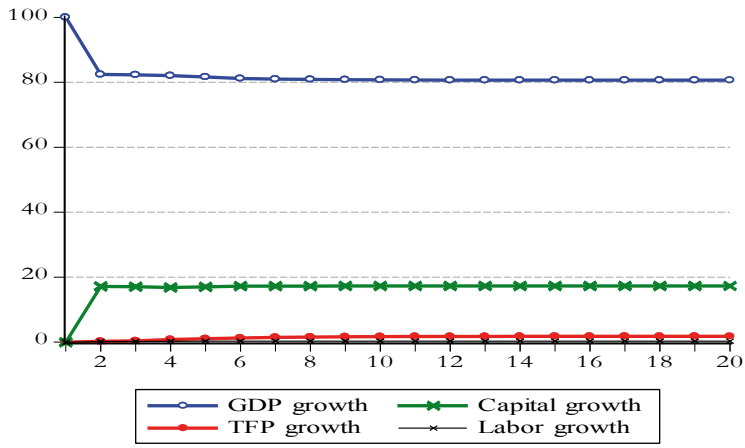
(3.3), the VAR to be estimated is of the form:

$$\Delta x_t = \sum_{j=1}^{p} \Gamma \Delta x_{t-j} + \varepsilon_t \qquad (3.4)$$

(see Enders, 2005 for details on how to derive equation 3.4 from 3.3). This is the VAR model that the study estimates in order to account for the variance in GDP growth. The study estimates a general VAR model with the variables GDP growth, capital growth, and TFP growth at first differences, and labour growth in levels to determine the appropriate lag length. The results from the lag selection show that the sequential modified LR test, Final Prediction error (FP) criteria and the Akaike information criteria (AIC) are appropriate for estimation at the model. The study then re-estimates the model with three lags and generates the variance decomposition of the changes in GDP growth. The variance decomposition graphs are given in Figure 3.2.

The graph shows that other than own shocks, capital growth is the major source of economic growth in Kenya, and accounts for around 17 per cent of GDP growth. TFP growth accounts for around 1 per cent of GDP growth while labour growth accounts for about 0.2 per cent of the changes in GDP growth. It is, however, important to be cautious with these results since the study uses the Choleskey decomposition, with the ordering GDP growth, TFP growth, capital growth and labour growth. If this ordering is changed, then the percentages will change. However, the general result from the variance decomposition, which does not change with the change in the ordering of the variables, is that TFP growth is a

**Figure 3.2: Variance decomposition of the changes in GDP growth in Kenya**



significant source of GDP growth in Kenya. This is what the study aimed to establish, after which it analyzes the government policy effects on TFP.

# 4. Determinants of Total Factor Productivity: Empirical Literature

Kenya has undergone different growth experiences in the last few decades after independence in 1963. After independence, Kenya experienced a very promising economic growth in the first decade (1964 -73), with growth becoming erratic thereafter (Mwega and Njuguna, 2002). Figure 4.1 shows the trends in GDP growth rates in Kenya between 1982 and 2006.

Figure 4.1 shows that the worst growth performance was registered in the 1990s when economic growth at one point was negative (in 1992). Since 2003, the economy picked up and recorded a 6.1 per cent growth in 2006 (Republic of Kenya, 2007). One important factor about Kenya's economic performance is that TFP growth has not been a significant factor in the observed aggregate economic performance. It is critical that TFP receives policy attention as the country gears towards realizing sustained economic growth as envisaged in Kenya Vision 2030.

The determinants of TFP can be discussed under two main categories, namely, macroeconomic policy and microeconomic policy environment. The macroeconomic determinants of TFP include openness to trade and foreign investment, macroeconomic stability, and financial stability and development. The microeconomic policy environment relates to those policies and institutions that impact on firm operations, including regulation, trade policy, industrial and agricultural development policy, science and technology policy, and fiscal and monetary policy interventions by the government. Section four of this study uses regression analysis to assess the significance of five key selected determinants of TFP, namely, macroeconomic stability, openness to trade and foreign direct investment, expenditure on research and

**Figure 4.1: GDP growth rates in Kenya (1982-2006)**

development, education and training, and financial sector stability and development. These have been found to be robust in cross-country studies on TFP determinants.

## 4.1 Macroeconomic Stability

Most economists agree that macroeconomic stability is essential for long-term growth of the economy. A stable macroeconomic environment boosts investor confidence by helping to reduce the risks and uncertainty associated with macroeconomic instability. Macroeconomic stability is considered as a threshold requirement for sustainable long-term growth (World Bank, 2005). High inflation and unsustainable public finances may have adverse effects on aggregate economic performance through the effects on production costs of firms, real interest rates and availability of investible resources. High domestic inflation relative to foreign price changes may lead to a real appreciation of the exchange rate, unless the exchange rate adjusts appropriately. In such circumstances, domestically produced commodities may become less competitive internationally. Akinlo (2005) examines the macroeconomic determinants of TFP in 34 Sub-Saharan countries and finds that inflation has a negative significant effect on TFP. Evers, Niermann and Shiffbauer (2007), using US time series data and a dynamic stochastic general equilibrium model to analyze the effects of inflation and investment composition on total factor productivity, find that inflation has a significant and negative effect on TFP.

## 4.2 Openness to Trade and Foreign Direct Investment

Openness to trade enhances competition as well as open opportunities for domestic firms and industries to gain greater access to cheap imported intermediate goods, larger markets, and advanced technologies that contribute to improved TFP. In an open trade regime, there is incentive to ugrade and innovate so as to remain competitive. Romer (1992), Grossman and Helpman (1991) and Barro and Sala-I-Martin (1995) argue that countries that are more open to the rest of the world have a greater ability to absorb technological advances generated in the leading nations. Several studies have looked at the relationship between openness of the economy and TFP. Frankel and Romer (1999) find that increasing openness, proxied by the ratio of trade to GDP by 1 per cent, raises productivity proxied by income per capita by between 0.5 to 2 per

cent. Sachs and Warner (1995) analyzes the effects of market reforms in several economies between 1970 and 1989, and finds that within the developing countries, the open economies grew faster by 4.49 per cent compared to closed economies that grew by 0.69 per cent per year. Within the group of developed countries, open economies grew faster by 2.29 per cent while the closed economies grew by 0.74 per cent per year. Garces-Ozanne and Arlene Locsin (2001) examine the effects of the degree of openness of an economy, the different roles of government, and human capital on TFP. The study finds evidence that the degree of openness of the economy influences TFP levels. Calderón-Madrid and Voicu (2004) analyzes the performance of Mexican manufacturing firms following trade liberalization to establish the effects of liberalization on the performance of the manufacturing firms. The study decomposes plants' productivity growth and patterns of job creation and destruction across their relative degree of integration into foreign product markets, their access to technology, and behaviour with respect to research and development. Their findings show that access to imported inputs is a significant vehicle for enhancing productivity effects of trade openness, and that investment in technology is most strongly correlated with plant productivity.

Kenya's trade policy after independence in 1963 was that of import-substitution, with strict import controls. Trade liberalization started in November 1981 when the government abolished the "no objection certificate", which was initially required from domestic producers and slowly started replacing import restrictions with equivalent tariffs (Glenday and Ryan, 2003). This was later followed by tariff reductions and rationalizations. Between 1997 and 1998, maximum tariffs were reduced from 170 per cent to 25 per cent, and the number of tariff bands reduced from 24 to 4, making the average tariff to fall from 49 per cent to 17 per cent (O'Brien and Ryan, 2001). By 1994, when all import-schedules were abolished and capital account restrictions relaxed, Kenya came to be classified as an open economy (Sachs and Warner, 1995). Apart from trade liberalization, there have been efforts to enhance regional economic integration, such as the Common Market for Eastern and Southern African (COMESA) countries and the East African Community (EAC).

Another important aspect of openness relates to foreign direct investment (FDI). It is hypothesized that FDI can enhance productivity through increased competition and access to new methods of production and organization, as well as advanced technologies. Argentino (2005), finds that FDI has a positive impact on TFP in a sample of 16 OECD

countries. Shiu and Heshmati (2006) analyzed the determinants of TFP growth in 30 Chinese provinces between 1993 and 2003. Their findings reveal that FDI and information and communication technology (ICT) investment are positive and significant effects on TFP difference between the provinces.

## 4.3 Financial Sector Stability and Development

Access to credit as well as efficiency of the financial sector have been considered in empirical literature. Restrictive policies and measures that limit access to credit may slow the process of capital accumulation, as credit is an input in the production process. When investors can access credit easily, they are in a better position to decide to invest in productive and innovative ways. For instance, easy access to credit may be an incentive to farmers to apply modern farming techniques such as using fertilizers and farm machinery. Love and Gatti (2006) estimate the impact of access to credit (as proxied by indicators of whether firms have access to a credit or overdraft facility) on productivity. The study uses information on firms' past growth as instruments for access to credit, and finds that credit access is significant and impacts on total factor productivity positively.

The cost of funds and efficiency of intermediation are also important factors in determining the contribution of the financial sector. The difference between the lending and savings rate, normally called interest rate margins or interest rate spreads, have been used in several studies as a proxy for efficiency in financial intermediation.

Wide margins are associated with inefficient financial markets while narrowing margins are interpreted as financial markets becoming more efficient and competitive. Akinlo (2005) analyzed the effects of macroeconomic factors on TFP among 34 sub-Saharan countries between 1980 and 2002. He found that high lending rates have a negative significant effects on TFP. The importance of financial sector development for TFP has also been analyzed from the point of view of financial deepening. A study by Nachega and Fontaines (2006) finds that a one percentage point increase in financial sector deepening measured by the change in the ratio of bank deposits to GDP induces a more than 1.5 percentage point increase in TFP measured by income per capita.

Kenya followed a controlled interest rate regime till the early 1990s when international financial institutions such as the IMF and the World

Bank, put pressure on the Kenyan monetary authorities to liberalize the financial markets. Controls on minimum and maximum rates were abolished in Kenya in December 1989, and Treasury bill rates were liberalized in November 1990. Bank interest rates were fully liberalized in July 1991. However, even with the liberalization of the interest rates, interest rate spreads have not come down commensurably. Figure 4.2 shows trends in interest rate margins in Kenya between 1968 and 2006.

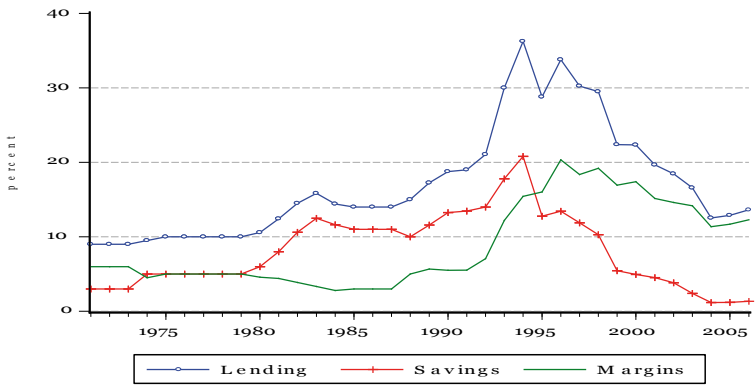
## 4.4 Research and Development

Improvements in research and development are vital in enhancing the technological capacity of an economy. An indication of the level and development of technological capacity is reflected in expenditure on Research and Development (R&D). Research and Development can affect productivity directly through ensuing innovations or indirectly through adaptation of technologies developed elsewhere, and spillover effects (Cohen and Levinthal, 1989). Therefore, if R&D is successful in these aspects, TFP will be boosted.

## 4.5 Human Capital Growth

Investment in education and training by enhancing the quality of workers is one way of increasing technical efficiency and progress. Various studies have attempted to assess the importance of human capital for long-term economic growth by using different indicators. Romer (1990) uses adult literacy rates as a proxy for human capital to estimate the effects of human capital on economic growth. Barro and Lee (1994)

**Figure 4.2: Interest rate margin trends in Kenya**




*Source: IMF, International Financial Statistics*

and Judson (2002) use public expenditure on education as a percentage of GDP. Sachs and Warner (1995) use primary, secondary and higher education attainment as the proxy for human capital. Sharpe (1998) argues that increased public support for training and higher education enhances overall productivity of the economy. Investment in education promotes more skilled and specialized labour input in improving the quality of human capital in the economy. Since more skilled workers are able to adjust in a dynamic, knowledge-based economy, an empowered human capital will result in enhanced productivity performance. Aurora & Natércia (2003) studied the effects of human capital and internal innovation on economic growth in Portugal between 1960 and 2001. The study obtains 0.40 long-run estimates for the elasticity related with the composite variable that measures the interaction between human capital and innovation capability.

## 4.6 Infrastructure Development

The way the government expends can either foster or hinder the process of economic growth and TFP depending on the nature and composition of public expenditure. Concentrating expenditure on improving health services and training facilities for instance, has the effect of improving labour productivity and therefore TFP. Increased expenditure on infrastructure to enhance both quantity and quality would lead to increased TFP, as less time is wasted in the production process. It is expected that improvements in the infrastructural networks will improve TFP. A few studies have attempted to analyse the effects of infrastructural development on TFP. Andreas (1997) uses time-series cross-section data from the manufacturing sector of the 11 Bundesländer in Germany from 1970 to 1993 to examine the impact of road infrastructure on private production, using three different approaches: a Cobb-Douglas production function, a translog production function and a growth accounting approach. The study finds that road infrastructure improvement contributes positively and significantly to increased production in the manufacturing sector.

# 5. Empirical Results

Theoretical and empirical literature suggests the following variables as the main determinants of total factor productivity (TFP) at the aggregate level: openness to trade and foreign direct investment, proxied by the ratio of total exports plus imports to GDP (OPEN) and Foreign Direct Investment (FDI), expenditure on research and development (R&D), education and training (edu), infrastructure development (infrexp), financial sector development proxied by interest rate margins (margins) and share of credit to the private sector, and inflation rates (infl) to signify the stability of macroeconomic stability. We assume that the relationship governing the interaction among these variables is linear in log transformation of the variables. Taking the natural logs of the variables, the benchmark regression equation is:

$$\ln TFP = \alpha_0 + \alpha_1 \ln RD_t + \alpha_2 \ln educ_t + \alpha_3 \ln Infr\exp_t + \alpha_4 \ln FDI_t + \alpha_5 \ln OPEN_t + \alpha_6 \ln M\arg ins_t + \alpha_7 \ln Inflation_t + \alpha_8 credit_t + \varepsilon_t \quad (5.1)$$

If we assume all the variables in the model (5.1) are endogenous so that they have feedback effects on each other, then we can represent the relationship among them using a vector autoregression (VAR) model. This assumption is logical since it is likely that some variables in the model will have feedback effects. To model the variables in VAR framework, let the vector $z_t$ denote the variables:

$$z_t = (RD_t, credit_t, educ_t, Infr\exp_t, FDI_t, OPEN_t, M\arg ins_t, Inflation_t) \quad (5.2)$$

Assuming the model has *p* lags, it can be represented by a multivariate *p*-order AR process of the form:

$$\Delta z_t = \pi z_{t-1} + \sum_{j=1}^{p} \delta \Delta z_{t-j} + \varepsilon_t \quad (5.3)$$

where $\pi = \alpha\beta'$ with the $\beta$ vector representing the cointegration vectors and $\alpha$ the vector of the adjustment coefficients.

## 5.1 Data Description and Sources

The justifications for inclusion of the variables in the model are given in section 2. In this section, a discussion of the data for the specific variables is provided. As for expenditure on Research and Development

(R&D), data on private sector R&D is not easily available at the aggregate level. We use government expenditure on R&D on the assumption that resources expenses indicate the level of effort used. The variable is calculated as government allocations to public research and development institutes, namely Kenya Industrial Research and Development Institute (KIRDI), Kenya Agricultural Research Institute (KARI), Kenya Forest Research Institute (KEFRI), Kenya Marine Fisheries Research Institute (KEMFRI) and the National Council for Science and Technology (NCST). Inflation is used as the indicator for macroeconomic stability. The data is obtained from Kenya National Bureau of Statistics (KNBS). Two indicators are used to capture openness, that is, the sum of imports and exports to GDP ratio, and Foreign Direct Investment. The indicators for financial stability and development that are tested in this study are access to credit and the interest margin. Government expenditures on education and enrolment in tertiary institutions are used as the indicator for human capital development. The data sources for the above variables include: Central Bank of Kenya Quarterly Bulletin, Monthly Economic Reviews, International Financial Statistics (IFS) 2007 CD ROM and website, World Bank Africa database 2007 CD ROM, UNCTAD, World Investment Report 2007 at http://www.unctad.org/, the International Labour Organization (ILO) website and the KNBS. The graphs of the variables are given in the Figure 5.1.

The movement of the variables in Figure 5.1 could be an indication that, except for FDI flows, all the other variables may not be stationary. The study conducted a formal unit root tests on the variables and the results are reported in the Table 5.1.

The unit root tests show that all the variables are integrated on order one except for FDI. Since all the variables are not integrated in the same order, they cannot all be cointegrated. However, there is a possibility of cointegration among the I(1) variables only. Since the study wants to establish the role of each and all variables in the model, including FDI which is found to be I(0), an error correction model to represent all the variables cannot be used. In this case, we use the single equation framework and estimate the model with all the variables included. The single equation representation is appropriate in this case since the model will not be mispecified. The model would only be mispecified if a single equation model, when the variables are cointegrated, is estimated. However, since the variables cannot be cointegrated, there are no error-correction terms that can be left out by specifying a single equation model. The mispecification problem, thus, does not arise.

**Figure 5.1: Movements in model variables at various levels**

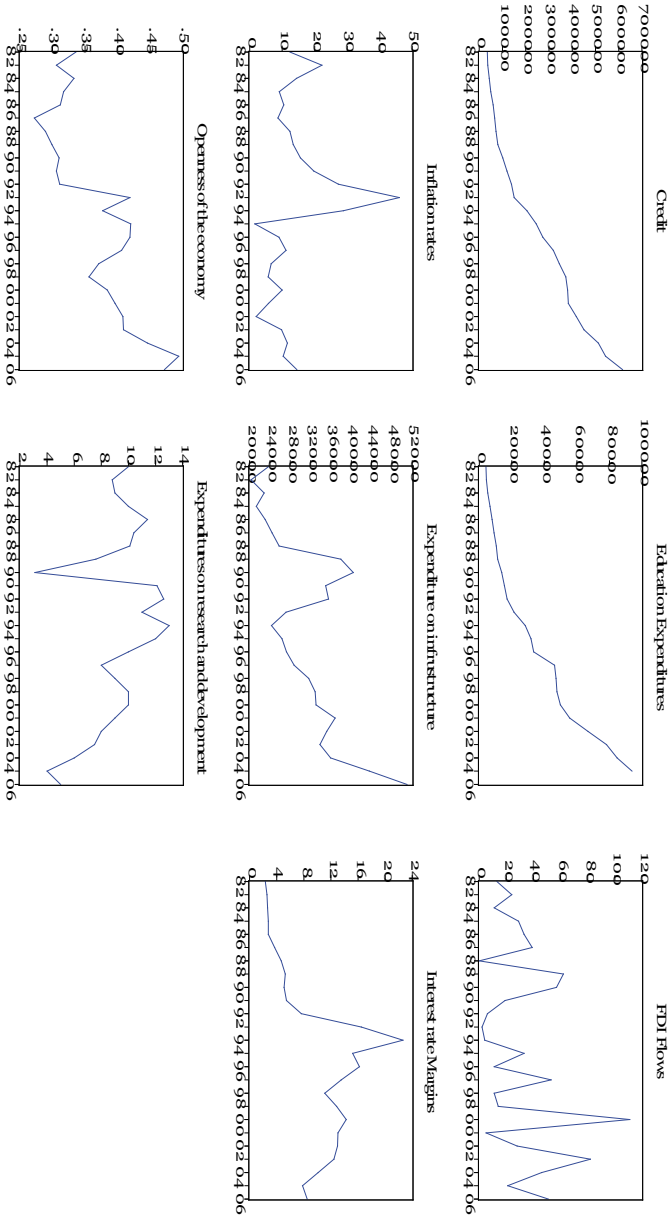


**Table 5.1: Unit root test results**

| Variable | ADF | PP | ADF | PP | Remarks |
|---|---|---|---|---|---|
| credit | -1.7328 (-3.6328) | -1.1464 (-3.6121) | -5.6801 (-3.6908) | -3.6374 (-3.6220) | I(1) |
| Education | -0.0333 (-3.6220) | -0.4592 (-3.6220) | -4.2686 (-3.6328) | -4.3223 (-3.6328) | I(1) |
| FDI | -5.6579 (-3.6121) | -5.8649 (-3.6121) | | | I(0) |
| Inflation | -2.4776 (-2.9918) | -2.4736 (-2.9918) | -5.1212 (-3.0048) | -6.6066 (-2.9980) | I(1) |
| Infrastru-cture | -0.2172 (-2.9918) | -0.5002 (-2.9918) | -3.5487 (-2.9980) | -3.5763 (-2.9980) | I(1) |
| Margins | -1.6370 (-2.9918) | -1.7080 (-2.9918) | -4.0218 (-2.9980) | -3.9765 (-2.9980) | I(1) |
| OPEN | -0.7956 (-2.9918) | -0.6146 (-2.9918) | -6.1000 (-2.9980) | -6.1000 (-2.9980) | I(1) |
| R&D | -2.3040 (-2.9918) | -2.3071 (-2.9918) | -5.3927 (-2.9980) | -6.4352 (-2.9980) | I(1) |

Note: Critical values at 5% are in parenthesis and the test statistics are in bold.

### 5.1.1 Single equation model results

Before commencing the estimations, the I(1) variables are first differenced to make them stationary. The OLS results from the regression of TFP growth on the other variables are reported in Table 5.2.

Several important observations can immediately be made from the results in Table 5.2. The first is that the coefficients of interest rate margins (inefficiency of the financial sector), government expenditures on research and development and inflation (macroeconomic stability) are all not significant. The other observation is that the coefficients of government expenditure on education, and openness to trade and FDI flows are all negative against our expectations, while the coefficients of domestic credit and infrastructure are positive in line with the expectations. Because of the insignificant variables, there is need to reduce the model to be more parsimonious for more robust results. This is done by eliminating the insignificant variables, one at a time, starting with the least significant in a general-to-specific modeling framework. Table 5.3 reports the results of the specific model obtained after eliminating all the insignificant variables.

The results from the specific model in Table 5.3 confirm the results from the general model in Table 5.2 and show that domestic credit, government expenditure on education and infrastructure, FDI and openness of the economy to trade are the only variables that significantly

**Table 5.2: OLS results from the general model**

| Dependent Variable: DTFP_GROWTH | | | | |
|---|---|---|---|---|
| Method: Least Squares | | | | |
| Sample (adjusted): 1982M02 2006M12 | | | | |
| Included observations: 299 after adjustments | | | | |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
| D_Inflation | -0.063586 | 0.102381 | -0.621070 | 0.5350 |
| DLOG_R & D | -0.230741 | 1.477453 | -0.156175 | 0.8760 |
| DLOG_Credit | 17.06505 | 9.479729 | 1.800162 | 0.0729 |
| DLOG_Education | -38.08513 | 8.437076 | -4.514020 | 0.0000 |
| DLOG_Infrastructure | 8.556257 | 6.041516 | 1.416243 | 0.1578 |
| DLOG_Margins | -2.291573 | 3.845475 | -0.595914 | 0.5517 |
| DLOG_OPEN | -9.202981 | 6.030653 | -1.526034 | 0.1281 |
| FDI | -0.014489 | 0.003227 | -4.489904 | 0.0000 |
| C | 0.598874 | 0.197699 | 3.029224 | 0.0027 |
| R-squared | 0.186886 | Mean dependent variable | | -0.080946 |
| Adjusted R-squared | 0.164455 | S.D. dependent variable | | 1.574252 |
| S.E. of regression | 1.438994 | Akaike info criterion | | 3.595404 |
| Sum squared resid | 600.5044 | Schwarz criterion | | 3.706789 |
| Log likelihood | -528.5129 | F-statistic | | 8.331682 |
| Durbin-Watson stat | 1.326327 | Prob(F-statistic) | | 0.000000 |

where: D represents the first difference operator, and LOG is the natural logarithm

influence TFP growth. The other variables, including government expenditures on research and development, inflation and inefficiency of the financial sector (interest rate margins) do not contribute significantly to the growth of TFP in Kenya. However, the impact of government expenditures on education, openness of the economy and FDI flows are found to be theoretically inconsistent.

The results show that an increase in the gap between the lending and deposit rates (interest margins) is not a significant factor in determining TFP growth in Kenya. Interest margins were included in the model to capture the inefficiency in the financial sector in Kenya. It was therefore expected that an increase in the margins (inefficiency) would restrict the growth of TFP. The findings that this variable is not significant could be a pointer to the fact that inefficiency of the financial institutions has not affected TFP growth in Kenya. The reason could be that the policies put in place to increase efficiency of the financial sector have borne fruits, and the financial markets are therefore relatively efficient. The investors, therefore, do not look at inefficiency of the financial sector as a major hindrance when making their investment decisions.

Inflation was used in the study as the indicator for stability of the macroeconomic environment. An increase in inflation is considered an increase in instability. The variable has the right sign but is insignificant. Perhaps this could be an indication that the macroeconomic environment

has been relatively stable over the sample period, such that an increase in instability has not affected TFP growth in Kenya.

Openness of the economy is one of the significant determinants of TFP growth, though with a negative coefficient. This variable, as was argued in section two, is included to capture the efforts and policies of the government aimed at ensuring free trade and free flow of goods and services across its borders. The findings that openness of the economy had negative effects on TFP growth may imply that the efforts by Kenya to liberalize its trade activities seem not to have been very conducive for TFP growth. The more open the country becomes to free trade, the more it affects TFP growth negatively. This could be because of free trade and cheaper imports that came into Kenya and drove out domestic investors from the market, hence affecting national productivity negatively. The liberalization of all capital account transactions between 1993-1994 is one of the policies that have been introduced in Kenya in an effort to open up trade. While several other policies have been implemented by the government to encourage exports from Kenya, it is clear that the volume of exports has not increased sufficiently enough to outstrip the avalanche of imports that come into Kenya due to free trade, leading to domestic producers being driven out of business. The policies and initiatives of the government to increase exports include joining of regional trading blocs

**Table 5.3: OLS results from the specific model**

| Dependent Variable: DTFP_GROWTH | | | | |
|---|---|---|---|---|
| Method: Least Squares | | | | |
| Sample (adjusted): 1982M02 2006M12 | | | | |
| Included observations: 299 after adjustments | | | | |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
| DLOG_Credit | 21.73180 | 8.552399 | 2.541018 | 0.0116 |
| DLOG_Infrastructure | 12.16843 | 4.964859 | 2.450911 | 0.0148 |
| DLOG_Education | -35.68863 | 7.626334 | -4.679657 | 0.0000 |
| DLOG_OPEN | -10.02993 | 5.698610 | -1.760067 | 0.0794 |
| FDI | -0.014206 | 0.003057 | -4.647305 | 0.0000 |
| C | 0.493432 | 0.174452 | 2.828468 | 0.0050 |
| R-squared | 0.182991 | Mean dependent variable | | -0.080946 |
| Adjusted R-squared | 0.169049 | S.D. dependent var | | 1.574252 |
| S.E. of regression | 1.435033 | Akaike info criterion | | 3.580115 |
| Sum squared resid | 603.3806 | Schwarz criterion | | 3.654372 |
| Log likelihood | -529.2273 | F-statistic | | 13.12505 |
| Durbin-Watson stat | 1.298030 | Prob(F-statistic) | | 0.000000 |

such as the Common Market for Eastern and Southern African (COMESA) countries and the East African Community (EAC), the formation of export processing zones and export processing zone authority, the setting up of the export promotion council, and protecting property rights through the Kenya Bureau of Standards (KBS). While all these seem to have been very good policy initiatives, they have apparently not been sufficient enough in raising TFP growth and subsequently GDP growth.

FDI is found to be significant in determining TFP growth in Kenya. The variable, however, has a negative coefficient. These results may be explained in the context of Harrison (1996), who argues that the entry of foreign investors implies domestic incumbents lose their market share, thus impeding their ability to attain scale economies. The foreign investors, in most cases, repatriate their profits from production back to their home countries, and are thus not used in generating new technology locally. In some cases, foreign investors come with their own expatriate workers who, at the end of the assignment, go back to their home countries, taking back with them the accumulated experience. Since the foreign firms have better production techniques, this puts them at an advantage over the domestic producers. They can thus easily produce at lower costs and drive domestic producers out of business. With domestic producers out of business, profits of the foreign firms are repatriated and there is no meaningful technological transfer to the local labour force. It is logically expected that the long term productivity of the country can only deteriorate. It could be in this light that FDI flows in Kenya have restricted TFP growth. To improve TFP growth, therefore, the government must put in place policies aimed at ensuring that part of the profits of foreign investors are invested locally, while at the same time restricting the number of expatriate employees that the foreign firms can bring along.

Government expenditure on education is found to be a significant and negative determinant of TFP growth. The findings could imply first, the quality of education in Kenya that could have produced the necessary skills to improve productivity has declined over the sample period and government expenditure in the past has not helped to improve quality of education. Second, the marginal productivity of workers with higher education as well as the efficiency of education itself could have deteriorated over the sample period. Third, the high number of highly qualified and experienced Kenyans moving from Kenya to other countries in search of better jobs could have resulted in brain drain, resulting in losses in productivity in the local economy.

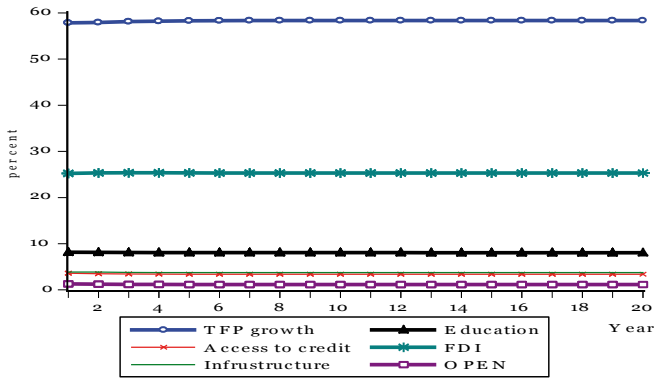
The results further indicate that government expenditure on research and development has not improved TFP growth. This is not surprising given that the government has scaled down its funding for research and development institutions, including its funding to universities and public research institutions.

### 5.1.2 VAR results

The variables included in the unrestricted VAR are TFP growth and those found to significantly contribute to TFP growth, in Kenya include access to credit, FDI government expenditures on infrastructure, government expenditures on education, and openness of the economy. The exogeneity tests on the variables reject the null hypothesis of exogeneity. This means that all the variables are endogenous in the model. The LR, FPE and AIC all indicate that two lags are the most appropriate for the model. The variance decomposition of the changes in TFP is given in Figure 5.2.

Figure 5.2 shows that other than own shocks, the other major contributor to TFP growth in Kenya was FDI flows, which accounted for around 25 per cent of the changes in TFP growth. Government expenditures on education accounted for around 8 per cent of the changes. This was followed by government expenditures on infrastructure, with a contribution of around 3.7 per cent and access to credit at 3.38 per cent. The least contribution came from openness of the economy to trade at 1.16 per cent. Table (A2) in the appendix gives the decompositions of the variations in TFP. Again, these percentages are likely to change with the change in the ordering of the variables, since the study used the Cholesky decomposition to generate the variance decompositions and, therefore, the study does not dwell much on the results (see the ordering used in the last row of Table A2).

**Figure 5.2: Variance decomposition of the changes in TFP in Kenya**



# 6. Summary, Conclusions and Policy Recommendations

## 6.1 Summary and Conclusions

The study aimed at determining the economic policy effects on TFP growth in Kenya. The motivation of the study was based on several findings, both theoretical and empirical, which showed that economic growth in many countries can be attributed not just to the growth of factors of production, but also total factor productivity (TFP). Most policy makers, however, seem ignorant of the importance of TFP growth in raising economic growth. In the process, they tend to concentrate too much policy attention on accumulating factors of production at the expense of raising TFP growth. This study identifies the sources of economic growth in Kenya in order to determine the place of TFP in economic growth. The study also attempted to establish the effects of government policies on TFP growth in Kenya.

The findings show that capital growth is a major source of economic growth in Kenya. On average, capital growth accounts for about 17 per cent of GDP growth in Kenya. The second major source of GDP growth is TFP growth, which accounts for about 1.8 per cent of GDP growth in Kenya. Labour growth accounts for the least in GDP growth, with a net contribution of around 0.28 per cent. The findings show the importance of TFP growth in driving economic growth in Kenya. It is, however ,important to be cautious with these results since the study uses the Choleskey decomposition with ordering GDP, TFP, capital and labour growth. If this ordering is changed, then the percentages will change. However, the general result from the variance decomposition, which does not change with the change in the ordering of the variables, is that TFP growth is a significant source of GDP growth in Kenya.

To determine government policy effects on TFP growth, this study regresses TFP growth on its determinants identified from literature. These determinants include government expenditures on education, which is included in the study to capture the effort of the government to improve human capital, which is one of the major determinants of TFP growth. The other determinants include government expenditure on research and development (R&D), government expenditure on infrastructural development, access to credit captured by claims of the banking institutions on the private sector, openness of the economy,

foreign direct investments (FDI), inflation to capture the (in)stability of the macroeconomic environment, and interest rate margins to capture the financial market (in)efficiency.

FDI, education expenditure, openness of the economy, and government expenditure on infrastructural development significantly contribute to TFP growth in Kenya. While government expenditure on infrastructure and access to credit increase TFP growth, government expenditure on education, openness of the economy to trade and FDI flows have not improved TFP growth. The other variables, including government expenditure on research and development, interest rate margins and inflation have no significant effects on TFP growth. The findings are an indicator of the policy areas that the government needs to put more efforts on in order to raise TFP growth, hence GDP growth.

Openness of the economy to trade has negative and significant effects on TFP growth. This is interpreted to mean that trade liberalization in Kenya has not helped improve TFP growth. Trade liberalization could have led to increased imports that may have driven some domestic producers out of production, hence restricting improvements in TFP growth. This is supported by the high number of factories that closed shop over the sample period in Kenya. Efforts by the government to increase exports, including joining regional trading blocs, among other recent policy initiatives, seem not enough in increasing exports to counter the avalanche of imports that come due to liberalized trade. It is therefore important for the government to put in place policies that will, in particular, make domestic production competitive and shield the local producers from cheap imports.

Government expenditure on education is a significant and a negative determinant of TFP growth. FDI is also found to be a negative and significant determinant of TFP growth in Kenya.

Access to credit is one of the positive determinants of TFP growth. Being a significant determinant of TFP growth implies that government policy in the past has focused enough attention on increasing access to credit. Interest rate margin (financial sector inefficiency) is insignificant in contributing TFP growth. This shows that the financial sector in Kenya is relatively efficient and, therefore, producers do not consider the inefficiency (the margins) as a big issue when making investment decisions. Inflation and government expenditure on research and development, on the other hand, have no significant effects on TFP growth in Kenya.

## 6.2 Policy Recommendations

One of the determinants of TFP growth that has not had any impact in Kenya is government expenditures on research and development. This is a very important source of innovations and improvements in the existing technology, and the government must take a closer look at. Funding of research institutions that are the kitchen of new technology, and modification of the existing technologies, must be increased if TFP growth is to be raised. The government has not been keen on raising funding for research institutions in the past few years and has instead cut its funding. This is being done in the hope that the research institutes will raise more funds from consultancies to bridge the gap. However, development of research capacity should be taken as public good that must not be left to the private sector alone.

Government expenditure on education is found to be a significant and negative determinant of TFP growth. The findings are attributed to poor quality of education, deteriorating marginal productivity of workers, as well as inefficiency of education and brain drain. While the government has invested heavily on education, with the latest initiative being the free primary education introduced in 2003, several other areas still need serious attention. It is important for the government to put in place policies that will increase the quality of education, efficiency of education and limit brain drain. To improve the quality of education, more investment is required inorder to increase the pupil-teacher ratio by employing more teachers, and the book-pupil ratio. Other areas of concern include policy initiatives to reduce brain drain, for instance by improving salaries and working conditions of public servants. To improve marginal productivity of workers, the government should stress and encourage continuing education and training of the labour force by giving scholarships and paid-training leave. This should also be encouraged in the parastatals, non-governmental organizations and private sector jobs.

FDI is found to be a negative and significant determinant of TFP growth in Kenya. The government, therefore, needs to put in place policies aimed at ensuring that part of the profits of foreign investors are invested locally, while at the same time restricting the number of expatriate employees that foreign firms can bring along with. It is important for the foreign investors to have majority of their senior staff as locals and not expatriates as happens in other countries. This would ensure that the experience gained from production is retained locally to increase efficiency of production in future assignments.

Openness of the economy is found to be a negative and significant determinant of TFP growth in Kenya. The efforts by Kenya to liberalize its trade activities seem not to have been very conducive for TFP growth. The government should encourage domestic production and discourage imports, provide more subsidies to domestic producers, and provide tax holidays. Opening up the country for trade without commensurate policies to make domestic production competitive will definitely drive domestic producers out of production. This would lead to unemployment and rendering labour idle.

## References

Akinlo A. E. (2005), "Impact of Macroeconomic Factors on Total Factor Productivity in Sub-Saharan African Countries", Research Paper No. 39 UN-WIDER.

Antle J.M. and Capablo S. (1988), "An Introduction to Recent Developments on Production Theory and Productivity Measurements", In Capablo S. and Antle J.M. (eds), *Agricultural Productivity Measurements and Explanations*, Washinton DC: Research for the Future.

Andreas S. (1997), "The Impact of Road Infrastructure on Productivity and Growth: Some Preliminary Results for the German Manufacturing Sector," *CIC Working Papers FS IV 97-47*, Wissenschaftszentrum Berlin (WZB), Research Unit: Competitiveness and Industrial Change (CIC).

Argentino P. (2005), "Foreign Direct Investment and Total Factor Productivity in OECD Countries: Evidence from Aggregate Data", *FEP Working Papers 188*, Universidade do Porto, Faculdade de Economia do Porto.

Aurora Teixeira and Natércia Fortuna (2003), "Human Capital, Innovation Capability and Economic Growth", FEP Working Papers 131, Universidade do Porto, Faculdade de Economia do Porto.

Barro, R. J. and Lee, J. (1994), "International Comparisons of Educational Attainments", *Journal of Monetary Economics* 32: Issue No. 3, 363-94.

Barro, R. J. and Sala-I-Martin, X. (1995), *Economic Growth,* New York: McGraw-Hill.

Calderón-Madrid, Ángel and Voicu, Alexandru (2004), "Total Factor Productivity Growth and Job Turnover in Mexican Manufacturing Plants in the 1990s" (January 2004), *IZA Discussion Paper No. 993.*

Capblo S and J.M. Antle (1988), Agricultural Productivity Measurements and Explanations, Washinton DC: Research for the Future.

Cohen, W. and Levithal, D. (1989), "Innovation and Learning: The Two Faces of R&D" *Economic Journal*, Vol. 99, 569-596.

Diewert, W. E. (1976), "Exact and Superlative Index Numbers", *Journal of Econometrics*, Vol. 4(2).

Easterly, William and Rose Levine (2000), "It's Not Factor Accumulation: Stylized Facts and Growth Models", Washington DC: World Bank.

Easterly, William and Ross Levine (2001), "It's Not Factor Accumulation", *The World Bank Economic Review* 15(2).

Engle, R.F. and Granger, C.W.J. (1987), "Co-integration and Error Correction: Representation, Estimation and Testing", *Journal of Econometrics*, Vol. 55, 251-276.

Evers, M., Niermann, S., and Shiffbauer, M. (2007), "Inflation, Investment Composition and Total Factor Productivity", Discussion Paper, Bonn Graduate School of Economics, Bonn, Germany.

Frankel, J.A., and D. Romer (1999), "Does Trade Cause Growth?", *American Economic Review*, Vol. 89 (June), 379-99.

Garces-Ozanne, Arlene Locsin (2001), *The Determinants of Total Factor Productivity: The High-performing Asian Economies Revisited*, PhD thesis, University of Otago.

Ghani Ajaz and Suri Vivek (1999), "Productivity Growth, Capital Acuumulation and the Banking Sector: Some Lessons from Malaysia", *Policy Research Working Paper*, Washington DC, World Bank.

Glenday, G. and Ryan, T.C.I. (2003), "Trade Liberalization and Economic Growth in Kenya", in Kimenyi, M.S., Mbaku, J.M. and Mwaniki, N. (eds), *Restarting and Sustaining Economic Growth in Africa: The Case of Kenya*, Ashgate, Aldershot and Burlington.

Grossman, G. M. and Helpman, E. (1991), "Trade, Knowledge Spillovers, and Growth," *European Economic Review*, Vol. 35(2-3).

Harberger, A. (1978), "On the Use of Distributional Weights in Social Cost-Benefit Analysis", *Journal of Political Economy,* 86, No. 2, pt. 2 (April 1978), S87-S120.

Harrison, A. (1996), "Determinants and Consequences of Foreign Investment in Three Developing Countries", in Mark Roberts and James Tybout (eds), *Industrial Evolution in Developing Countries: Micro Patterns of Turnover, Productivity, and Market Structure*, Oxford: Oxford University Press.

Judson, Ruth (2002), "Measuring Human Capital Like Physical Capital: What Does It Tell Us?" *Bulletin of Economic Research*, Vol. 54 (3).

Kimenyi M. S., Mbaku J. M. and Mwaniki N. (2003), *Restarting and Sustaining Economic Growth and Development in Africa,* Contemporary Perspectives on Developing Economies, Ashgate, England, and USA.

Kimuyu, Peter (1998), Equipment Acquisitions by Kenyan Manufacturers. Discussion Paper No. DP/010/98, Institute of Policy Analysis and Research, Nairobi, Kenya.

Krugman, P. (1994), "The Myth of Asian's Miracle", *Foreign Affairs*, Vol. 73, November/December.

Love, Inessa and Gatti, Roberta (2006), "Does Access to Credit Improve Productivity? Evidence from Bulgarian Firms" (May 1, 2006). World Bank Policy Research Working Paper No. 3921.

Mwega F. and Njuguna N. (2002), "Explaining Africa's Economic Growth: The Case of Kenya", GDN Global Collaborative Project on Explaining growth, Nairobi. http://www.gdnet.org/pdf/draft_country_studies/Kenya-MwegaFR.pdf.

Nachega, J. C. and Fontaines, T. (2006), "Economic Growth and Total Factor Productivity in Niger", *IMF Working paper* WP/06/208, Washington DC.

Nehru, V. and Dhareshwar A. (1993), "A New Database on Physical Capital Stock: Sources, Methodology, and Results," *Rivista de Analisis Economico*, 8, 37-59.

Njuguna E. N., Karingi S. N., Kimenyi M. S. (2003), Alternative Methodologies for Measuring Kenya's Potential Output and Output Gap, KIPPRA's Discussion Paper No. 28, Nairobi: Kenya Institute for Public Policy Research and Analysis.

O'Brien, F.S. and Ryan, T.C.I. (2001), "Kenya", in Devarajan, S., Dollar, D.R., Holmgren, T. (eds.), *Aid and Reform in Africa*, Washington DC, World Bank.

Park, W. (1995), "International R&D Spillovers and OECD Economic Growth", *Economic Inquiry* 33 (1995).

Republic of Kenya (2010), "Economic Survey 2009", Nairobi: Government Printers.

Rodriguez-Claire (1997), "The Role of Trade in Technology Diffusion", University of Chicago, Mimeo.

Romer, P. (1992), "Increasing Returns and New Developments in the Theory of Growth," NBER Working Papers 3098.

Romer, P. M. (1990), Human Capital and Growth: Theory and Evidence. Carnegie-Rochester Conference Series on Public Policy, 32.

Sachs, F. and Warner, A. (1995), "Economic Reform and the Process of Global Integration", *Brookings Papers on Economic Activity* 1995(1).

Solow, Robert M. (1957), "Technical Change and the Aggregate Production Function", *Review of Economics and Statistics,* 39.

Sharpe, A. (1998), "Productivity: Key to Success", Report Centre for the Study of Living Standards, Ottawa.

Shiu A. and Heshmati A. (2006), "Technical Change and Total Factor Productivity Growth for Chinese Provinces: A Panel Data

Analysis," *IZA Discussion Papers 2133*, Institute for the Study of Labour (IZA).

Solow, Robert M. (1957), "Technical Change and the Aggregate Production Function", *Review of Economics and Statistical* 39.

World Bank (2005), World Development Report 2005: *A Better Investment Climate for Everyone,* Washington DC: World Bank.

# Appendix

## Table A1: Variance decomposition of GDP growth in Kenya

| Period | S.E. | GDP growth | TFP growth | Capital growth | Labour growth |
|---|---|---|---|---|---|
| 1 | 0.304676 | 100.0000 | 0.000000 | 0.000000 | 0.000000 |
| 2 | 0.343753 | 82.41195 | 0.244659 | 17.14004 | 0.203353 |
| 3 | 0.351981 | 82.29704 | 0.394596 | 17.07621 | 0.232158 |
| 4 | 0.359978 | 82.05975 | 0.829398 | 16.84221 | 0.268645 |
| 5 | 0.362761 | 81.64066 | 1.049793 | 17.01574 | 0.293811 |
| 6 | 0.365059 | 81.19143 | 1.285947 | 17.23234 | 0.290289 |
| 7 | 0.366123 | 81.00233 | 1.460141 | 17.24808 | 0.289452 |
| 8 | 0.366667 | 80.87976 | 1.565051 | 17.26642 | 0.288763 |
| 9 | 0.367024 | 80.78532 | 1.648223 | 17.27808 | 0.288372 |
| 10 | 0.367216 | 80.72917 | 1.699564 | 17.28309 | 0.288179 |
| 11 | 0.367319 | 80.69683 | 1.731296 | 17.28383 | 0.288047 |
| 12 | 0.367379 | 80.67625 | 1.751935 | 17.28379 | 0.288026 |
| 13 | 0.367412 | 80.66430 | 1.764207 | 17.28348 | 0.288009 |
| 14 | 0.367431 | 80.65736 | 1.771545 | 17.28309 | 0.288004 |
| 15 | 0.367441 | 80.65335 | 1.775905 | 17.28274 | 0.288008 |
| 16 | 0.367446 | 80.65108 | 1.778416 | 17.28249 | 0.288011 |
| 17 | 0.367449 | 80.64981 | 1.779861 | 17.28232 | 0.288014 |
| 18 | 0.367451 | 80.64910 | 1.780679 | 17.28221 | 0.288016 |
| 19 | 0.367452 | 80.64871 | 1.781137 | 17.28214 | 0.288017 |
| 20 | 0.367452 | 80.64849 | 1.781391 | 17.28210 | 0.288018 |

Cholesky Ordering: GDP growth, TFP growth, Capital growth, Labour growth

## Table A2: Variance decomposition of TFP growth in Kenya

| Period | S.E. | TFP growth | Credit | Infra-structure | Education | FDI | OPEN |
|---|---|---|---|---|---|---|---|
| 1 | 1.492073 | 57.83875 | 3.607406 | 3.865609 | 8.166550 | 25.22478 | 1.296909 |
| 2 | 1.542221 | 57.91921 | 3.513539 | 3.853292 | 8.133118 | 25.33690 | 1.243934 |
| 3 | 1.595500 | 58.11534 | 3.441470 | 3.783061 | 8.102877 | 25.36932 | 1.187929 |
| 4 | 1.606455 | 58.20745 | 3.411477 | 3.765646 | 8.084950 | 25.35844 | 1.172033 |
| 5 | 1.611882 | 58.27671 | 3.395409 | 3.752944 | 8.073486 | 25.33725 | 1.164200 |
| 6 | 1.613497 | 58.31093 | 3.389234 | 3.748708 | 8.067536 | 25.32098 | 1.162612 |
| 7 | 1.614121 | 58.32974 | 3.386670 | 3.746819 | 8.064361 | 25.30990 | 1.162512 |
| 8 | 1.614328 | 58.33816 | 3.385819 | 3.746187 | 8.062825 | 25.30410 | 1.162899 |
| 9 | 1.614407 | 58.34148 | 3.385533 | 3.745949 | 8.062075 | 25.30172 | 1.163244 |
| 10 | 1.614444 | 58.34200 | 3.385425 | 3.745846 | 8.061713 | 25.30154 | 1.163467 |
| 11 | 1.614471 | 58.34119 | 3.385344 | 3.745774 | 8.061520 | 25.30259 | 1.163579 |
| 12 | 1.614495 | 58.33975 | 3.385256 | 3.745708 | 8.061398 | 25.30427 | 1.163618 |
| 13 | 1.614519 | 58.33810 | 3.385159 | 3.745643 | 8.061302 | 25.30618 | 1.163616 |
| 14 | 1.614542 | 58.33644 | 3.385062 | 3.745581 | 8.061214 | 25.30811 | 1.163594 |
| 15 | 1.614564 | 58.33486 | 3.384972 | 3.745524 | 8.061129 | 25.30995 | 1.163566 |
| 16 | 1.614584 | 58.33342 | 3.384892 | 3.745473 | 8.061047 | 25.31163 | 1.163537 |
| 17 | 1.614602 | 58.33213 | 3.384824 | 3.745429 | 8.060969 | 25.31314 | 1.163511 |
| 18 | 1.614619 | 58.33099 | 3.384767 | 3.745391 | 8.060896 | 25.31447 | 1.163488 |
| 19 | 1.614633 | 58.32999 | 3.384721 | 3.745359 | 8.060828 | 25.31564 | 1.163469 |
| 20 | 1.614646 | 58.32912 | 3.384683 | 3.745332 | 8.060767 | 25.31664 | 1.163453 |

Cholesky Ordering: credit, Infrastructure, Education, OPEN, FDI, TFP growth