CREDIT Research Paper

No. 05/06

Fiscal Policy and Economic Growth in Kenya

by

Daniel M'Amanja and Oliver Morrissey

Centre for Research in Economic Development and International Trade, University of Nottingham

The Centre for Research in Economic Development and International Trade is based in the School of Economics at the University of Nottingham. It aims to promote research in all aspects of economic development and international trade on both a long term and a short term basis. To this end, CREDIT organises seminar series on Development Economics, acts as a point for collaborative research with other UK and overseas institutions and publishes research papers on topics central to its interests. A list of CREDIT Research Papers is given on the final page of this publication.

Authors who wish to submit a paper for publication should send their manuscript to the Editor of the CREDIT Research Papers, Professor M F Bleaney, at:

Centre for Research in Economic Development and International Trade,
School of Economics,
University of Nottingham,
University Park,
Nottingham, NG7 2RD,
UNITED KINGDOM

Telephone (0115) 951 5620
Fax: (0115) 951 4159

CREDIT Research Papers are distributed free of charge to members of the Centre. Enquiries concerning copies of individual Research Papers or CREDIT membership should be addressed to the CREDIT Secretary at the above address. Papers may also be downloaded from the School of Economics web site at:
www.nottingham.ac.uk/economics/research/credit

CREDIT Research Paper

No. 05/06

Fiscal Policy and Economic Growth in Kenya

by

Daniel M'Amanja and Oliver Morrissey

Centre for Research in Economic Development and International Trade, University of Nottingham

The Authors
The authors are respectively Research Student and Professor of Development Economics in the School of Economics, University of Nottingham.

June 2005

Fiscal Policy and Economic Growth in Kenya

by

Daniel M'Amanja and Oliver Morrissey

Abstract

The question of whether or not fiscal policy stimulates growth has dominated theoretical and empirical debate for a long time. One viewpoint believes that government involvement in economic activity is vital for growth, but an opposing view holds that government operations are inherently bureaucratic and inefficient and therefore stifles rather than promotes growth. In the empirical literature, results are equally mixed. The aim of this paper is not to resolve the raging debate but to add to the fiscal policy-growth literature by examining the case of a small open developing country, Kenya. We used time series techniques to investigate the relationship between various measures of fiscal policy on growth on annual data for the period 1964 – 2002. Categorising government expenditure into productive and unproductive and tax revenue into distortionary and non-distortionary, we found unproductive expenditure and non-distortionary tax revenue to be neutral to growth as predicted by economic theory. However, contrary to expectations, productive expenditure has strong adverse effect on growth whilst there was no evidence of distortionary effects on growth of distortionary taxes. On the other hand, government investment was found to be beneficial to growth in the long run. These results should prove useful to policy makers in Kenya in formulating expenditure and tax policies to ensure unproductive expenditures are curtailed while at the same time boosting public investment.

Outline

1. Introduction
2. Theoretical Issues and Empirical Evidence
3. Econometric Model and Data
4. Regression Results
5. Discussion of Empirical Results
6. Conclusions

1. INTRODUCTION

Proponents of government intervention in economic activity maintain that such intervention can spur long term growth. They cite government's role in ensuring efficiency in resource allocation, regulation of markets, stabilization of the economy, and harmonization of social conflicts as some of the ways in which government could facilitate economic growth. In the context of endogenous growth, government role in promoting accumulation of knowledge, research and development, productive public investment, human capital development, law and order can generate growth both in the short- and long-run [Easterly and Rebelo (1993), Chrystal and Price (1995), Mauro (1995), Folster and Henrekson (1999)]. Opponents hold the view that government operations are inherently bureaucratic and inefficient and therefore stifle rather than promote growth. It seems then that as to whether government's fiscal policy stimulates or stifles growth remains an empirical question. Even so, the existing empirical findings are mixed, with some researchers finding the relationship between fiscal policy and growth either positive, negative, or indeterminate.

Our aim in this paper is not to resolve the fiscal policy-growth debate but rather to contribute to the literature by examining the effects of fiscal policy on growth in a small developing economy, Kenya. We hope to shed some useful light by considering the effects of various public expenditure and taxation components on growth. Economic theory tells us that the nature of the tax regime can harm or foster growth. A regime that causes distortions to private agents' investment incentives can retard investment and growth. Analogously, if the regime is such that it leads to internalisation of externalities by private agents, it may induce efficiency in resource allocation and thus foster investment and growth. The same applies with the nature of government expenditure: excessive spending on consumption at the expense of investment is likely to deter growth and *vice versa*.

Barro (1990) and Kneller *et al* (1999) provide a theoretical basis for, as well as empirical evidence of, the beneficial effect of productive government expenditure and the harmful effect of taxation. Our theoretical model is predicated in these two papers. Government expenditure is classified into productive and unproductive while tax revenue is decomposed into distortionary and non-distortionary categories. We test the prediction of endogenous growth models with respect to the impact of the structure of fiscal policy on growth. Specifically, we test the theoretical hypothesis that unproductive expenditure and non-distortionary taxes have neutral effects on long run growth and therefore can be eliminated from the growth model without loss of useful information. We also show that removing these components improves the accuracy of parameter estimates of the remaining variables. We then use the pruned model to estimate and analyse the effects of fiscal policy on growth in Kenya. In their empirical testing of the theoretical model for 22 OECD countries, Kneller *et al* (1999) used panel data estimation technique to verify Barro's (1990) theoretical model. We depart from this approach and employ time series techniques on annual time series data covering the period 1964 – 2002 to carry out this analysis for a single country. Kenya has had mixed economic performance since independence and it would be interesting to know the role of fiscal and related variables over this period.

The performance of the economy during the first decade of independence in 1963 was impressive. The growth of real GDP averaged 6.6% per year over the period 1964 –1973, and compared favourably with some of the newly industrialised countries (NICs) of East Asia. This remarkable performance is attributed to consistency of economic policy, promotion of smallholder agricultural farming, high domestic demand, and expansion of market for domestic output within the East African region. The second decade marked the end of easy growth options and the emergence of powerful external shocks which, together with imprudent fiscal and monetary management, ushered in an era of slow and persistent economic decline with average real GDP falling to 5.2% over the period. In the third decade, the effects of expansionary fiscal policy of the previous decade, which led to the establishment of highly protected but grossly inefficient private industries and state corporations, began to cause serious strain on the economy's scarce resources. Budget deficits increased rapidly, exports and imports fell, and the economy performed poorly with average real GDP falling further to 4.2% over the period. The downward spiral continued in the fourth decade of independence. A combination of poor fiscal and monetary policy regime, external and internal shocks as well as political events resulted in the worst economic performance in the short history of the country. The average real GDP fell to a low of 2.2% between 1990 and 2002. The unresolved question to Kenyan policy makers and indeed many observers of the local economy is, what went wrong, and what remedy, if any, is there for Kenya's economic rejuvenation? We attempt to investigate some of these causal factors in this paper.

The remainder of the paper is structured as follows. Section 2 examines some theoretical issues and empirical evidence surrounding the nexus between productive and unproductive expenditures on the one hand, and distortionary and non-distortionary taxes on the other. This is followed by results of unit roots tests in section 3. The main regression results, including procedural issues on testing the neutrality of selected fiscal components are covered in section 4. Section 5 discusses the empirical results while a summary and some concluding remarks appear in section 6.

2 THEORETICAL ISSUES AND EMPIRICAL EVIDENCE

Theoretical Issues

According to endogenous growth theory, fiscal policy can affect both the level and growth rate of per capita output. A detailed illustration of the mechanism through which fiscal policy influences growth can be found in, amongst others, Barro (1990) and Barro and Sala-i-Martin (1992, 1995). These authors employ a Cobb-Douglas-type production function with government provided goods and services *(g)* as an input to show the positive effect of productive government spending and the adverse effects associated with distortionary taxes. The production function, in per capita terms, can be given as follows,

$$y\ k^{1-a}g^{a} \qquad (1)$$

where y is per capita output, k is per capita private capital and A is a productivity factor. If the government balances its budget in each period by raising a proportional tax on output at rate (τ) and lump-sum taxes (L), the government budget constraint can be expressed as,

$$ng+C=L+tny \qquad (2)$$

where n is the number of producers in the economy and C is government consumption, which is assumed unproductive. Theoretically, a proportional tax on output affects private incentives to invest, but a lump sum tax does not. Subject to a specified utility function, Barro (1990) and Barro and Sala-i-Martin (1992) derive the long run growth rate (γ) in this model as,

$$g=l\,(1-t)(1-a)A^{1/(1-a)}(g/y)^{a/(1-a)}-m \qquad (3)$$

where l and m stand for parameters in the assumed utility function. From (3), it is clear that the growth rate is a decreasing function of distortionary tax rate (t) and an increasing function of productive government expenditure (g). It is also evident that growth rate is not affected by both non-distortionary taxes (L) and unproductive government expenditure (C). The above specification assumes the government balances its budget each period, an assumption that is unlikely to hold in reality especially in the less developed countries. Our empirical model follows Kneller *et al* (1999) and Bleaney *et al* (2000) in which they take a more practical view by assuming a non-balancing government budget constraint in some periods. Taking this into account, we can re-write (3) to obtain the following expression.

$$ng+C+b= L + tny \quad (4)$$

Where b is the budget deficit/surplus in a given period. Since g is productive, its predicted sign is positive, but t is negative as it distorts incentives of private agents. Both C and L are hypothesised to have zero effects on growth. Similarly, the effect of b is expected to be zero so long as Ricardian equivalence holds, but may be non-zero otherwise (Bleaney *et al*, 2000). We specify our growth equation in the spirit of Kneller *et al* (1999) by considering both fiscal ($\mathbf{x_{it}}$) and non-fiscal ($\mathbf{z_{it}}$) variables so that the growth equation becomes,

$$y_t = a + \sum_{i=1}^{k} b_i z_{it} + \sum_{j=1}^{m} g_j x_{jt} + e_{it} \quad (5)$$

where y_t is the growth rate of output, **x** is the vector of fiscal variables, **z** is the vector of non-fiscal variables, and e_{it} are white noise error terms. In theory, if the budget constraint is fully specified, then $\sum_{j=1}^{m} x_{jt} = 0$ because expenditures must balance revenues. To avoid this, we need to omit at least one element of **x** (say x_m) to avoid perfect collinearity (Kneller *et al*, 1999). Naturally, the omitted element must be that which theory suggests has neutral effect on growth, for to select any other would introduce substantial bias in parameter estimates. Consequently, we can re-write (5) in the following form.

$$y_t = a + \sum_{i=1}^{k} b_i z_{it} + \sum_{j=1}^{m-1} g_j x_{jt} + g_m x_{mt} + e_{it} \quad (6)$$

From (6), we can then omit x_{mt} to obtain our final growth equation given below.

$$y_{it} = a + \sum_{i=1}^{k} b_i z_{it} + \sum_{j=1}^{m-1} (g_j - g_m) x_{jt} + e_{it} \quad (7)$$

The growth equation denoted by (7), as specified in Kneller *et al* (1999), constitutes our estimatable model. Specified in this manner, the interpretation of the coefficients of fiscal variables should be seen in terms of implied financing. That is, we test the null hypothesis that $(g_j - g_m) = 0$ instead of the conventional null that $g_j = 0$. Accordingly, the interpretation of the coefficient of fiscal variables is the *'effect of a unit change in the relevant variable offset by a unit change in the element omitted from the regression'* (Kneller *et al*, 1999: 175). If the null is rejected, more precise parameter estimates can be obtained if the neutral elements are eliminated from the model (i.e. $g_m = 0 \Rightarrow (g_j - g_m) = g_j$; we test this).

In view of the fact that there is no generally agreed growth model to guide on what factors to include in a growth equation, we drop those fiscal variables which, as stated above, are found to have a neutral effect on growth. We formulate four variants of the growth equation (7). First, a model is estimated in which all fiscal variables (except budget deficit[1] which we assume has no long term growth effect but likely to have adverse short run effect) are included. Second, unproductive government consumption expenditure is dropped from the equation while retaining all the other expenditure and revenue items and then testing for zero coefficient of the remaining neutral element (i.e. non-distortionary revenue). Third, we drop non-distortionary tax revenue, but retain all the other variables including unproductive expenditure and test for zero coefficient of the other neutral element (i.e. unproductive consumption expenditure). Theoretically, the two neutral elements of fiscal policy should be insignificant in the model and therefore in the fourth and final specification, we drop both of them. This is like imposing common zero restriction on coefficients of both elements and our expectation, based on theory, is that both would have no effect on long run growth. If, indeed, we do

1 At this stage, budget deficit was dropped to avoid estimating an identity.

not reject the null, then model four should yield more precise parameter estimates, with lower standard errors of the remaining fiscal variables.

Empirical Evidence

The last two decades have witnessed an upsurge of empirical research aimed at unravelling the relationship between various measures of fiscal variables and economic growth. In this endeavour, cross-section, panel, and time series data have been used. Attempts to underpin the growth relationship are undermined by conceptual, statistical and estimation concerns. Not surprisingly, empirical findings have been diverse: Nijkamp and Poot (2002) conducted a meta-analysis of past empirical studies of fiscal policy and growth and found that in a sample of 41 studies, 29% indicate a negative relationship between fiscal policy and growth, 17% a positive one, and 54% an inconclusive relationship. One of the contributory factors to these varied empirical results is the measure used to proxy for fiscal policy. Different investigators have used different measures of government spending as proxies for government size, e.g. total government spending, government consumption, total government revenue, or functional categories of government expenditure among others.[2] Most of these measures are expressed as shares in GDP (GNP) either as levels or as growth rates. Admittedly, the choice of a given measure depends on which data series are available to the researcher, and given that some measures are better than others, results are bound to differ.

There are, of course, many other empirical problems contributing to the mixed results in the empirical literature. These include use of different model specifications and estimation techniques, sample sizes, quality of data, and limited availability of data on relevant variables. A related problem is that some researchers use government expenditure as an exogenous variable while others use it as an endogenous variable which causes and is caused by economic growth – either choice might generate different results [Agell *et al* (1997), Glomm and Ravikumar (1997), Peacock and Scott (2000), Easterly (2001), Nijkamp and Poot (2002)]. Nevertheless, most researchers agree that if government policy influences growth, then it could be an important factor in explaining variations in long run growth among countries.

2 For example, Peacock and Scott (2000) quote fourteen such measures of government size.

Those researchers who have used functional categories of public expenditure in their growth regressions have also found mixed results. For example, Devarajan *et al*. (1993) found government expenditure on health and transport and communications to be growth promoting but found no positive impact of education and military spending. Albala and Mamatzakis (2001), using time series data covering 1960-1995 to estimate a Cob-Douglas production function that includes public infrastructure for Chile, found a positive and significant correlation between public infrastructure and economic growth. These results reinforce the argument that empirical outcomes are likely to differ from country to country and time to time even when same estimation techniques are employed. We therefore believe the solution to the fiscal policy-growth conundrum rests in specific country studies.

3 ECONOMETRIC MODEL AND DATA

3.1 Econometric model

We start our empirical analysis of fiscal policy and growth by formulating an autoregressive distributed lag (ADL) model. The choice of an ADL model rather than a static one is motivated by the need to capture all the dynamic responses in the dependent variable brought about by changes in its own lags and the contemporaneous and lagged values of the other explanatory variables. Additionally, an ADL model is more appropriate for small samples like ours. Starting by directly estimating a static long run equation may fail to capture any immediate, short run, and long run responses in the system thus generating imprecise coefficient estimates [Banerjee *et al* (1993), Charemza and Deadman (1997), Johnston and DiNardo (1997)]. Estimating the model in this manner yields valid *t*-statistics even when some of the right hand variables are endogenous (Enders, 1995). Following Johnston and DiNardo (1997), we can represent the general ADL (p,q) in the following form,

$$A(L)\boldsymbol{y}_t = \alpha + B(L)\boldsymbol{x} + e_t \quad (8)$$

where $A(L) = 1 - \alpha_1 L - \alpha_2 L^2 - \ldots - \alpha_p L^p$; $B(L) = \beta_0 + \beta_1 L + \beta_2 L^2 + \ldots + \beta_q L^q$; p,q are lag lengths, $A(L)$ and $B(L)$ are polynomial lag operators, L is the lag operator such that $L^p y_t = y_{t-1}$, and e_t are white noise residuals. We will therefore use the framework given in (8) to estimate equation (7).

Test for Cointegration

Granger (1986, 1988) and others have shown that if two series y_t and x_t are cointegrated of order d, b, i.e. $y_t \sim CI\ (d, b)$, then the series have a long run equilibrium relationship and any deviation from this equilibrium is temporal and will eventually be corrected and the long run equilibrium restored. For this to happen, however, two conditions must hold. First, all the components of y_t must be $I(d)$ such that differencing them generates series that are integrated of a lower order, and second, there must exist a vector b such that, $z_t = b'y_t \sim I(d-b)$. If for instance y_t is integrated of order one ($y_t \sim$ I(1)), then its first difference would be integrated of order zero (stationary) i.e. $y_t \sim$ I(0), in which case y_t and x_t are cointegrated. Therefore, cointegration implies that even though the series are non-stationary, there exists a linear combination that is itself stationary (Hendry and Juselius, 2001). By Granger's representation theorem, if variables are cointegrated, there must be causality in at least one direction and the long run relationship is free of spurious correlations. Cointegration also implies that I(1) variables can be estimated by OLS method to produce an OLS estimator of b that is super-consistent in the sense that, as the sample size T grows larger, the estimator of b converges to its true value much faster.

Testing for cointegration in a single equation context usually involves testing for unit roots in the residuals of the cointegrating relationship i.e. from the long run equation. In that case, the null hypothesis is that the residuals are non-stationary (have unit roots) with the alternative being they are stationary. One widely used test for cointegration is the Engle-Granger (EG) method which uses residuals from the long run equilibrium to test for cointegration. It is a single equation approach, and assumes there is only one dependent endogenous variable and all the independent variables are weakly exogenous[3]. The method involves two stages: one,

3 As earlier mentioned, however, an unrestricted ADL model may have endogenous explanatory variables without necessarily attenuating classical inferences (see Enders, 1995 for an explanation).

estimation of the long run equation and two, use of residuals from the estimated long run relationship to conduct the unit roots/cointegration test using the ADF method. One disadvantage of this approach therefore is that any errors in the first step are likely to be transmitted into the second stage thus affecting the reliability of the final results [Enders (1995), Harris (1995), Sturm *et al* (1996)].

If y_t and x_t are *CI(1, 1)*, the long run model can then be reformulated into an error correction model (ECM) which integrates short- and long- run dynamics of the model. An ECM takes the following form.

$$\Delta y_t = a + \sum_{i=1}^{p} f_i \Delta y_{t-i} + \sum_{i=0}^{p} d_i \Delta x_{t-i} + pECT_{t-1} + e_t \qquad (9)$$

Where ECT_{t-1} is one period lag of the residual term (disequilibrium) from the long run relationship, e_t is white noise error term, and a, f_i, d_i, p are parameters. Equation (9) can be estimated by the usual OLS method since all its terms (in first differences) are I(0) and therefore standard hypothesis testing using t-ratios and related diagnostic tests can be conducted on the error term. Theoretically, the coefficient of the one period lag of the disequilibrium term should be negative (i.e. $\pi < 0$) and significant if the disequilibrium is to be corrected in subsequent period and long run equilibrium restored. In this light, the coefficient of the error term represents the speed of adjustment to the long run equilibrium i.e. it shows by how much any deviation from the long run relationship is corrected in each period.

Causality Analysis

Granger causality tests whether lagged values of one variable predict changes in another, or whether one variable in the system explains the time path of the other variables. Hence, a variable x is said to Granger cause another variable y ($x \rightarrow y$) if past values of x can predict present values of y. Granger (1988) posits two cardinal principles namely the cause precedes the effect and; '*the causal series contains special information about the series being caused that is not available in the other available series*' (Granger, 1988: 200). Similarly, there is an instantaneous causality from x to y ($x \Rightarrow y$) if present and past values of x predict present value of y. If causality is in one direction e.g. from x to y, we have **uni-directional** causality while if x Granger causes y and y Granger causes x, we have **bi-directional or feedback** causality ($y \leftrightarrow x$). There are two commonly used causality tests: one due to

Granger (1969) and the other due to Sims (1972). The former is however more widely used in applied econometrics, partly because of its simplicity and also because it is less costly in terms of degrees of freedom (Charemza and Deadman, 1997). The test for Granger causality is performed by estimating equations of the following form.

$$\Delta y_t + a_0 + \sum_{i=1}^{m} a_{1,i}\Delta y_{t-i} + \sum_{i=0}^{m} a_{2,i}\Delta x_{t-i} + dECM_{t-1} + e_t \qquad (10)$$

$$\Delta x_t + b_0 + \sum_{i=1}^{m} b_{1,i}\Delta x_{t-i} + \sum_{i=0}^{m} b_{2,i}\Delta y_{t-i} + gECM_{t-1} + m_t \qquad (11)$$

Where ε_t and μ_t are white noise disturbance terms (normally and independently distributed), *m* are the number of lags necessary to induce white noise in the residuals, and ECM_{t-1} is the error correction term from the long run relationship. x_t is said to Granger-cause y_t if one or more $a_{2,i}$ $(i = 1,\ldots m)$ and d are statistically different from zero. Similarly, y_t is said to Granger-cause x_t if one or more $b_{2,i}$ $(i = 1,\ldots m)$ and g are statistically different from zero. A feedback or bi-directional causality is said to exist if at least $a_{2,i}$ and $b_{2,i}$ $(i = 1,\ldots m)$ or d and g are significantly different from zero. If on the other hand, $a_{2,0}$ or $b_{2,0}$ are statistically significant, then we have an instantaneous causality between y_t and x_t. To test for causality, we use either the significance of the *t*-statistic of the lagged error correction term or the significance of *F*-statistics of the sum of lags on each right hand side variable.

3.2 Data and Variables

All the data series on fiscal and non-fiscal variables were obtained from the *Economic Survey* annual publication, published by the government of Kenya. Some adjustments were made to convert most of the series from fiscal years[4] to calendar years and also to express real GDP in one base year (1982). Where there were some negative values in some years (e.g. budget deficits), the series were transformed into positive values by adding a scalar across the observations if we needed to take logs (see Appendix A for Variable definitions and raw data). In this study, recurrent or consumption expenditure (GC) is further divided into productive (PGC) and unproductive (UGC) expenditure. This classification follows Barro (1990) who defines productive expenditure as that which enters into the production function of the private agent and unproductive expenditure as that which enters into the private agent's utility function. It is not theoretically clear which items of public expenditure fall under the Barro categories and as a consequence, some subjectivity cannot be entirely ruled out. For our purpose, expenditure on health, education and economic services was treated as productive and the rest of recurrent expenditure was assumed unproductive. There are, of course, caveats to this categorization since there may be some elements of productive expenditure that are unproductive and *vice versa*. **Figure 1** below presents trends of the main categories of expenditure expressed as shares in GDP for the period 1964 – 2002.

Figure 1: Expenditure Trends (as shares of GDP) for Kenya, 1964 – 2002

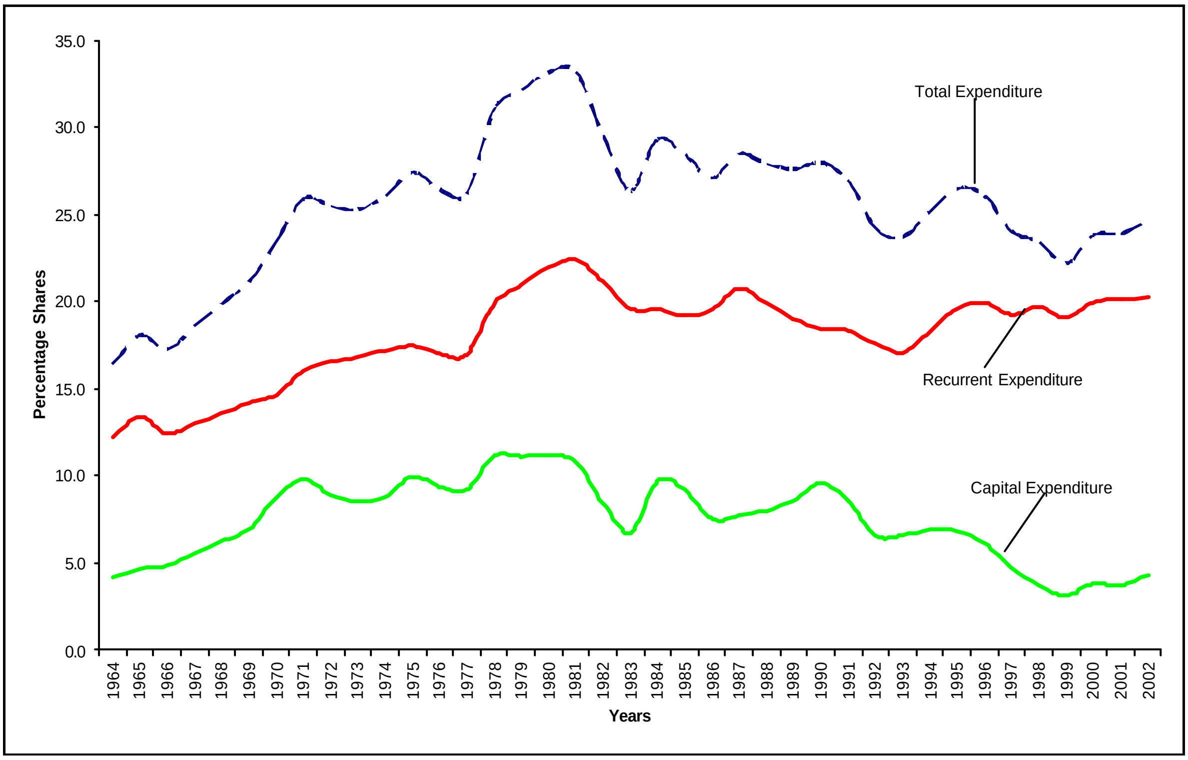


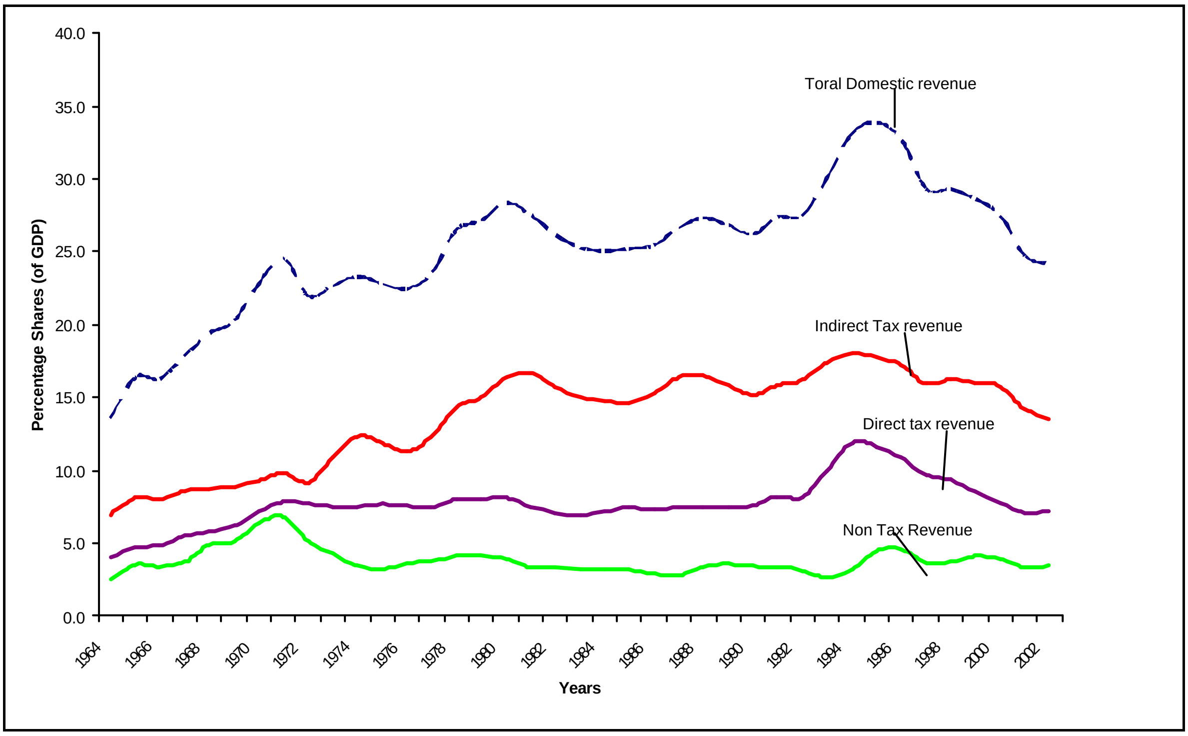
Figure 1 above reveals that the share of government recurrent expenditure (net of debt repayment) averaged between 15% and 20% over the study period while that of capital expenditure has been consistently below 10% throughout the entire period and has actually been falling for most of the 1980s and 1990s. The declining trend in capital expenditure over this period may be attributed to austerity measures imposed on the government by the Bretton

4 A fiscal year in Kenya begins on 1st July and ends on 30th June while a calendar year begins on 1st January and ends on 31st of December (also see note under Appendix A2).

woods institutions - either in form of World Bank's structural adjustment programmes or through IMF's stabilization programmes. Since most recurrent expenditure is all but fixed (salaries and wages, interest on public debt, constitutional offices etc), the only leeway the government has in the wake of these austerity measures is its development budget. Thus most of the expenditure cuts have been effected through reductions in development expenditure, which in turn could have contributed to the declining trend of overall government expenditure especially in the 1990s. This is a worrying trend because capital expenditure is expected to provide the necessary infrastructure for private sector investment and growth and therefore low budgetary allocation on this item means these services have been under-provided. On the other hand, recurrent (consumption) expenditure has remained relatively high (and could have been much higher had we included the debt redemption component) and shows an upward trend in the 1990s.

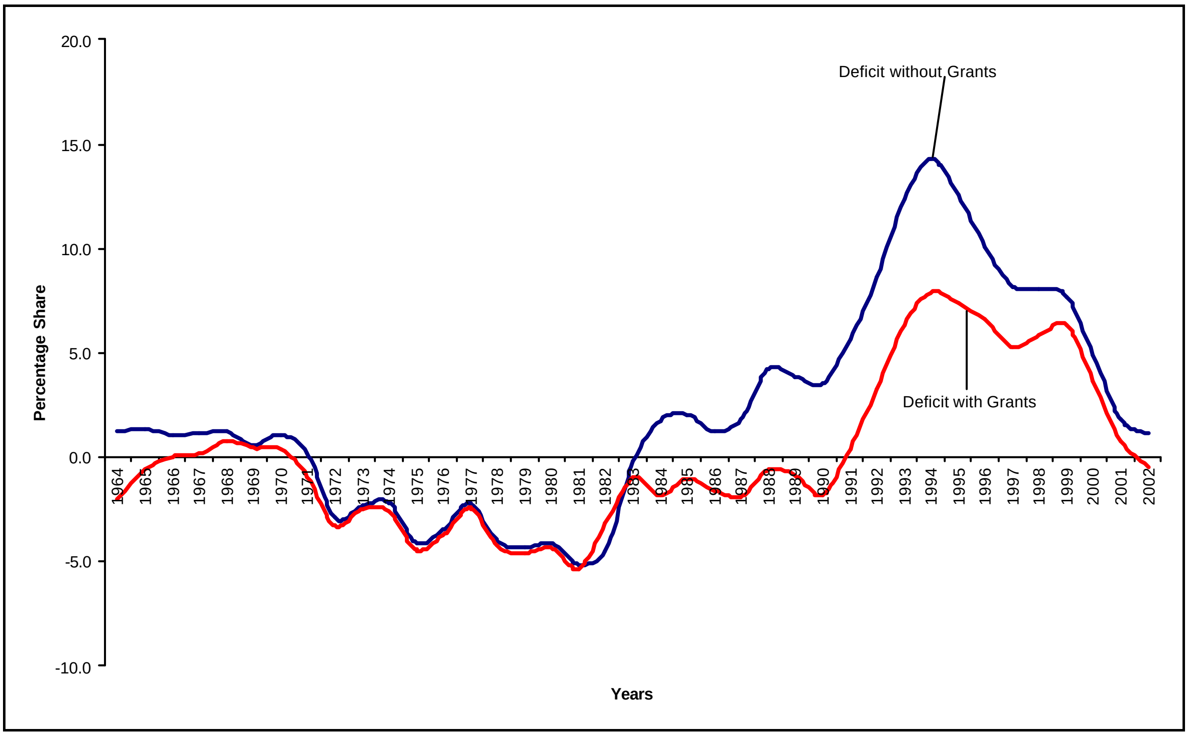
On the revenue side, the major components – direct and indirect taxes – have not kept pace with the growth of expenditure. **Figure 2** below shows trends in the revenue elements for the period 1964 - 2002. The share of indirect tax revenue in GDP accounts for the bulk of tax revenue (13.6%) followed by direct tax revenue (7.7%) and then non-tax revenue (3.8%). Non-tax revenue includes, *inter alia*, other taxes not classified under direct or indirect taxes, fines, forfeitures, licences, property income, and privatisation proceeds.

Figure 2: Revenue Trends as Shares of GDP for Kenya, 1964-2002



In the first decade of independence, all the components of revenue were increasing due to rising buoyancy and elasticity caused by the rapidly growing economy over this period. However, in the second decade, direct tax and non-tax revenue tapered off with the only increase coming from indirect taxes – accounted for by expenditure taxes resulting from the commodity boom of mid 1970s. In the third decade, all the revenue components stagnated as a result of the slow down of the economy over this period. The next upsurge of revenue discernible from figure 2 is around 1992-1998 which can be attributed to improved tax administration in response to tax reforms started in late 1980s and early 1990s as well as increased consumption taxes arising from general election spending binges of 1992/93 and 1996/97. The implication of the differences in growth rates of expenditure and revenue is a persistent budget deficit over the sample period. **Figure 3** shows shares of budget deficit in GDP with and without grants over the study period.

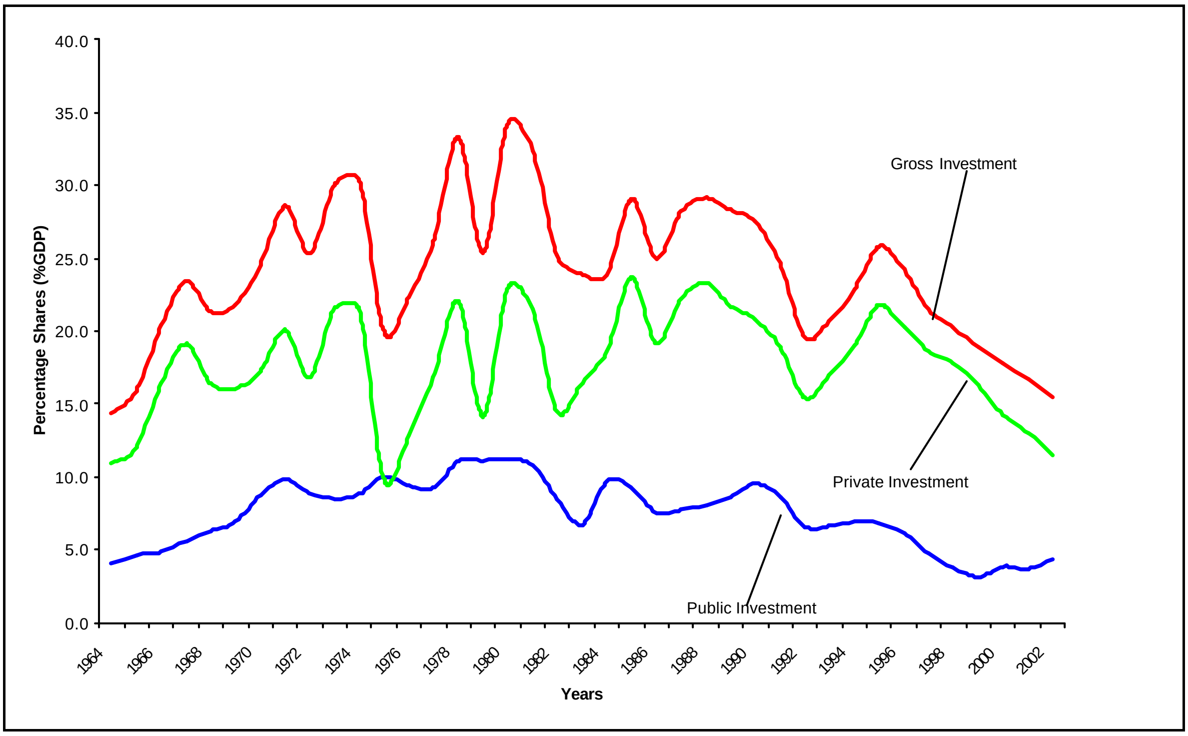
Figure 3: Trends in budget deficit with and without Grants (% of GDP), 1964 – 2002



A notable feature from the above figure is the sharp increase in budget deficit in the first half of 1990s when the share of budget deficit without grants rose from 3.5% in 1990 to a high of 14.3% in 1994 before falling gradually to a low of 1.1% in 2002. The rise in deficits around this time is partly due to fiscal indiscipline on the side of government and rising public debt obligation. On the other hand, the fall after 1994 could be attributed to the fiscal austerity measures undertaken by the government under the auspices of the Bretton Woods institutions as a precondition for financial support. For estimation purposes, and in view of the fact that deficits (BD) are likely to significantly affect growth in the short run than in the long run, we exclude it in the long run analysis (*see* footnote 8).

Among the non-fiscal variables used in this study are private investment (PINV), school enrolment (AENR) and foreign aid in form of grants (AID). Private investment is seen in many countries, including Kenya, as the engine of growth. However, its measurement and composition has been contentious in the growth literature. One measure is derived by deducting the government investment (GINV) from gross fixed capital formation (GFCF). Government investment in this study is proxied by total development budget of the government. In the 1970s, growth of gross capital stock averaged 7.1% per annum but has consistently been falling to an annual average of 2.7% in the 1980s and by 1990s, growth in gross capital formation was just enough to offset its depreciation. Available statistics also show that GFCF has been declining over time. For instance, GFCF as share of GDP has fallen from 27.9% between 1980 and 1989 to 21.7% between 1990 and 2001. **Figure 4** below shows trends of shares of gross capital investment, private investment and government investment over the period 1964 – 2002.

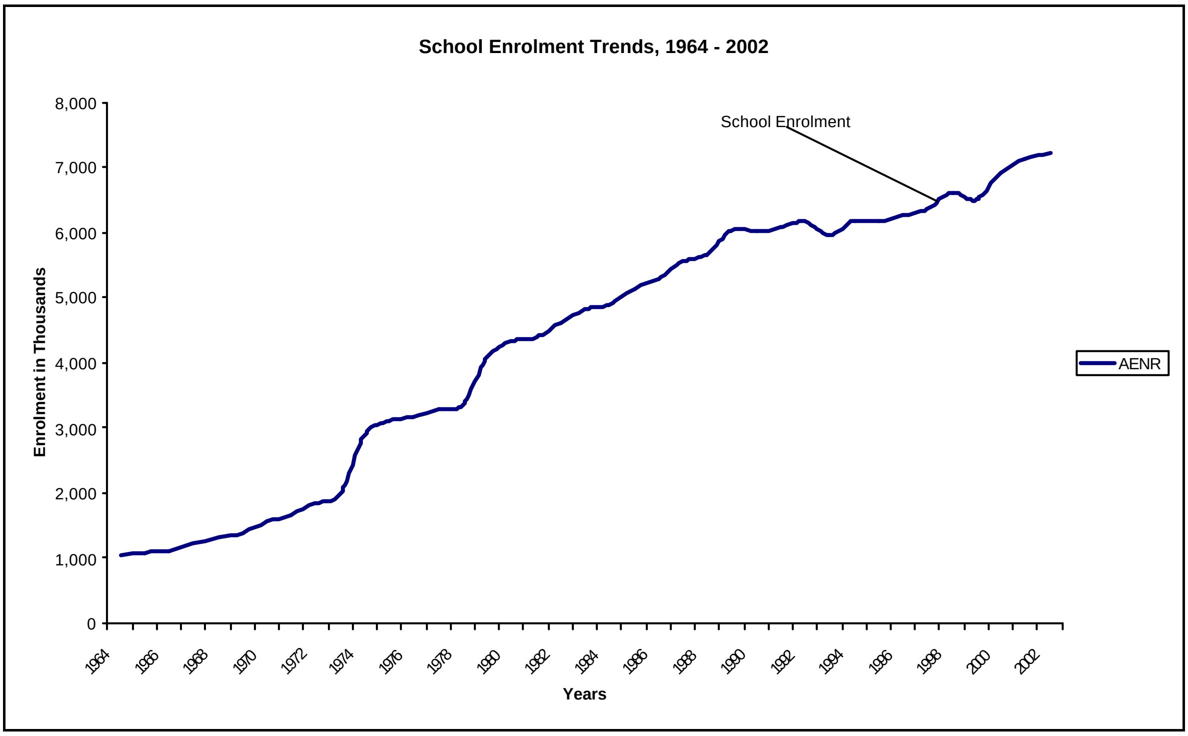
Figure 4: Investment Trends in Kenya, 1964-2002



Most of the decline in GFCF could be attributed to the apparent decline in public investment particularly beginning in the 1990s. This is consistent with our earlier discussion where we found that most of the macroeconomic fundamentals started deteriorating in early 1990s. Over this period, the government resorted to excessive domestic borrowing in response to foreign aid freeze in 1991. The period also coincides with the first multiparty general elections in 1992 which was associated high expenditure as well as political uncertainties which could have adversely affected investment. Private investment experienced some upsurge between 1987 and 1991 partly due to the semi-coffee boom of 1986 and also in response to some of the policies put in place at the time by the government to encourage private sector investment. It fell in the next three years due to problems related to political uncertainties and poor macroeconomic environment. The upsurge after 1994 could be attributed to the far reaching reforms taken during this time aimed at revitalising the economy, including privatisation of state enterprises.

Another non-fiscal variable covered in this study is school enrolment, which is widely used in the growth literature to proxy for human capital development or growth of labour force. Some researchers use either primary or secondary school enrolment or both to proxy for this variable. In the current study, both actual primary and secondary school enrolment were taken as reported in various publications of the *Economic survey*. For estimation purpose, log of actual enrolment was taken. The trend of total school enrolment in thousands for the period 1964 – 2002 is shown in **figure 5** below.

Figure 5: School Enrolment Trends, 1964 – 2002



For economic growth, however, increase in enrolment figures alone may not be enough; quality of schooling and the type of skills taught at school may matter more than mere numbers. As Pritchett (2003) observes, it might be advisable to go beyond 'education is good' for growth and focus more on quality of learning, nature and the dynamism of demand and supply of school graduates.

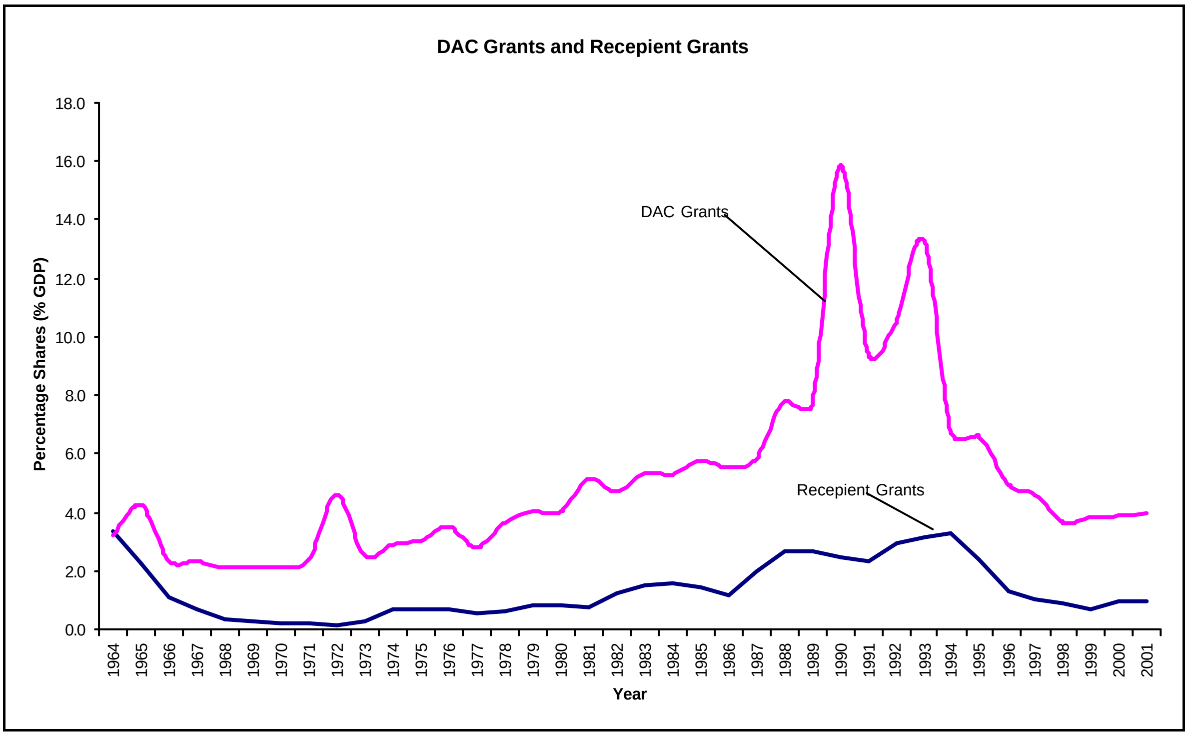
The last variable we consider is foreign aid, which has become an integral part of development planning in most developing countries. The flow of external resources or foreign aid is either from a country to another or from multilateral institutions to a country and comes in many forms (financial, technical assistance, food/commodity and equipment). According to the *Economic Survey*, series on foreign resources are classified as either external grants (for which there is no future repayment) or net external loans (where net means inflows less outflows).

Foreign aid, if well utilized, can contribute positively to a country's gross saving and investment and ultimately to economic growth. Kenya has had her share of foreign capital inflows and according to official statistics, about 70% of the government's development budget is donor financed i.e. in form of grants and project loans. Besides, the government has relied on the World Bank and the IMF for programme support for macroeconomic stabilization – a prerequisite for investment, growth and development.

Between 1964 and 1973, external grants to the government were falling, but starting rising gradually thereafter until 1994 when they started falling before picking up again in 1999. On average, grants constitute a small share in GDP averaging a mere 1.3% of GDP over the study period[5]. These low percentage shares of external resources are as reflected in the government of Kenya official records and it's upon these figures that financial budgeting and economic planning are based. However, examining other sources of data on grants, especially the OECD/DAC dataset, gives a slightly different picture. For the period 1964 – 2001, DAC data show that, on average, grants amounted to 5.1% of GDP compared with 1.3% from the *Economic Survey* between 1964 and 2002. **Figure 6** compares DAC grants and grants recorded in official books of the recipient country.

Figure 6: Trends of DAC and Recipient country Grants, 1964 – 2001

5 This percentage is calculated from government's own Economic Survey.



As can be seen in the above plot, DAC grants to Kenya are much higher that what the recipient country records. This is because the DAC data includes all external grants earmarked for Kenya as a country not necessarily for the government i.e. includes grants meant for non-governmental organisations (NGOs). Moreover, the data is on commitment basis and not what is actually released to Kenya. It also includes grants for technical assistance, machinery and equipment – components that are difficulty to measure and likely to be excluded from official records.

The ups and downs in the trend of grants reflect the frosty relationship between the government and donors since the advent of structural adjustment programmes in the 1980s. It has become a ritual: the government turns to donors whenever faced with macroeconomic imbalances and donors on their part pledge their support so long as the government honours agreed conditionalities. Once disbursements start and the domestic economic situation improves, the government reneges on agreed conditionalities, donors respond by discontinuing funding. At some stage, the government turns to donors once again and the ritual continues. So for foreign aid to make desired impact on growth, the flow should be less volatile and more predictable. Both parties must be realistic and sign conditionalities that are technically and politically feasible so as to avoid disruptions of planned projects and programmes and thus improve the effectiveness of foreign aid.

4 REGRESSION RESULTS

4.1 Dynamic Modelling of Fiscal Policy and Growth

Section 2 gave a thumbnail sketch of the four variants of the modelling procedure for estimating equation 7. In summary, model 1 is a general model that includes all the fiscal variables. Model 2, excludes unproductive consumption expenditure while model 3 leaves out only non-distortionary tax revenue. In model 4, both are dropped. If these variables are indeed irrelevant in explaining growth as posited by theory, then the signs and magnitudes of the remaining coefficients in the growth equation should remain largely unchanged, but significant. Furthermore, in any specification in which either of the neutral elements is included, its coefficient should be insignificant.

Using an ADL model given in (8), we began by estimating an over-parameterised model (including all relevant variables and lags) and then systematically testing downwards for their significance and other diagnostics such that in the final model, only the most relevant variables remained [Banerjee *et al* (1993), Inder (1993), Charemza and Deadman (1997)]. From the dynamic model, the static long run relationship was derived followed by the PcGive-unit root test, which is also the test for cointegration among the variables. After ascertaining cointegration and robustness of the long run relationship, an ECM was reformulated to incorporate short run and long run dynamics. The same procedure was performed for each of the four models. In view of the many variables in the model and the limited sample size we have, the number of lags we could accommodate into the ADL dynamic equation was restricted to only one period[6]. Results for each specification are discussed in the following sections.

6 We also tried two lags but the second lag was statistically insignificant and was therefore dropped from the model.

Time series models that incorrectly assume stationary process lead to invalid parameter estimates. It has therefore become a norm in cointegration analysis literature to first assess the data series for time series properties. This is achieved by testing for unit roots in the series to ensure they are integrated of same order, usually one, so that their first differences are integrated of order zero. If the series are integrated of the same order and cointegrate, then estimation results and statistical inferences would be non-spurious (Granger and Newbold, 1974). In this study, we tested for unit roots using the widely used Augmented Dickey-Fuller (ADF) test (see Appendix B: Table B1 for the results). These results indicate that each data series is integrated of order one or non-stationary in levels and stationary in first differences, but with no significant drift or time trend. Thus all data series are integrated of order one – a result that permitted testing of cointegration and related analyses.

A synopsis of the estimation results for models 1 – 4 is presented in **Table 1** for the long run models and **Table 2** for the short run models. In each estimation, diagnostic tests were examined to ensure they were satisfactory and, where a variable was dropped, the variable exclusion test (*F*-test) was undertaken to guarantee that indeed the variable was irrelevant to the model. Since the purpose of models 1 - 3 was to demonstrate that elimination of the neutral fiscal variables was statistically permissible, and that doing so would not only leave coefficients of remaining variables unchanged but also improve their accuracy, we skip the estimation details for those models[7]. Our focus is on model 4, which is distilled from the previous three. Results contained in Table 1 are largely consistent with prior theoretical prediction. We find that both unproductive government expenditure and non-distortionary taxes have neutral effect on growth and that dropping one or both of them does not alter, in any significant way, magnitudes and signs of the coefficients of the retained variables. In addition, there is cointegration in all the models as would be expected. Variable exclusion test also validated exclusion of the aforementioned fiscal variables.

We now turn to model 4 in which both unproductive expenditure and non-distortionary taxes were dropped. As previously discussed, doing so should yield more precise coefficient estimates (reflected in lower standard errors relative to any of the previous two models). The model was then subjected to the estimation and testing procedures discussed previously, starting with a dynamic model, cointegration test, static long run, and re-formulation and estimation of an ECM[8]. Results of the estimated ECM for model 4 are reported in column 5 of **Table 2** below. All the coefficients except that of school enrolment are highly significant. The coefficient of the error correction term possesses the expected negative sign and is quite significant. It is on the basis of results contained in column 5 of tables 1 and 2 that our subsequent analysis will be based.

7 To save on space, we have not reported detailed estimation results including diagnostic tests for models 1 – 3 but a summary of these is given in tables 1 and 2 for the long run and short run models respectively.

8 Diagnostic tests for the dynamic model for model 4 and results of cointegration test are given in Appendix B: Tables B3 and B4. To confirm budget deficits have no long term effect on growth, model 4 was re-estimated with this variable included and results confirmed our expectation, but had marginal significance in the short run. Estimated coefficients for the remaining variables remained as in the model without deficits (results not included). Consequently, budget deficit variable was excluded from the model.

Table 1: Summary of Regression Results for the long run Models

VARIABLE	Model I	Model II	Model III	Model IV
CONSTANT	3.2**	3.1**	3.2**	3.2**
	(0.22)	(0.18)	(0.148)	(0.142)
PGC	-	-	-0.15**	-0.13**
	0.16**	0.15**	(0.049)	(0.044)
UGC	(0.06)	(0.05)	0.04	---
	-0.04	---	(0.044)	---
GINV	(0.06)	---	0.05**	0.04**
	0.05**	0.04**	(0.014)	(0.011)
DT	(0.02)	(0.01)	0.05	0.05*
	0.05	0.07*	(0.032)	(0.027)
IDT	(0.06)	(0.04)	---	---
	-0.003	-0.06	---	---
NTR	(0.11)	(0.08)	0.15**	0.15**
	0.14**	0.14**	(0.029)	(0.027)
AID	(0.03)	(0.03)	-0.02**	-0.02**
	-	-	(0.009)	(0.008)
PINV	0.02**	0.02**	0.10**	0.10**
	(0.01)	(0.009)	(0.022)	(0.021)
AENR	0.10**	0.11**	0.20**	0.18**
	(0.04)	(0.032)	(0.026)	(0.022)
	0.20**	0.20**		
	(0.04)	(0.035		
Sigma	0.016	0.016	0.015	0.015
RSS	0.005	0.005	0.005	0.005
R^2	0.978	0.977	0.978	0.976
F(19,18)	42.3[0.000]**	50.2[0.000]*	52.3[0.000]**	60.3[0.000]**
-------------------	-----------	*	------------------	------------------
---------	----------	-----------	--	0.790[0.4674]
AR1-2 test:	1.014[0.3850]	----------	1.016[0.3818]	1.182[0.2899]
ARCH 1-1	0.431[0.5209]	0.844[0.4413]	0.496[0.4904]	2.389[0.3029]
test:	3.389[0.1837]	1.400[0.2474]	3.344[0.1879]	0.273[0.6071]
Normality	0.116[0.7380]	2.417[0.2986]	0.022[0.8829]	
test:		2.228[0.1471]		
RESET test:				
N	38	38	38	38
Cointegration	-5.66*	-5.84**	-6.23**	-6.53**

Notes:

/[1] Model I: General over-parameterised model (with all variables included)

/[2] Model II: Unproductive expenditure omitted.

/[3] Model III: Non-distortionary tax revenue omitted.

/[4] Model IV: Both unproductive expenditure and non-distortionary revenue omitted.

/[5] Standard errors are in parentheses.

*/[6] ** & * indicate significance at 1% and 5% respectively in the case of coefficients or rejection of the null of no cointegration at the same significance levels.*

/[7] Signs and magnitudes of coefficients remain largely unchanged across the three specifications.

Table 2: Summary of Regression Results for the Error Correction Models

VARIABLE	Model I	Model II	Model III	Model IV
CONSTANT	-0.004	-0.002	-0.002	-0.001
	(0.003)	(0.003)	(0.003)	(0.003)
DPGC	-0.24**	-0.24**	-0.24	-0.25**
	(0.045)	(0.045)	(0.043)	(0.044)
DUGC	-0.04	---	-0.05	---
	(0.045)	---	(-0.038)	---
DGINV	-0.01	-0.05	-0.01	-0.02
	(0.019)	(0.018)	(0.019)	(0.018)
DDT	0.15**	0.20**	0.15**	0.21**
	(0.049)	(0.048)	(0.044)	(0.047)
DIDT	-0.02	-0.07	---	---
	(0.056)	(0.048)	---	---
DNTR	0.10	0.10**	0.11**	0.11**
	(0.021)	(0.021)	(0.021)	(0.021)
DAID	0.02	0.02**	0.02	0.01
	(0.010)	(0.010)	(0.009)	(0.009)
DPINV	0.04**	0.05**	0.04**	0.04**
	(0.012)	(0.011)	(0.010)	(0.010)
DAENR	0.03	0.02	0.03	0.03
	(0.045)	(0.045)	(0.043)	(0.043)
ECM_{t-1}	-1.05**	-1.05**	-1.06**	-1.08**
	(0.122)	(0.122)	(0.122)	(0.126)
Sigma	0.014	0.014	0.014	0.014
RSS	0.005	0.005	0.005	0.005
R^2	0.809	0.800	0.808	0.793
F(19,18)	11.4[0.000]**	12.4[0.000]**	13.1[0.000]**	13.9[0.000]**
----------------------------	---------------------	---------------------	--------------------	------------------
AR1-2 test:	1.305[0.2889]	0.844[0.4413]	1.332[0.2815]	0.923[0.4094]
ARCH 1-1 test:	0.673[0.4197]	1.400[0.2474]	0.716[0.4052]	1.596[0.2173]
Normality test:	3.389[0.1837]	2.417[0.2986]	3.344[0.1879]	2.389[0.3029]
Hetero test:	0.223[0.9951]	0.268[0.9917]	0.334[0.9773]	0.367[0.9681]
RESET test:	1.912[0.1785]	2.228[0.1471]	1.743[0.1979]	2.021[0.1662]

Notes: *Same comments as in table 1*

We note in passing that both the unproductive government consumption expenditure and nondistortionary revenue have zero coefficients throughout the four models confirming the Barro's (1990) theoretical prediction and Kneller's *et al* (1999) empirical findings for OECD countries. It is also worthy noting that the final model is more accurate relative to the other three models in which either of the neutral elements is included. This is shown by the smaller standard errors in model 4 than in the other models. Before discussing these results in greater detail in section 5, we perform some causality analysis in section 4.2 below to try and get some insights into how variables interact among themselves.

4.2 Causality Analysis

We conducted causality analysis based on model 4 and followed the procedure discussed in section 3. Although this method is more appropriate for bivariate relationships, it can in practice be used in a multivariate system but one must control for the other variables in the model. More formally, let y_t and x_t be variables of interest (those that we wish to investigate), and let z_t be a vector containing all the other (conditioning) variables in the model. We test for causality by modifying equations (10) and (11) to obtain the following equations.

$$\Delta y_t = a_0 + \sum_{i=1}^{m} a_{1,i} \Delta y_{t-i} + \sum_{i=0}^{m} a_{2,i} \Delta x_{t-i} + \sum_{i=0}^{m} a_{3,i} \Delta z_{t-i} + dECM_{t-1} + e_t \tag{12}$$

$$\Delta x_t = b_0 + \sum_{i=1}^{m} b_{1,i} \Delta x_{t-i} + \sum_{i=0}^{m} b_{2,i} \Delta y_{t-i} + \sum_{i=0}^{m} b_{3,i} \Delta z_{t-i} + gECM_{t-1} + m_t \tag{13}$$

Except for the additional vector of conditioning variables, the description of the model remains as discussed earlier. **Table 3** below provides a summary of the results of Granger causality test for the long run model.

Table 3 Summary of causality tests on Model 4

Direction	Chi-sq. (c^2)	P-Value	Conclusion
PGC ® Yp	6.2240	[0.0079]**	Bi-directional causality between PGC and output (Yp)
Yp ® PGC	5.3689	[0.0136]*	
GINV ® Yp	6.8776	[0.0053]**	Uni-directional causality from government investment to output
Yp ® GINV	0.8558	[0.4399]	No causality from output to government investment
DT ® Yp	5.8360	[0.0101]*	Weak bi-directional causality between tax revenue and output
Yp ® DT	4.6995	[0.0212]*	
NTR ® Yp	7.5069	[0.0037]**	Bi-directional causality between non-tax revenue and output
Yp ® NTR	8.4810	[0.0022]**	
AID ® Yp	9.6562	[0.0012]**	Causality runs from aid to output but not output to aid.
Yp ® AID	0.5243	[0.5999]	
PINV ® Yp	12.1780	[0.0003]**	Uni-directional causality running from private investment to output.
Yp ® PINV	2.3074	[0.1254]	
AENR ® Yp	7.2543	[0.0043]**	Causality is from enrolment to output, not the reverse.
Yp ® AENR	0.6958	[0.5104]	
PGC ® AID	11.9570	[0.0004]**	Causality runs from aid to govt consumption expenditure
AID ® PGC	0.2113	[0.8113]	
AID ® DT	5.6114	[0.0116]*	Weak causality running from aid to tax revenue
Yp ® PGC	0.2026	[0.8183]	
GINV ® PGC	5.7745	[0.0105]*	Causality running from PGC to Government investment
PGC ® GINV	0.4402	[0.6500]	
PGC ® NTR	5.0304	[0.0170]*	Bi-directional causality between non-tax revenue and PGC
NTR ® PGC	6.1504	[0.0083]**	
PINV® PGC	7.5824	[0.0035]**	Uni-directional causality running from private investment to PGC.
PGC® PINV	2.6560	[0.0948]	
AENR® PGC	7.4966	[0.0037]**	Uni-directional causality running from enrolment to PGC
PGC® AENR	0.1753	[0.8405]	
NTR ® GINV	2.5759	[0.1011]	Causality is from Government investment to non-tax revenue
GINV ® NTR	6.0551	[0.0088]**	
PINV® GINV	1.0125	[0.3812]	No causality between private and public investment.
GINV® PINV	2.3661	[0.1196]	

Notes:

/[1] In most of the cases, where there is no causality in either direction, results are not reported in the table (private and public investment included to highlight the surprising finding of non-causality between the two).

*/[2] **, * indicate rejection of the null of non-causality at the 1% and 5% significance levels respectively.*

/[3]Main focus is on fiscal variables and how they impact among themselves and other variables in the model.

These results show three bi-directional causality relationships between productive government consumption expenditure and per capita output, non-tax revenue and per capita output, and between productive consumption expenditure and non-tax revenue. These results show that there is no Granger causality between per capita output and government investment, which is not entirely surprising given that in Kenya over 70% of government capital budget is externally funded. What is surprising, however, is that aid in this model does not appear to Granger cause government investment neither does government investment cause foreign aid (grants)[9]. Perhaps it could be the case that the measure of aid used is not representative of actual capital inflows into the country or that its effect on government investment is an indirect one via other variables. Another surprising result is that there is no causal link between private and public investment as we expected. As we argue later, this could be attributed to weaknesses inherent in causality tests. It could also be the case that presence of many variables might be reducing the effectiveness of the causality test.

5 Discussion of Empirical Results

Following Barro (1990), Kneller *et al* (1999) posit that removing unproductive consumption expenditure and/or non-distortionary taxes should have no significant effect on the magnitudes and/or signs of the other variables in the model. Using panel data for 22 OECD countries, Kneller *et al* (1999) ascertain this to be true. One objective of this paper was to use similar concept on a single country, but using time series techniques on annual data. Our results are consistent with their findings save for the signs of coefficients of some of the variables. Estimated coefficients of productive consumption expenditure (PGC) and foreign grants (AID) have contrary signs [from] what was hypothesized.

Table 1 compares coefficients of the static long run models for each of the four growth equations. Although the magnitudes of the coefficients are not exactly the same, the differences are not significant and can be attributed to the collinearity between some of the variables and/or poor quality of data arising from measurement errors common in most developing countries. Although all the coefficients in model 4 are significant in the long run, this is not the case in the short run as some coefficients are not statistically significant (see table 2 above).

There is, however, strong cointegration in all the specifications meaning that a robust long run relationship exist among some or all the variables in the model. Consistent with Kneller's *et al* (1999) finding for OECD countries, omission of the two neutral variables leads to a more precise parameter estimates of the remaining fiscal variables. We therefore base our interpretation and discussion on results of model 4.

Contrary to theoretical prediction, we found a negative and significant correlation between what we defined as productive government consumption expenditure and real per capita GDP. Its elasticity with respect to real per capita income was –0.13. The beneficial impact of such recurrent expenditure (PGC) may require far longer lags to be observed than we were able to incorporate. Another lesson for future research is to attempt to re-define the variable with a view to putting together only those elements of consumption expenditure that are truly productive such as expenditure on preventive health care, medicines, and doctors (in hospitals) or school equipment and teaching quality (in schools).

Government investment has a positive and significant coefficient with an output elasticity of 0.04. In her study of debt and growth in Kenya, Were (2001) also found a strong positive relationship between public investment and growth in Kenya. Similarly, Barro (1989) and Easterly and Rebelo (1993) in their respective cross-country studies, found a positive and significant relationship between government investment and output. Thus our results are consistent with most studies in this area and confirm the theoretical prediction of a positive and significant impact of public investment on growth. The implication is that Kenya's economy is likely to perform better if more resources are diverted from government consumption to investment spending. In the short run, however, government investment does not appear to be a significant factor influencing growth in Kenya. This could be attributed to the fact that government investments have long gestation periods before yielding beneficial returns.

Distortionary tax and non-tax revenues were found to be positively correlated with per capita output, with both possessing long run elasticities of 0.05 and 0.15 respectively. Their positive sign and significance were also witnessed in the short run. A possible interpretation of this

9 In most cases, results are not included in table 3 if there is no causality in any direction.

finding is that both forms of revenues are perhaps better ways of financing government investment and hence growth than alternatives such as domestic and/or external borrowing. Furthermore, it might be the case that distortionary taxes in Kenya may have led to internalisation of externalities by private agents thereby inducing efficiency in resource allocation (see Hoppner (2001) for the case of Germany). The results on non-tax revenue seem to suggest that this form of revenue is non-distortionary and therefore is associated with economic growth.

Foreign aid (grants) was hypothesised to have a positive relationship with per capita output but we found a negative one. Perhaps grants to Kenya are either fungible, discourage private investment, or tied to donors' desires thus creating adverse effects on growth. The way we have specified our model, aid is better interpreted as a way of financing increased government spending rather than an alternative source of revenue. From our empirical results, the aid coefficient remained consistently negative and significant in all the four long run models, with a constant magnitude of - 0.02. Our finding tallies with that of Strauss (1998) and, indeed, most of the general findings of studies on aid and growth in Africa[10]. Another possible explanation is that the variable could be causing distortionary effects e.g. through Dutch disease or discouraging savings [Younger (1992), Elbadawi (1999)]. The policy implication may be that for aid to be effective in promoting investment and growth in Kenya, it must be tied to carefully selected and 'monitorable' development projects and programmes. The macroeconomic and governance environment must be right and the flow of aid more reliable and predictable [Collier (1999), Lensink and Morrissey (2000)].

Consistent with what was hypothesised, private investment in Kenya was positively related to growth i.e. in conformity with the prediction of economic theory. We found a positive and significant coefficient of private investment in all the models. The magnitude of its coefficient also remained the same, around 0.1. This is largely consistent with other studies such as those by Were (2001), Mwega and Ndung'u (2002), and Glenday and Ryan (2003), in which private investment was found to be a positive and significant determinant of growth in Kenya. In the short run, private investment coefficient remained positive and significant with a magnitude of 0.04. The policy implication here is that, as is the current government view, private investment remains the engine of growth in Kenya. Relative to other growth determinants, private investment is more volatile and quite sensitive to such factors as political uncertainty, corruption, risks, poor macroeconomic environment and so on. To that extent, the government must ensure these factors are 'right' if private investment is to continue playing its rightful role as an instrument of growth in Kenya.

The proxy for human capital development, school enrolment, turned out to be one of the most important determinants of long run growth in Kenya. It remained persistently positive and highly significant in all the specifications, with an output elasticity of 0.2. This outcome is consistent with theory and shows that education is important for not only improving an individual's skills and thus productivity but also has externality effects across the economy. Other studies on the Kenyan economy have found similar results. Among these are studies by Were (2001) and Glenday and Ryan (2003) who have found the coefficient on school enrolment to be positive and significant. In the above context, the current government policy of providing free primary education is a move in the right direction. To strengthen this policy, however, the government must ensure there is quality teaching by improving all the factors that water down the quality schooling. In addition, factors affecting demand for and supply of skilled manpower must be addressed if this form of human capital development is to continue playing its role in the growth process.

The coefficients of the error correction terms for all the short run models were about unity (-1.08 for model 4) suggesting that any disequilibrium in the long run growth path is fully corrected in subsequent period. In view of these empirical results, our single equation growth model is robust and should provide useful for guiding policy in Kenya and other countries sharing similar characteristics as Kenya.

6 CONCLUSIONS

10 For example, see Killick (1991) and the special issue of the *Journal of African Economies*, Volume 4, Number 4 (1999) which has a number of papers on aid effectiveness in Africa.

In this study, we set out to investigate the impact of fiscal policy and related variables on growth in Kenya. We sought to isolate consumption expenditure and revenue components that do not contribute to growth and remove them from our growth model without loss of informational value and robustness of the model. Then we proceeded to use recent developments in time series econometrics to analyse some of the important variables affecting growth in Kenya. The resultant model appears robust and can be used to draw some important policy lessons for economic policy in Kenya and other SSA countries.

One of the key finding is that fiscal policy matters for economic growth. Productive consumption expenditure and government investment have a role in determining growth of real per capita income in Kenya. Productive consumption expenditure seems to have a strong negative effect on growth, suggesting that composition of this expenditure category needs to be re-examined with a view to re-organising it so that it contributes to economic growth. On the other hand, our results suggest that boosting government investment can enhance its complementarity role to private investment and growth. The government should increase its own investment in areas that are beneficial to the private sector and eschew from those that compete with or crowd it out. In the same vein, any austerity measures aimed at reducing government expenditure should not be achieved by budgetary cuts on development budget, as is often the case in Kenya, for this reduces public investment. Consistent with theoretical prediction, unproductive consumption expenditure and non-distortionary taxes have neutral effects on growth. Reducing unproductive expenditure to prop up government investment (which is productive according to this study) is a policy recommendation worthy pursuing.

Another implication of our empirical findings is that both private investment and human capital development have strong beneficial effects on per capita income in Kenya. Thus a government policy that ensures their quality and sustained growth can potentially improve the pace of Kenya's economic advancement. Volatility of private investment to both internal and external shocks and other factors is incontestable in theory and practice. Consequently, it is the onus of the government to institute measures that protect and promote private sector investment in order to attain higher levels of growth and prosperity.

Notwithstanding the fact that this study has some limitations especially those emanating from variable measurements, its findings do evoke some important policy issues for Kenya's growth strategy in as far as fiscal policy and foreign aid are concerned. In other words, the study should stimulate some exciting debate on the effectiveness of some components of government expenditure as well as foreign aid in spurring growth in Kenya and indeed many countries in the Sub-Saharan African region.

REFERENCES

Agell, J., Lindh, H. and Ohlsson, H. (1997), 'Growth and the Public Sector: A Critical Review Essay', *European Journal of Political Economy*, 13: 33-52.

Albala, J.M., and Mamatzakis, E.C. (2001), 'Is Productive Infrastructure Productive? Evidence from Chile', *Applied Economic Letters*, 8: 195-98.

Banerjee, A., Dolado, J.J., Galbraith, J.W., and Hendry, D.F. (1993), *Cointegration, Error-Correction, And the Econometric Analysis of non-stationary data: Advanced Texts in Econometrics*, Oxford University Press.

Barro, R.J. (1989), 'Economic Growth in a Cross Section of Countries', *NBER Working Paper*, Working Paper N0. 3120.

Barro, R.J. (1990), 'Government Spending in a simple Model of Endogenous Growth', *Journal of political economy*, 98 (2): 103-25.

Barro, R.J. and Sala-I-Martin, X. (1992), 'Public Finance in Models of Economic Growth', *Review of Economic studies*, 59: 645-661.

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

Bleaney, M., Gemmel, N. and Kneller, R. (2000), 'Testing the Endogenous Growth Model: Public Expenditure, Taxation and Growth over the Long-run', *Discussion Paper No. 00/25*, University of Nottingham.

Charemza, W.C. and Deadman, D.F. (1997), *New Directions in Econometric Practice: General to Specific Modelling, Cointegration and Vector Autoregression*, 2nd edition, Edward Elgar Publishing Ltd, Cheltenham, UK.

Chrystal, K.A. and Price, S. (1994), *Controversies in Macroeconomics*, 3rd Ed. Harvester Wheatsheaf.

Collier, Paul (1999), 'Aid, 'Dependency': a Critique', *Journal of African Economies*, 8 (4): 528-545.

Deverajan, S., Swaroop, V., and Zou, H. (1993, 'What Do Governments Buy? The Composition of Public Spending and Economic Performance', *Policy Research Working Paper WPS1082*, The World Bank.

Easterly, W. (2001), 'The lost Decades: Developing Countries Stagnation in spite of Policy Reform 1980 – 1998', *Growth@WorldBank.org.*

Easterly, W. and Rebelo, S. (1993), 'Fiscal Policy and Economic Growth: An Empirical Investigation', *Journal of Monetary Economics*, 32: 417-458.

Elbadawi, I.A. (1999), 'External Aid: Help or Hindrance to Export Orientation in Africa?', *Journal of African Economies*, 8 (4): 575-616.

Enders, Walter (1995), *Applied Econometric Times Series*, John Wiley & Sons, Inc., USA.

Folster, S. and M. Henrekson (2001), 'Growth Effects of Government Expenditure and Taxation in rich Countries', *European Journal of Political Economy*, 45: 1501 – 1520.

Glenday, G. and Ryan, T.C.I. (2003), 'Trade Liberalisation and Economic Growth in Kenya', in *Restarting and Sustaining Economic Growth and Development in Africa: the Case of Kenya*, edited by M.S. Kimenyi, J.M. Mbaku, and N. Mwaniki, Ashgate Publishing Ltd.

Glomm, G. and Ravikumar, B. (1997), 'Productive Government Expenditures and Long-run Growth', *Journal of Economic Dynamics and Control*, 21: 183 – 204.

Granger, C.W.J. (1969), 'Investigating Causal Relationships by Econometric Models and Cross Spectral Methods', *Econometrica*, 37: 424-435.

Granger C.W.J. (1986), 'Developments in the study of integrated economic variables', *Oxford Bulletin of economics and statistics*, 48 (2): 213-28.

Granger C.W.J. (1988), 'Some Recent Developments in a Concept of Causality', *Journal of Econometrics*, 39: 199-211.

Granger, C.W.J. and Newbold, P. (1974), 'Spurious Regressions in Econometrics', *Journal of Econometrics*, 2: 111-120.

Harris, R. (1995), *Using Cointegration Analysis in economic Modelling*, Prentice Hall, Essex, England.

Hendry, D.F. and Juselius, K. (2001), 'Explaining Cointegration Analysis: Part II', *The Energy Journal*, 22 (1): 75-120.

Hoppner, Florian (2001), 'A VAR Analysis of the Effects of Fiscal Policy in Germany', *Institute for International Economics*, University of Bonn.

Johnston, J. and DiNardo, J. (1997), *Econometric Methods*, 4th edition, Singapore: McGraw-Hill.

Inder, B. (1993), 'Estimating Long Run Relationships in Economics: A Comparison of Different Approaches', *Journal of Econometrics*, 57: 53-68.

Killick, Tony (1991), 'The Developmental Effectiveness of Aid in Africa', *Working Papers, WPS 646,* Policy, Research, and External Affairs, The World Bank.

Kneller, R., Bleaney, M.F. and Gemmell, N. (1999), 'Fiscal Policy and Growth: Evidence from OECD countries', *Journal of Public Economics*, 74: 171-190.

Lensink, R. and Morrissey O. (2000), 'Aid Instability as a measure of uncertainty and the positive impact of Aid on Growth', *Journal of Development Studies*, 36 (3): 31 – 49.

Mauro, Paolo (1995), 'Corruption and Growth', *Quarterly Journal of Economics*, 110: 681 – 712.

Mwega, F.M. and Ndung'u, N.S. (2002), 'Explaining African Economic Growth Performance: The Case of Kenya', *Draft final report prepared for the AERC collaborative project on Explaining African Economic Performance*.

Nijkamp, P. and Poot, J. (2002), 'Meta-Analysis of the Impact of Fiscal Policies on Long-Run Growth', *Tinbergen Institute Discussion Paper,* TI 2002-028/3.

OECD (1964 – 2001), Geographical Distribution of Financial Flows to Developing Countries, Paris: Organisation for Economic Co-operation and Development.

Peacock, A. and Scott, A. (2000), 'The Curious Attraction of Wagner's Law', *Public Choice*, 102: 1-17.

Pritchett, Lant (2003), 'A Conclusion to Cross-National Growth Research: A Forward to the Countries Themselves' in *Explaining Growth: A Global Research Project* edited by McMahon and Lyn Squire, London: International Economic Association.

Republic of Kenya (various issues), *Economic Survey*, Government Printer, Nairobi.

Republic of Kenya (various issues), *Budget Speech*, Government Printer, Nairobi.

----------------- (2003), *Economic Recovery Strategy for Wealth and Employment Creation*, 2003 – 2007, Government Printer, Nairobi.

Strauss, Tove (1998), 'Growth and Government: Is there a Difference Between Development and Developing Countries? *Working Paper Series in Economics and Finance N0. 275*, Department of Economics, Stockholm School of Economics, Sweden.

Sturm, J.E., Kuper, G.H. and Haan, J. (1996), 'Modelling Government Investment and Economic Growth on a Macro Level: A Review', *CCSO Series No. 29*.

Were, M. (2001), 'The Impact of External Debt on Economic Growth and Private Investment in Kenya: An Empirical Assessment', *Paper presented at the WIDER Development Conference on Debt Relief, 17-18th August 2001*, Helsinki.

Younger, Stephen D. (1992), 'Aid and the Dutch Disease: Macroeconomic Management when Everybody Loves You', *World Development*, 20(11): 1587 – 1597.

APPENDIX A: DATA AND VARIABLES

Appendix A1: Variable definitions/descriptions

VARIABLE	DESCRIPTION	REMARKS/EXPECTED SIGN ON GROWTH
(1) Non-fiscal		
NY	Nominal GDP at factor cost as reported in various publications of the *Economic Survey* (Government of Kenya)	All variables except school enrolment are expressed as ratios of NY
Y	Real GDP in constant 1982 prices. Splicing of series done for the period 1964-1972 (was in 1964 constant prices) while 1972-2002 (was in constant 1982 prices).	The splicing converted data into continuous series expressed in constant 1982 prices.
Yp	Real per capita GDP at factor cost expressed in constant 1982 prices.	Real GDP divided by total population. Used as dependent variable to proxy for real output growth.
AID	Nominal receipts from abroad in form of grants (share of NY).	Positive or negative depending on its usage by the government and on existence or otherwise of other supporting policies.
PINV	Private Investment – obtained by deducting government investment (GINV) from gross fixed capital investment (GFCF)	Expected to impact positively on economic growth.
(2) Fiscal		
UGC	Unproductive government consumption is (total consumption or recurrent expenditure (GC) ***less*** recurrent expenditure on health, education & economic services).	Theoretically, expected to have negative but insignificant impact on growth.
PGC	Productive consumption expenditure – defined here to include expenditure on health, education & economic services	A positive relationship with economic growth is hypothesized but may be negative depending on its actual composition.
GINV	Government investment proxied by government's capital or development expenditure (budget)	Positively correlated with growth i.e. may affect growth directly or indirectly through its complementary role to private investment.
DT	Direct (income) tax revenue (distortionary revenue)	Mostly negative association with growth; distorts incentives of private agents

Fiscal cont.	**DESCRIPTION**	**REMARKS/EXPECTED SIGN ON GROWTH**
IDT	Indirect tax revenue (nominal) – non-distortionary revenue	Hypothesised to have a positive but insignificant effect on growth (does not distort incentives).
NTR	Non-tax revenue – includes capital revenue, fines, forfeitures, dividends etc	Positive effect on growth since it is non-distortionary way of financing government expenditure.
BD	Budget deficit – total revenues less total expenditures	Ambiguous, mostly negative for LDC because of crowding out effects. May have neutral effect on long run growth if Ricardian equivalence holds.
AENR	Log of (Primary + secondary school) enrolment, proxy for human capital development/labour force growth.	Positive correlation with economic growth expected.

Note:- *All these variables except AENR were expressed as shares in GDP and then their logs taken.*

Appendix A2: Raw Data Series on Fiscal and non-fiscal Variables, 1964 – 2002

YEAR	NY	Y	Yp	GC	PGC	UGC	GINV	DT	IDT	NTR	AID	BD	PINV	AENR
1964	329	1,178	128	40	24	16	14	13	23	8	11	4	34	1,051
1965	327	1,190	125	44	27	17	15	15	27	12	7	4	37	1,090
1966	380	1,359	139	47	30	17	18	18	30	13	4	4	59	1,107
1967	401	1,414	140	52	35	18	22	22	35	15	3	5	72	1,223
1968	432	1,525	144	59	39	20	27	25	38	21	1	5	65	1,311
1969	469	1,623	149	67	45	21	32	29	42	24	1	3	70	1,398
1970	514	1,735	154	75	58	17	45	37	48	33	1	6	81	1,555
1971	567	1,854	159	91	74	17	56	45	56	39	1	1	106	1,666
1972	664	1,926	160	110	83	27	59	51	61	34	1	- 19	109	1,838
1973	755	1,979	159	127	91	36	64	56	82	32	2	- 18	163	1,991
1974	900	2,040	158	155	113	42	79	68	111	31	6	- 20	194	2,902
1975	1,088	2,099	157	190	141	50	109	84	129	35	8	- 45	109	3,108
1976	1,314	2,191	158	224	170	54	124	99	148	48	9	- 46	171	3,175
1977	1,684	2,369	165	286	222	63	155	126	207	64	10	- 37	286	3,295
1978	1,833	2,550	172	365	286	79	204	147	262	76	11	- 74	407	3,357
1979	2,033	2,676	175	427	335	93	226	163	305	84	16	- 89	290	4,083
1980	2,298	2,783	167	505	382	123	257	186	376	90	19	- 95	532	4,326
1981	2,659	2,949	170	596	451	146	287	200	443	89	20	- 137	574	4,391
1982	3,049	3,049	169	645	495	150	258	216	480	101	37	- 137	510	4,623
1983	3,474	3,142	167	682	516	165	235	242	522	114	52	- 8	595	4,818
1984	3,876	3,164	162	760	559	201	377	276	573	122	60	68	549	4,891
1985	4,424	3,330	164	850	624	227	409	330	647	140	63	90	878	5,140
1986	5,115	3,516	166	1,002	736	266	386	372	782	147	59	61	893	5,302
1987	5,648	3,687	169	1,174	895	279	435	420	927	157	111	103	1,157	5,554
1988	6,472	3,878	173	1,288	1,020	268	520	483	1,066	220	173	275	1,367	5,664
1989	7,478	4,070	177	1,423	1,124	299	644	556	1,182	266	202	288	1,474	6,035
1990	8,634	4,254	179	1,593	1,273	320	826	656	1,311	295	213	304	1,550	6,011
1991	9,540	4,312	177	1,750	1,400	351	822	782	1,507	323	220	535	1,529	6,070
1992	11,403	4,332	173	2,008	1,586	422	751	925	1,849	357	336	982	1,483	6,159
1993	14,185	4,343	170	2,426	1,941	485	938	1,418	2,469	375	449	1,752	1,999	5,960
1994	16,903	4,475	171	3,093	2,521	573	1,166	2,007	3,048	539	560	2,412	2,699	6,177
1995	19,646	4,690	175	3,860	3,164	696	1,345	2,290	3,482	882	476	2,475	3,731	6,169
1996	22,215	4,907	179	4,439	3,637	802	1,363	2,411	3,833	1,018	290	2,243	4,010	6,256
1997	26,813	5,024	178	5,175	4,304	871	1,273	2,599	4,274	983	276	2,190	4,491	6,364
1998	29,668	5,113	177	5,847	4,927	920	1,108	2,770	4,815	1,101	255	2,384	4,895	6,620
1999	31,873	5,185	176	6,084	5,075	1,009	996	2,714	5,098	1,310	229	2,457	5,007	6,505
2000	34,272	5,173	171	6,846	5,734	1,112	1,316	2,669	5,403	1,347	337	1,666	4,810	6,914
2001	38,501	5,237	169	7,768	6,510	1,257	1,432	2,732	5,477	1,293	365	706	4,986	7,133
2002	42,546	5,295	168	8,619	7,185	1,433	1,849	3,085	5,734	1,454	490	474	4,735	7,218

Source: *Republic of Kenya: Economic Survey (Various Issues)*

Note: *Series on fiscal variables and foreign aid, which were in fiscal years, had to be converted into calendar years by simple averaging.*

APPENDIX B: UNIT ROOTS AND COINTEGRATION

Table B1: DF/ADF tests for unit roots and time trend (Levels and first differences)

$$\text{ADF Model: } DYt = a + bT + gY_{t-1} + \sum_{i=1}^{p} d_i \Delta Y_{t-i}$$

VARIABLES IN LEVELS						FIRST DIFFERENCES	
	Ho: γ=0	Ho:β=γ=0 (ϕ_3-test)	Ho:β=α=γ=0 (ϕ_2-test)	Lag lentgh	Inference	H_0: γ=0	Inference
Y_{Pt}	-2.08 (-3.53)	5.289 (6.73)	4.607 (5.13)	0	I(1)	5.383**	I(0)
PGC_t	-2.35 (-3.53)	3.878 (6.73)	2.992 (5.13)	1	I(1)	319**	I(0)
UGC_t	-2.12 (-3.53)	2.283 (6.73)	1.542 (5.13)	0	I(1)	4.753**	I(0)
$GINV_t$	-2.27 (-3.53)	4.921 (6.73)	3.282 (5.13)	0	I(1)	-4.812**	I(0)
DT_t	-2.31 (-3.53)	3.710 (6.73)	2.543 (5.13)	1	I(1)	3.789**	I(0)
IDT_t	-0.682 (-3.53)	4.447 (6.73)	3.976 (5.13)	0	I(1)	-5.047**	I(0)
NTR_t	-3.08 (-3.53)	4.739 (6.73)	3.165 (5.13)	1	I(1)	4.990**	I(0)
$GRANT_t$	-3.12 (-3.53)	5.003 (6.73)	3.337 (5.13)	1	I(1)	-3.658**	I(0)
BD_t	-2.61 (-3.53)	3.417 (6.73)	2.295 (5.13)	5	I(1)	6.274**	I(0)
$PINV_t$	-0.903 (-3.53)	0.737 (6.73)	0.763 (5.13)	6	I(1)	7.512**	I(0)
$AENR_t$	-0.654 (-3.53)	3.694 (6.73)	10.581 (5.13)	0	I(1)	-4.978**	I(0)

Note: *Unit roots test statistics are generated from PcGive version 10.1. Critical values for ADF-test are simulated from McKinnon (1991) tables and their values at 5% significance level are given in parentheses. Simulation of the critical values are based on the formula* $C(p) = f_{¥} + f_1T^{-1} + f_2T^{-2}$ *given in Harris (1995: 158). See table B2 for more details of the simulation. The simulated critical values for the* f_i *tests at 1% and 10% significance levels are –4.22 and 3.20 respectively. In the above table, ** indicate significance at 5% level.*

At the 5% significance level, all the variables appear to be non-stationary i.e. I(1), but with no significant drift and/or time trend[11]. When first differences of the I(1) variables were tested for unit roots, all indicated stationarity i.e. I(0), as shown in the last two columns of table B1 above and therefore rules out any possibility of higher order of integration (i.e. I(2)) in our data series. Thus our data series are non-stationary in levels and stationary in first differences.

11 In all the cases, we could not reject the null of no drift and time trend since calculated ϕ_3 and ϕ_2 were less than their corresponding critical values as can be seen in table B1 above.

Table B2: Simulated Critical Values for Unit Roots Test

	1%	**5%**	**10%**
ϕ_∞	-3.9638	-3.4126	-3.1279
$\phi_1 T^{-1}$	-0.21982	-0.10629	-0.06363
$\phi_2 T^{-2}$	-0.03285	-0.01235	-0.00525
Critical Values	**-4.21647**	**-3.53124**	**-3.19678**

Note:

The following formula was used to simulate the above critical values:

$$C(p) = f_{¥} + f_1 T^{-1} + f_2 T^{-2}$$

Where C(p) is the percentage critical value and T the sample size (Harris, 1995:54).

	1%	5%	10%
ϕ_∞	-3.9638	-3.4126	-3.1279
ϕ_1	-8.353	-4.039	-2.418
ϕ_2	-47.44	-17.83	-7.58
N	1	1	1
T	38	38	38

Note:

1) *The values used for the $f_{¥}$, f_1 and f_2 are drawn from Mackinnon (1991) as reproduced in Harris (1995: 158) table A.6. These are based on a model with a constant and trend.*
2) *N = number of regressors in the ADF model.*
3) *For purposes of simulating the critical values, the sample size was rounded off to 50 since 38 is closer to 50 than 25.*

Table B3: Dynamic model for Model 4

[Dependent variable is real per capita GDP and sample size is 1964 – 2002]

	Coefficient	Std.Error	t-value	t-prob	Part.R^2
Yp_1	-0.0843277	0.1661	-0.508	0.617	0.0116
Constant	3.48615	0.5713	6.10	0.000	0.6286
PGC	-0.252329	0.06520	-3.87	0.001	0.4050
PGC_1	0.113920	0.05610	2.03	0.055	0.1579
GINV	-0.0170609	0.02433	-0.701	0.490	0.0219
GINV_1	0.0591699	0.02598	2.28	0.033	0.1908
DT	0.205662	0.07032	2.92	0.008	0.2799
DT_1	-0.150456	0.07555	-1.99	0.059	0.1527
NTR	0.112062	0.03092	3.62	0.002	0.3738
NTR_1	0.0559422	0.03167	1.77	0.091	0.1242
AID	0.0141613	0.01727	0.820	0.421	0.0297
AID_1	-0.0352791	0.01715	-2.06	0.052	0.1613
PINV	0.0367885	0.01535	2.40	0.025	0.2070
PINV_1	0.0668622	0.01997	3.35	0.003	0.3376
AENR	0.0343815	0.06774	0.508	0.617	0.0116
AENR_1	0.162109	0.07008	2.31	0.030	0.1956

sigma	0.0159222	RSS	0.00557737597
R^2	0.976272	F(15,22) =	60.34 [0.000]**
log-likelihood	113.786	DW	1.65
no. of observations	38	no. of parameters	16
mean(Yp)	5.10133	var(Yp)	0.00618556

AR 1-2 test:	**F(2,20) =**	**0.79025 [0.4674]**
ARCH 1-1 test:	**F(1,20) =**	**1.1819 [0.2899]**
Normality test:	**Chi^2(2) =**	**2.3888 [0.3029]**
hetero test:	**Chi^2(30)=**	**28.850 [0.5255]**
RESET test:	**F(1,21) =**	**0.27256 [0.6071]**

From Table B3 above, we note that all the diagnostic tests are satisfactory implying that, as was the case for models 1-3, there is no evidence of model misspecification. For example, our explanatory variables account for 98% of the changes in the dependent variable. The Jarque-Bera statistic for testing normality of residuals is 2.389, with a *p*-value of 0.303; consequently, we cannot reject the null hypothesis of normality. The null of zero autocorrelation in the residuals cannot be rejected since the Breusch-Godfrey asymptotic test for serial correlation up to the second order is 0.790 which gives a *p*-value of 0.467. The assumption of homoscedastic residuals is also not rejected as the test for ARCH residuals has a *p*-value of 0.290. Finally, the Ramsey RESET test for specification error gives a *p*-value of 0.607 which soundly rejects the null of model misspecification. Although not included in this report, variable exclusion test was conducted which confirmed that the dropped variables in models 2 and 3 are in fact irrelevant. The robustness of the model was further supported by graphical evaluations.[12]

Table A2.2: Unit root test for cointegration for Model 4

Variable	F-test		Value	[Prob]	Unit-root t-test
Yp	F(1,22)	=	0.25785	[0.6167]	**-6.5294****
Constant	F(1,22)	=	37.234	[0.0000]**	
PGC	F(2,22)	=	7.8115	[0.0027]**	-2.8008
GINV	F(2,22)	=	5.7814	[0.0096]**	3.1945
DT	F(2,22)	=	5.7431	[0.0098]**	1.8194
NTR	F(2,22)	=	10.258	[0.0007]**	4.3547
AID	F(2,22)	=	3.8644	[0.0365]*	-2.3273
PINV	F(2,22)	=	9.4896	[0.0011]**	4.3565
AENR	F(2,22)	=	13.540	[0.0001]**	5.1651

Note: *The null of no cointegration is strongly rejected (1% significance level).*

The table demonstrates that indeed there is cointegration and hence a genuine long run relationship among the variables. With a unit root *t*-statistic of –6.5348, the null of no cointegration is strongly rejected implying that variables are cointegrated and therefore the estimated coefficients are non-spurious.

12 This was confirmed by examining graphs of actual and fitted, cross plot of actual and fitted, residual density, histogram, and residual correlogram. They all gave an indication of goodness of fit of the model and absence of serial correlation and normality problems. However, to save on space, these graphs are not reported here but could be availed on request.

CREDIT PAPERS

05/01 **Indraneel Dasgupta and Ravi Kanbur,** "Community and Anti-Poverty Targeting"

05/02 **Michael Bleaney and Manuela Francisco,** "The Choice of Exchange Rate Regime: How Valid is the Binary Model?

05/03 **Michael Bleaney and Todd Smith,** "Closed-End Funds in Emerging Markets"

05/04 **Jorn Rattso and Hildegunn E. Stokke,** "Ramsay Model of Barriers to Growth and Skill-biased Income Distribution in South Africa"

05/05 **Hildegunn E Stokke,** "Productivity Growth in Backward Economies and the Role of Barriers to Technology Adoption"

05/06 **Daniel M'Amanja and Oliver Morrissey**, "Fiscal Policy and Economic Growth in Kenya"

05/07 **Daniel M'Amanja, Tim Lloyd and Oliver Morrissey**, "Fiscal Aggregates, Aid and Growth in Kenya: A Vector Autoregressive (VAR) Analysis"

Members of the Centre

Director

Oliver Morrissey - aid policy, trade and agriculture

Research Fellows (Internal)

Simon Appleton – poverty, education, household economics
Mike Bleaney - growth, international macroeconomics
Indraneel Dasgupta – development theory, household bargaining
Norman Gemmell – growth and public sector issues
Tim Lloyd – agricultural commodity markets, time series analysis
Chris Milner - trade and development
Wyn Morgan - futures markets, commodity markets
Doug Nelson - political economy of trade
Trudy Owens – survey analysis, poverty, employment
Tony Rayner - agricultural policy and trade

Research Fellows (External)

Manuela Francisco *(University of Minho)* – inflation and exchange rate regimes
David Fielding *(University of Otago)* – investment, monetary and fiscal policy
Ravi Kanbur (*Cornell*) – inequality, public goods – Visiting Research Fellow
Henrik Hansen *(University of Copenhagen)* – aid and growth
Stephen Knowles *(University of Otago)* – inequality and growth
Sam Laird (*UNCTAD*) – trade policy, WTO
Robert Lensink *(University of Groningen)* – aid, investment, macroeconomics
Scott McDonald *(University of Sheffield)* – CGE modelling, agriculture
Mark McGillivray *(WIDER, Helsinki)* – aid allocation, aid policy
Andrew McKay *(University of Bath)* – household poverty, trade and poverty
Christophe Muller *(Alicante)* – poverty, household panel econometrics
Farhad Noorbakhsh *(University of Glasgow)* – inequality and human development
Robert Osei *(ISSER, Ghana)* – macroeconomic effects of aid
Alberto Paloni *(University of Glasgow)* – conditionality, IMF and World Bank
Eric Strobl *(University of Paris)* – labour markets
Finn Tarp *(University of Copenhagen)* – aid, CGE modelling