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What determines the long run growth rate in Kenya?

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Abstract

This paper examines the determinants of total factor productivity (*TFP*) in Kenya. We utilized the theoretical insights from the Solow (1956) growth model and its extension by Mankiw, Romer and Weil (1992) and followed Senhadji's (2000) growth accounting procedure. We find that growth in Kenya, until the 1990s was mainly due to factor accumulation. Since then, *TFP* has made a small contribution to growth. Our findings imply that while variables like overseas development aid, foreign direct investment and progress of financial sector improves *TFP*, trade openness is the key determinant. Consequently, policy makers should focus on policies that improve trade openness if the long run growth rate is to be raised.

JEL classification: O10; O40

Keywords: Solow model; Growth accounting; Total factor productivity; Trade openness

1. Introduction

Lifting the long run growth rate is, arguably, the pursuit of every economy. Since there are a number of policies designed to promote productivity growth and stability in Kenya, it is important to ask: which is best and how good is it in enhancing the long run growth rate? It is obvious that this is a difficult question given the recent economic turmoil, external pressure from donors, and oil crisis and economic mismanagement. Evidence shows that progress in the liberalization of the trade regime in Kenya has been sporadic, with periods of significant progress followed by slower movement and even reversals; see Odhiambo and Otieno (2006, p. 11).

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Since independence Kenya has embarked on pursuing a variety of investment and trade policies. There is a widespread belief that policies aimed at enhancing openness eventually stimulate long run growth (Edwards, 1998; Sachs & Warner, 1995). The structural adjustment programmes (SAPs) implemented by Kenya in the 1980s led the economy to shift from a highly protected import-substitution strategy to policies that boost exports. The International Monetary Fund (IMF) and the World Bank played a crucial role in facilitating the SAPs. Most of the trade liberalization (openness) policies were undertaken as part of the SAP, however Kenya's participation as a member of the World Trade Organization (WTO) also endorsed her benefits related to tariffs, import licensing and other trade interventions.

Kenya has increasingly participated in regional integration initiatives within Africa and beyond, with the aim of improving terms of trade, overall investment, growth and development. For example, Kenya is now a member of various regional trade organizations, such as the Common Market for Eastern and Southern Africa (COMESA), East African Community (EAC), Caribbean and Pacific States and the European Union (ACP-EU) and the Cotonou Partnership Agreement. Despite these forays into increasing trade liberalization, it is currently unclear as to whether they have been beneficial to the long run growth of this African economy. In fact, recent research by Odhiambo and Otieno (2006) contend that liberalization and trade openness in Kenya have failed to spell out a clear long-term path towards economic growth. They argued that most policies or initiatives were not sustainable, due to a lack of institutional framework and weak policy formulation. This paper attempts to re-examine the determinants of total factor productivity (*TFP*) in Kenya; particularly the relative importance of trade openness in long run growth.

The theoretical framework of Solow's (1956) growth model and the growth accounting framework in Solow (1957) is utilized in this paper. The Solow growth model implies that the long run growth rate of an economy depends on the rate of technical progress or *TFP* and his growth accounting framework showed that nearly half of the long run growth rate in developed countries is attributable to *TFP*. However, it is not known what factors determine *TFP* and for this reason the Solow growth model is known as the exogenous growth model (*EXGM*).

Subsequently, two alternative developments have taken place to analyze the determinants of *TFP*. Barro (1991, 1999), Lucas (1988), Romer (1986, 1990), etc., have developed the endogenous growth models in which *TFP* is endogenously determined by factors like the stock of knowledge through education and research and development, investment in human capital formation, in infrastructure, etc. While these endogenous growth models (*ENGMs*) are very useful they have a few limitations. Firstly, they are difficult to estimate because their structural equations are intrinsically non-linear in parameters and variables. Secondly, since the dependent variable is the long run growth rate it is necessary to proxy this rate with the average growth rate over longer spans of time. This reduces the number of observations for estimation. Therefore, in estimating *ENGMs* it is necessary to use cross-country data with a large cross-section dimension. Thirdly, there is no theoretical *ENGM* in which more than one or two variables are used to show how they influence *TFP*. Consequently, empirical works based on *ENGM*s use by and large ad hoc specifications; see Easterly, Levine, and Roodman (2004).

A second alternative is to extend the Solow growth model. Senhadji (2000) has used the growth accounting framework of Solow (1957) to estimate *TFP*, as the Solow residual, for 88 countries. He then regressed the estimated *TFP*s on some potential determinants of *TFP*. This approach has recently been used by Rao and Hassan (2012) to explain the long run growth rate of Bangladesh. In this paper we shall use this approach of Senhadji to analyze the determinants of the long run growth rate of Kenya.[1] This paper is organized as follows: Section 2 provides a brief overview of the Kenyan economy and describes results from the few relevant studies on *TFP* growth in this country. Sections 2 and 4, respectively, detail specification and empirical results. Section 5 concludes.

2. Brief overview of Kenya economy

Improving the growth rate in Kenya is of paramount importance. This low income African country has experienced a slow recovery from the multiple shocks it endured in 2008 and 2009: post election violence in early 2008, sharp rises in oil and food prices, the global financial crises, and worst drought in a decade in 2009. An indication of the stagnation of the economy in 2009, was that the agricultural sector, the foundation of the economy, actually contracted by more than 3%. The drought also affected electricity supply, and thus impacted on general infrastructure services, as well as the manufacturing sector.

According to data from the World Bank, the GDP per capita in Kenya (in constant 2000 US$) has only recently returned to the level it was at in 1990 (GDP per capita of $450 in 1990, $453 in 2008). Additionally, its average rate of growth of output (*GDP*) from 1977 to 2007 was 2.3% with large fluctuations due to unexpected multiple shocks. During this period its per capita output grew only at 0.42% implying that this rate should be raised to 1.39% if Kenya aims to double its per capita output in 50 years time. Most importantly, detailed empirical investigation is required to investigate determinants of this growth rate and decompose the influence of the different factors that shape this trend.

Beaulieu (1990) investigated the changes in the input structure of production and found that such changes resulted in 11% of the growth in gross output over the time period of 1967–1986. Shaaeldin (1989) looked into the sources of industrial growth, and in addition to Kenya, also looked at Tanzania, Zambia and Zimbabwe over the period 1964–1983. They found an average negative growth rate for *TFP*, except for Zimbabwe, which had a positive but insignificant *TFP* growth rate. Mwega (1995) found that productivity growth in Kenya's manufacturing sector was dominated by labour and capital in the post independence period of 1965–1983, and by labour and *TFP* growth in the next decade. Onjala's (2002) estimates of *TFP* showed that *TFP* growth contributed more to agriculture, than the manufacturing sector. Moreover, he found inconsistent evidence to support the link between *TFP* growth and trade policy.

Recently, Leitch (2010) pointed out a number of underlying causes for the weak growth performance in the sub-Saharan Africa, i.e., slavery and colonialism, poor governance, lack of infrastructure or capacity, low levels of foreign investment, poverty and violence, and mass unemployment. Given the wide range of factors that contribute to poor growth rate of this region, there is a need to focus empirical analysis at the country level (for example, Kenya) and delve further into the factors that can help stimulate growth and assist with future policy direction.

Many approaches are available for studying the sources of economic growth, and in particular the basis of productivity growth. For African countries, very few studies have applied a growth accounting framework. In Kenya, determinants of productivity have only been partially examined.

[1] An alternative method is to extend the production function by making *TFP* a function of a few of its crucial determinants. The extended production function can be easily estimated with the country specific or cross-country data, for example see Rao (2010a,b), Rao and Hassan (2012), Rao and Rao (2009), Rao and Tamazian (2008), and Rao and Vadlamannati (2010).

Moreover, there is a lack of studies that have analyzed the relevance of trade openness policies for long run growth.

Although the aforementioned existing empirical studies offer significant insights on Kenya's economic performance, their empirical approach is equivocal. These studies have mainly utilized *OLS* estimation and this traditional method has been criticized for not addressing endogeneity issues, see Engel and Granger (1987) and Enders (2004). Further, none of these studies have analyzed the relevance of a set of potential variables that influence growth, with a view to influence or direct policy. Therefore, our paper attempts to fill these gaps by applying the latest time series techniques such as Engel and Granger's (1987) two step method, Phillip and Hansen's (1990) fully modified ordinary least squares and Pesaran, Shin, and Smith's (2001) autoregressive distributed lag bounds test.

3. Model specification and methodology

3.1. Model specification

Many earlier studies on growth have used somewhat ad hoc specifications to examine the determinants of growth; see Easterly, Levin and Roodman (2004) and Rogers (2003). In contrast Senhadji's approach is based on the Solow (1956) growth model and the growth accounting framework of Solow (1957). He has also used an extension to the Solow growth model by Mankiw et al. (1992, *MRW*). *MRW* have augmented the production function with human capital and showed that the Solow growth model can adequately explain the observed growth rates in the developed and developing countries. Therefore, following Senhadji we specify the Cobb–Douglas production function, augmented with human capital, and with the constant returns to scale as follows:

$$Y_t = A_t K_t^{\alpha} (H_t \times L_t)^{1-\alpha} \quad (1)$$

Take the logs of the variables in (1) to get:

$$\ln \quad Y_t = \ln \quad A_t + \alpha \quad \ln \quad K_t + (1-\alpha)(\ln \quad L_t + \ln \quad H_t) \quad (2)$$

Therefore the production function in its first difference is:

$$\Delta\ln \quad Y_t = \Delta\ln \quad A_t + \alpha\Delta\ln \quad K_t + (1-\alpha)(\Delta\ln \quad L_t + \Delta\ln \quad H_t) \quad (3)$$

where Y = output, A = stock of knowledge, K = stock of capital, H = an index of human capital formation through education and L = employment. The latter 3 are the conditioning variables. In Solow model, the variable of interest is the per worker income y^*. The steady state output per worker can be expressed as[2]:

$$y^* = \left[\frac{s}{d+n+g}\right]^{\alpha/(1-\alpha)} \times A$$
$$\ln \quad y^* = \frac{\alpha}{1-\alpha} \quad \ln\left[\frac{s}{d+n+g}\right] + \ln \quad A \quad (4)$$

[2] Derivation of steady state output per worker is clearly presented in Romer (2006) and Sorensen and Whitta-Jacobsen (2005).

Therefore

$$\Delta\ln \quad y^* = 0 + \Delta\ln \quad A = g \tag{5}$$

where d = depreciation rate, s = proportion of output saved and invested, n = growth of labour force and g = growth of the stock of knowledge. These are assumed to be invariant in (5). Solow model has useful implications on growth. First, when the economy is on its steady state and given that the parameters are constant, per worker income will grow at the rate of technical progress. In other words, if the technical progress is zero, per worker income will not grow. An important implication of Solow model is that government policies to increase investment ratio will have only permanent level effects, i.e., higher investment rates will only increase per worker incomes. Such policies will have only transitory growth effects. If the policy makers wish to permanently raise the rate of growth of output, then they should implement policies to increase g.

3.2. The ARDL method

We shall estimate the production function (1) with alternative methods to attain the share of profits, which is crucial for the growth accounting exercise. Few commonly utilized techniques are London School of Economics Hendry's General to Specific (*GETS*) approach, Engel and Granger's (1987) two step method (*EG*), Phillip and Hansen's (1990) fully modified ordinary least squares (*FMOLS*), Stock and Watson's (1993) dynamic ordinary least squares (*DOLS*), Johansen and Juselius's (1990) maximum likelihood (*JML*) and Pesaran et al.'s (2001) autoregressive distributed lag (*ARDL*) bounds test. Although the *JML* technique is widely used in empirical works, lately Rao, Singh and Kumar (2010) have argued that applied economists should use an estimation technique that is simple and easy to implement. We argue that all techniques may provide consistent cointegrating estimates if no endogeneity issues exist. A similar view was also taken by Rao (2007).

The main advantage of the *ARDL* technique is the fact that it obviates the need to classify variables into $I(1)$ or $I(0)$. Simply put, compared to other cointegration techniques, there is no need for unit root pre-testing. The use of *ARDL* technique can be further justified for other reasons. For instance, when compared to *GETS* and *EG*, *ARDL* curtails the endogeneity problems and all the variables are assumed to be endogenous. Another useful distinction of *ARDL* from others is that the long and short run variables are estimated simultaneously, eliminating problems associated with omitted variables and autocorrelation. Due to these reasons, we apply the *ARDL* technique to examine the determinants of long run growth in Kenya. Nevertheless, we also compare our estimates with the *EG* and *FMOLS* techniques.[3]

For convenience, we shall use a simple specification with two variables – Y and X. Therefore for this model the *ARDL* technique requires estimation of the following unrestricted error correction models:

$$\Delta\ln \quad Y_t = a_{oY} + \sum_{i=1}^{n} b_{iY} \quad \Delta\ln \quad Y_{t-1} + \sum_{i=1}^{n} c_{iY} \quad \Delta\ln \quad X_{t-1} + \sigma_{1Y} \quad \ln \quad Y_{t-1} + \sigma_{2Y} \quad \ln \quad X_{t-1} + \varepsilon_{1t} \tag{6}$$

[3] In addition to *ARDL*, we are using *EG* and *FMOLS* and to obtain valid estimates with these latter techniques, tests for non-stationarity in the variables should be performed.

$$\Delta\ln \quad X_t = a_{oX} + \sum_{i=1}^{n} b_{iX} \quad \Delta\ln \quad X_{t-1}$$
$$+ \sum_{i=1}^{n} c_{iX} \quad \Delta\ln \quad Y_{t-1} + \varpi_{1X} \quad \ln \quad X_{t-1} + \varpi_{2X} \quad \ln \quad Y_{t-1} + \varepsilon_{1t} \tag{7}$$

where ln is the natural log, Δ is the first difference operator, Y is the dependent variable and X is the explanatory variable. Applying the *ARDL* technique comprises two simple steps, see Pesaran and Pesaran (1997, p. 304). The first step entails testing for the existence of a cointegrating relationship between the variables. The F tests are utilized to test for the existence of cointegrating relationships. When a cointegrating relationship is observed, the F test dictates which variable should be normalized.

The asymptotic distributions of the F-statistics are non-standard under the null hypothesis of no cointegration relationship between the variables. Two sets of asymptotic critical values are provided by Pesaran and Pesaran (1997). The first set assumes that all variables are $I(0)$ while the second set assumes that all variables are $I(1)$. If the computed F values fall outside the inclusive band, a conclusive decision could be drawn without knowing the order of integration of the variables. More precisely, if the empirical analyses show that if the computed F-statistics is greater than the upper bound critical value, and then we reject the null hypothesis of no cointegration and conclude that there exists a long run cointegrating relationship between the variables. If the computed F-statistics is less than the lower bound critical value, then we cannot reject the null of no cointegration. In the second step of *ARDL* technique, an additional two-step procedure is required to estimate the model. The first stage is determining the lag order in the *ARDL* model by either the Akaike Information Criteria (*AIC*) or the Schwarz Bayesian Criteria (*SBC*). In the second stage, the cointegrating vector is estimated with the *OLS*, i.e., the long run coefficients. Microfit 5.0 has the routines for these steps. The *ARDL* also entails estimating the short run dynamic *ARDL* model in the final step, however, we are interested in the equilibrium long run results only.

4. Empirical results

4.1. Unit root tests

We first test for the time series properties of *Y*, *K*, and *LH*. The Augmented Dicky–Fuller (*ADF*) and Elliot–Rothenberg–Stock (*ERS*) tests are used and the results are presented in Table 1. The null hypothesis of non-stationarity of *Y*, *K*, *LH* is tested against the alternative hypothesis of stationarity.[4] Clearly, the *ADF* test indicates that the unit root null for the level variables cannot be rejected at 5% level. Alternatively, the null that their first differences contain unit roots is clearly rejected. Similarly, the computed *ERS* test statistics are more than the 5% critical values, implying that all the levels of the variables are non-stationary. However, the test statistics are lower than critical values for the first difference of these variables and reject the unit root null at 5% level. It is well known that the *ERS* is a powerful test than *ADF*, therefore we argue that the level variables are non-stationary and their first differences are stationary.

[4] When using the *ARDL* approach there is a need to test for unit roots to exclude the possibility of I(2) series. Justification for this is shown in De Vita, Endresen, and Hunt (2006).

Table 1
ADF and ERS unit root tests 1977–2008.

Variable	LAG	ADF	ERS
$\ln Y$	[1,1]	2.025 (3.56)	5.026 (3.66)
$\Delta\ln Y$	[0,1]	3.076 (2.95)	2.051 (7.23)
$\ln K$	[1,1]	−1.108 (3.56)	9.025 (2.85)
$\Delta\ln K$	[0,2]	7.028 (2.95)	7.041 (7.23)
$\ln LH$	[2,1]	−1.735 (3.56)	10.256 (2.85)
$\Delta\ln LH$	[1,1]	4.942 (2.95)	4.120 (7.23)

Notes: LAG is the lag length of the first differences of the variables. For example [1,1] means that one lagged first difference is found to be adequate in the two test statistics, respectively. For both ADF and ERS, the absolute value 5% critical values are given below the test statistics in parentheses. A time trend is included because it is significant in levels and first differences of the variables. In E-views, the null hypothesis of unit roots is rejected if the computed ERS test statistic is below the critical value.

Table 2
Estimates of the cointegrating equations 1977–2008.

Production function	$Y_t = A_t K_t^{\alpha}(H_t \times L_t)^{\beta}$		
	Intercept	α	β
EG	1.725 (13.36)*	0.411 (2.01)*	0.629 (5.86)*
FMOLS	0.266 (2.03)*	0.437 (1.86)**	0.704 (3.46)*
ARDL	1.543 (9.05)*	0.410 (8.04)*	0.636 (5.35)*

The *t*-ratios are reported below the coefficients.
* Denotes significance at 5% levels.
** Denotes significance at 10% levels.

This study employs annual data for Kenya over the period 1977–2008. Data for Y (real gross domestic product) and K (capital stock[5]) were obtained from the International Monetary Fund (2010). Labour force data (L) was sourced from the World Bank (2010), and human capital (an average of educational attainment, denoted H) information was available in the Barro and Lee (2010) data set).

4.2. Production function and growth accounting

The stylized value of capital share of output (α) is 1/3 especially in advanced countries. However, many growth accounting exercises have shown that α is slightly greater than 1/3 in developing countries, see for instance, Oketch (2006), Rao and Hassan (2012), Rao and Vadlamannati (2010). In what follows, we estimate the value of α with the *EG*, *FMOLS* and *ARDL* techniques. The results are provided in Table 2.

In all three methods, the share of capital α is around 0.4 and statistically significant. For the purposes of our growth accounting exercise we select α as 0.410.[6] Note that the estimated α using the three methods is based on unconstrained equations, i.e., no constant returns. Therefore, when we tested the null that there is constant returns ($\alpha + \beta = 1$) in the unconstraint equations, the Wald test cannot reject the null hypothesis. The *ARDL* technique indicated that there exists a unique

[5] Derived using perpetual inventory method: $K_t = 0.95 \times K_{t-1} + I_t$. It is real gross domestic fixed investment.
[6] We selected the *ARDL* share of capital (0.41) because this is highly significant.

Table 3
Decomposition of growth.

	Mean $\Delta\ln Y$	Mean $\Delta\ln K$	Mean $\Delta\ln(L+H)$	Growth due to factor accumulation	Growth due to *TFP*
1977–2008	0.023	0.026	0.017	0.022	0.002
Contribution to Growth (%)				95.65%	4.35%
1977–1989	0.012	0.039	0.019	0.018	−0.006
Contribution to Growth (%)				150.00%	−50.00%
1990–1999	0.019	0.018	0.012	0.018	0.001
Contribution to Growth (%)				94.74%	5.26%
2000–2008	0.202	0.039	0.019	0.186	0.016
Contribution to Growth (%)				92.08%	7.92%

cointegrating relationship between *Y*, *K* and *LH*. The *SBC* criterion indicated a lag length of 2 periods. When *Y* is the dependent variable, the computed *F* statistic (7.9196) is greater than the upper bound of the 95% critical value (4.378) resulting in the rejection of the null hypothesis of no long run relationship.

Growth accounting allows one to break down growth into components that can be attributed to the observable factors to the growth of factor accumulation (capital stock, labour force and human capital) and the *TFP*. As noted earlier, *TFP* is so called Solow residual and this is our measure of ignorance of the determinants of growth. The estimated value of α (0.410) is vital because this is used in growth accounting exercise to estimate the *TFP*. Using this value, *TFP* is estimated as follows:

$$TFP = \Delta\ln \quad Y - 0.410 \quad \Delta\ln \quad K - (1 - 0.410)(\Delta\ln \quad H + \Delta\ln \quad L) \tag{8}$$

The results for growth accounting exercise for Kenya is reported in Table 3. During the period 1977–2008, average output growth was 2.3% and factor accumulation and *TFP* grew, respectively, at nearly 96% and 4%. In all periods, the results show that factor accumulation has been the major factor for growth in Kenya. The contribution of *TFP* is virtually negligible. Growth in the period 1977–1989 was entirely dominated by factor accumulation. The average growth of output in the same period was 1.2%. However, the average *TFP* grew at 5.26% in the period 1990–1999 and further increased to 7.92% on average during 2000–2008. During 2000s the average output growth was nearly 2% and this was mainly due to factor accumulation, although *TFP* growth was 7.92%. Based on the average annual per capita output growth rate of 0.42% over the period 1977–2008,[7] this implies that it would require Kenya 165 years to double its current GDP per capita of $453 (2008 value, in US$ constant 2000). Similarly, if Kenya attempts to double its GDP per capita over the next 50 years, it requires the average annual per capita output growth rate to increase to 1.39%.

[7] Based on World Bank data.

Table 4
List of Potential Variables.

Variables	Definition	Source
RY	Workers' remittances and compensation of employees to GDP ratio.	World Bank (2010)
ODAY	Overseas development aid to GDP ratio.	World Bank (2010)
FDIY	Foreign direct investment to GDP ratio.	World Bank (2010)
M2Y	Money and quasi money (*M2*) to GDP ratio.	World Bank (2010)
GY	General government final consumption expenditure to GDP ratio.	World Bank (2010)
π	Rate of inflation (calculated using GDP deflator)	International Monetary Fund (2010)
TO	Sum of export plus import of goods and services to GDP ratio.	World Bank (2010)
PCY	Private consumption to GDP ratio	International Monetary Fund (2010)
DUM	Dummy variable to capture impact of financial reforms and liberalization policies. *DUM* is constructed as 1 from 1985 to 2008, 0 otherwise.	Authors computations
T	Time trend	Authors compilation

4.3. Determinants of TFP

In this section we examine the factors that determine the *TFP* for Kenya. According to Durlauf, Johnson, and Temple (2005), there are a large number of potential variables that affect *TFP*.[8] However, data on time series variables are limited for developing countries and hence it becomes difficult to select and examine a large number of variables. Consequently, we have selected 10 potential variables that affect *TFP* which are outlined in Table 4.

To capture the effects of other trended but ignored variables which may have positive or negative effects, we included a time trend (*T*) in our analysis. Many of the independent variables chosen for this empirical exercise are widely recognized as necessary to understanding determinants of *TFP*, these include macro indicators such as *M2Y*, inflation level, consumption to GDP ratio, etc. Of the remaining variables chosen, *FDIY* has figured prominently in recent analysis regarding the reasons for poor economic growth in sub-Saharan Africa. Research by Adams (2009) which focused on *FDIY* and Domestic Investment in particular, concluded that the African continent required a targeted approach to *FDIY*, along with increased local capacity, and cooperation between government and multinational enterprises.

Financial reforms have also received a high degree of interest; Oduor, Karingi, and Mwaura (2011) investigated determinants of financial market efficiency in Kenya and motivated their research by explaining that the Kenyan economy experiences wide interest margins, a clear indication of a repressed and inefficient financial sector.

Trade openness is the key variable in this analysis. With the exception of Onjala (2002), no other study analyzed the relationships between trade openness and growth for Kenya. Onjala (2002) found some evidence, albeit inconsistent evidence, of a link between trade policy and *TFP* in Kenya. Trade liberalization or openness policy in Kenya in the post structural adjustment

[8] For examples of these potential variables, see Arndt (2006), Abu-Bader and Abu-Qarn (2003), Dar and AmirKhalkhali (2002), Feldstein (2008), Duval and Maisonneuve (2010), Kwack and Sun (2005), López-Puey and Mancebón (2010), Lipow and Antinori (1995), Odhiambo (2009), Salinas-Jiménez, Alvarez-Ayuso, and Delgado-Rodríguez (2006), and Salvatore (2008).

Table 5
Determinants of TFP 1977–2008.

	(1)	(2)	(3)
C	1.002 (3.18)*	1.965 (4.06)*	4.665 (6.73)*
T	0.867 (6.58)*	4.316 (7.24)*	0.009 (1.69)**
$ODAY_t$	0.004 (1.69)**	0.017 (2.85)*	0.135 (2.88)*
$FDIY_t$	0.003 (1.90)**	0.027 (1.77)**	0.127 (1.90)**
GY_t	−0.003 (2.06)*	−0.008 (2.05)*	−0.018 (2.76)*
π_t	−0.599 (2.17)*	−0.362 (2.04)*	−0.599 (5.04)*
$M2Y_t$	0.009 (1.30)	0.174 (2.49)*	0.127 (2.08)*
DUM		0.019 (2.34)*	0.096 (2.07)*
TO_t			0.036 (7.12)*

Note: The *t*-ratios are reported below the coefficients.
* Denotes significance at 5% levels.
** Denotes significance at 10% levels.

is mainly driven by multilateral and bilateral agreements such as obligations under WTO, the ACP-EU economic partnership agreements, EAC and COMESA tariff reductions and bilateral trade agreements. It is therefore important to analyze the relevance of trade openness in the *TFP* of Kenya.

The *ADF* and *ERS* unit root tests for all independent variables chosen indicated that they are *I*(1) in levels.[9] Since *TFP* is *I*(0) in levels, it is inappropriate to use techniques such as *EG* and *FMOLS*. Therefore we employ the *ARDL* technique to estimate the *TFP* functions because this method generally performs well regardless of whether the variables are *I*(1) or *I*(0).

The cointegrating equations of *TFP* are reported in Table 5. Note that two of the selected potential variables were deleted because they were statistically insignificant in all regressions: *PCY* and *RY*. We used the remaining 8 variables to examine which of these have a significant impact on *TFP*. First we estimated the *TFP* function without *DUM* and *TO*. These results are reported in column (1). Here all the estimated coefficients are significant at conventional levels, except *M2Y*. The estimated variables also have expected signs. In column (1), the null of no cointegration was rejected.[10] Second, when *DUM* was added with other potential variables (except *TO*), the *M2Y* became significant at the 5% level, see column (2).[11] The estimates of *M2Y* have also increased mildly.

The estimates in column (3) are interesting because this has useful policy implications.[12] Here *TO* is added to other potential variables and this is highly significant. All the other estimates are also significant at conventional levels, with expected signs. While variables like overseas development aid, foreign direct investment, progress of financial sector and trade openness have a significant positive impact on *TFP*, others such as current government spending and rate of inflation have detrimental effects. Note that the trend variable is highly significant in columns (1) and (2) but not in (3). This signifies that the unknown determinants of growth are trended. An

[9] The *ADF* and *ERS* unit root test results for potential variables are not reported to conserve space but can be obtained from the authors.

[10] The computed *F* statistic (8.834) was greater than the upper bound of the 95% critical value (4.378).

[11] In column (2), the null of no cointegration was rejected because the computed *F* statistic (4.529) was greater than the upper bound of the 95% critical value (4.378).

[12] In column (3), the null of no cointegration was also rejected. The computed *F* statistic (5.843) was greater than the upper bound of the 95% critical value (4.378).

important implication of our long run results is that trade openness is the key determinant of *TFP* in Kenya.[13]

Our findings imply that policy makers should focus on policies that enhance trade openness because this will increase *TFP* in Kenya. To further improve the trade openness, Kenya should continue to participate in the multilateral and bilateral agreements (WTO, ACP-EU, EAC and COMESA). This recommendation is consistent with the recent Trade Policy Review of Kenya conducted by the World Trade Organisation in 2007. The report (WTO, 2010) indicated that trade openness and ultimately performance depends on Kenya working at the regional level with the other two members of the EAC (Tanzania and Uganda). The full establishment of free trade areas across EAC is imperative to efficient resource allocation in its member countries. Further, an obstacle highlighted was overlapping trade partnerships which are complex and difficult to manage. Consequently, increased effort at the regional rather than country level, via EAC's multilateral commitments is required, for both goods and services. Thus, our findings support Sachs and Warner (1995) and Edwards (1998) that openness stimulates long run growth.

5. Conclusions

In this article, we examined the determinants of *TFP* in Kenya using time series data for the period 1977–2008. We utilized theoretical insights from the Solow (1956) growth model and its extension by Mankiw, Romer and Weil (1992) and followed Senhadji's (2000) growth accounting procedure. To the best of our knowledge, this is the first study to use these frameworks for the purpose of investigating the potential factors driving the long run growth rate in Kenya. Our growth accounting exercise showed that growth in Kenya, until the 1990s was mainly due to factor accumulation. Since then, *TFP* has made a small contribution to growth. We next employed the *ARDL*, *EG* and *FMOLS* techniques to estimate the factor shares of output, and all three methods of estimation pointed towards the capital share of output in Kenya being approximately 0.4.

The *TFP* equations were estimated with the *ARDL* technique. Our findings imply that potential drivers, such as overseas development aid, foreign direct investment, progress of financial sector and trade openness have a significant and positive impact on *TFP.* Alternatively, current government spending and rate of inflation appear to have adverse effects on *TFP*. An interesting finding was that the trend variable was highly significant when trade openness was omitted in the regressions, and became weakly significant once trade openness was included in the model. Policy makers may find this result relevant as it implies that trade openness is a key determinant of *TFP* in Kenya. Consequently, future policy direction should focus in the first instance on policies that improve Kenya's trade openness, such as increasing its participation in multilateral and bilateral agreements (WTO, ACP-EU, EAC and COMESA). This recommendation, with an emphasis on EAC, is consistent with the recent Trade Policy Review of Kenya conducted by the World Trade Organisation in 2007.

Other policy applications point towards foreign direct investment being highly relevant. This complements findings by Adams (2009), who highlighted the sizeable contribution of foreign direct investment to capital flows and in general, economic growth. A targeted approach to foreign direct investment is also emphasized by Agosin and Mayer (2000). They note that foreign direct investment is relatively more productive in parts of Asia (China, Taiwan and South Korea),

[13] We did interchangeably drop and add other potential variables but the trend remained highly significant.

as investment applications are screened and differential incentives are provided to different applications. It is also important to note that increasing foreign direct investment is not a factor that operates in isolation, its economic impact depend on a range of issues: synergies between foreign and domestic investment, ability to increase absorption capacity of local firms, and cooperation between the government agencies and multinational firms.

This research also unveiled the strong relationship between financial reforms/development and *TFP* growth in Kenya. Financial reforms often boost payments technology and result in more efficient and liquid financial intermediation. Rao and Kumar (2011) argued that financial reforms could cause large variations in the demand for money. To this end, the monetary policy should allow for adjustments in the bank rate to control the rate of inflation.

Finally, this study has not examined the level and growth effects of the selected independent variables in the econometric methods employed, as well as the short run dynamic model of *TFP*. While both of these research areas are outside the scope of the paper, they present as possible directions for future research with respect to fully understanding drivers of Kenya's growth rate.

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