J Prod Anal (2010) 33:125–146
DOI 10.1007/s11123-009-0155-5

Growth, productivity and diversification in Africa

Hakim Ben Hammouda · Stephen N. Karingi · Angelica E. Njuguna · Mustapha Sadni Jallab

Published online: 22 September 2009

Abstract The purpose of this article is to investigate the relationship among economic growth, productivity and diversification. Our results have shown that deepening diversification leads to improvements in total factor productivity among other determinants in African economies. The significance of the link between diversification and economic growth in the case of African economies cannot be gainsaid. It means that African countries can scale up their economies' growth by raising their total factor productivity through pursuing policies that enhance diversification.

Keywords Export diversification · Growth · African economies

JEL classification F1 · O1 · O4 · C2

1 Introduction

There is abundant literature with empirical evidence showing that the level of exports influences growth.[1] However, it is argued that it is not just the level of exports that lead to growth but also the level of diversified exports or products. The theory identifies two ways in which diversification may influence growth or income. Firstly, diversification may enter as a production factor by increasing the productivity of the other factors of production (see Romer 1990) and secondly, it may increase income by expanding the possibilities to spread investment risks over a wider portfolio (Acemoglu and Zilibotti 1997).

The renewal of the debate on diversification was coupled with a consensus on its role in the growth dynamics. Indeed, recent literature explains the fragility of growth in African economies and the continent's marginalization in global economy by the poor diversification of African economic structures. Several authors have sought to explain the connection between diversification and growth. Particularly, recent works on endogenous growth have emphasized the importance of diversification. Thus, the Romer model introduced a beneficial effect of diversification, which is expressed through the availability of inputs within an economy and can contribute to increasing labour productivity and human capital (Berthélemy and Soderling 2001; Al-Marhubi 2000). Diversification can equally contribute to growth by increasing the number of sectors and accordingly investment opportunities and by reducing investors' risks. But for different authors diversification plays a major role in economic growth through the stabilization of export revenues. Indeed, specialization in only one product was always considered a source for volatility and great instability. These works took inspiration from researches on financial portfolios and the different diversification strategies in order to reduce investors' risks. At this stage, different works have shown the correlation between diversification and stability of export revenues and accordingly the sustainability of growth dynamics (Romer 1990; Acemoglu and Zilibotti 1997).

H. Ben Hammouda · M. Sadni Jallab (✉)
World Trade Organization/Organisation Mondiale du Commerce, Centre William Rappard, Rue de Lausanne 154, 1211 Geneva, Switzerland
e-mail: msadnijallab@gmail.com

S. N. Karingi · A. E. Njuguna
United Nations Economic Commission for Africa, PO Box 3005, Addis Ababa, Ethiopia

[1] Besides the view that exports cause growth, the causal relationship could also run the other way, with growth causing rapid exports growth.

In the analysis of the link between diversification and growth, most of the authors used macro-econometric models where they sought to test the correlation between the level of growth and the different indices of diversification. The works of Berthélemy and Chauvin (2000), who used a particular methodology, must be mentioned. Firstly, they used the traditional methodology of breaking down the contribution of different factors to growth, that is the Cobb Douglas production function to decompose the contributions of capital, labor and total factor productivity. Thereafter, through an econometric regression they considered the different factors that could explain the total productivity of factors. At this stage, they had retained several explanatory variables that are indices of diversification, development finance, economic openness and human capital. This methodology is interesting for it enables, through the total productivity of factors, to show the contribution of diversification to economic growth (Berthélemy and Chauvin 2000; Berthélemy and Soderling 2001; Stanley and Bunnag 2001).

The main purpose of this paper is to investigate the relationship among economic growth, productivity and diversification. After the introduction, Sect. 2 undertakes a growth accounting exercise in order to quantify the relative contribution of capital, labor and total factor productivity in economic growth of African countries. In Sect. 3, the relationship between the total factor productivity and diversification is explored, on the basis that the transmission mechanism of diversification to economic growth could be through this route as indicated in Romer (1990). In Sect. 4, a further investigation to deepen the understanding of the link between economic growth and diversification is presented by revisiting the diversification regimes in Africa. Lastly, Sect. 5 concludes.

2 The sources of growth

To be in a position to investigate the link between growth and diversification, one has to quantify the contribution of total factor productivity to economic growth. This section analyzes the sources of growth for African countries using the standard growth accounting method, making it possible to disaggregate the share of growth that is contributed by total factor productivity, capital and labor. Following in the tradition of the Solow-growth modeling, a production function is used as a benchmark to study and identify the sources of economic growth. This approach provides an understanding of the different sources of growth, and makes it possible to quantify the contribution of each factor. Consider the Cobb-Douglas production function with constant return to scale:

$$Y = AK^{\alpha}L^{1-\alpha} \tag{1}$$

where Y is output, A is the total factor productivity, K is capital stock, L is labor, and α is a constant with $0 < \alpha < 1$. The constant α measures the elasticity of output with respect to capital when the supply of labor is held constant; and similarly $(1 - \alpha)$ measures the elasticity of output with respect to labor, when the supply of capital is held constant. This form of production technology has been proven useful in many empirical studies. By taking the logarithm of Eq. 1, and differentiating it with respect to time it is possible to derive the growth in output. This gives:

$$\frac{d\ln Y}{dt} = \frac{d\ln A}{dt} + \alpha\frac{d\ln K}{dt} + (1-\alpha)\frac{d\ln L}{dt} \quad \text{or} \quad \frac{\dot{Y}}{Y} = \frac{\dot{A}}{A} + \alpha\frac{\dot{K}}{K} + (1-\alpha)\frac{\dot{L}}{L} \tag{2}$$

where the dotted variables denote time derivatives. Equation 2 states that the growth in output is the sum of the growth in capital, growth in labor and growth in total factor productivity (TFP). Capital accumulation is an essential element in the growth process, as it enlarges the economy's capacity to produce while increases in labor or labor force has traditionally been considered a positive factor in stimulating economic growth. Technical progress or TFP is also an important and perhaps the main factor in the growth process. It is the advances in technology that continue to stimulate the growth of the rich industrial countries, especially as their population growth rates are more at replacement levels. In Africa on the other hand, there is a popular idea that it is more the factor accumulation that drives economic growth, with below average contribution by the TFP. As will be shown in Sect. 3, the TFP is a transmission mechanism that channels the effects of several factors like diversification in influencing growth.

In order to decompose the contribution of capital, labor and TFP to growth, it is necessary to first estimate the value of capital and labor elasticities, represented by α. This is done by taking the logarithm of Eq. 1, which yield the following regression model:

$$\ln Y_t = \delta + \alpha \ln k_t + \beta \ln L_t + e_t \tag{3}$$

where $\mathrm{Ln}Y$ = log of GDP, $\ln K$ = log of capital, $\ln L$ = log of labour force, $\delta = \ln A$, $\beta = (1 - \alpha)$, e is the error term and t is time index. In this study, a panel of observations from a number of African countries was used and therefore, the equivalent empirical model may be written as:

$$y_{it} = \kappa_i + \beta' x_{it} + e_{it}, \quad \begin{matrix} i = 1, \ldots, N \\ i = 1, \ldots, T \end{matrix} \tag{4}$$

where β' is a vector of parameters to be estimated; κ_i is a constant representing the individual-specific effects which may be considered as either fixed or random; y_{it} is the value

Table 1 Mean, standard deviation and other statistical indicators by variables, 1981–2000[a]

Variable	Mean	SD	Minimum	Maximum
Output/GDP (in billion USD)	7.10	19.90	0.11	138.58
Capital stock (in billion USD)	13368.86	128118.52	0.10	1511303.33
Labor force (in million)	4.81	7.59	0.10	47.83
Diversification	0.51	0.18	0.13	0.97
Human capital	23.89	18.93	3.57	90.00
Openness				
Export + imports % of GDP	65.17	34.07	19.52	188.98
Export % of GDP	28.48	15.16	6.17	73.41
Financial development				
Credit1	19.12	18.57	2.10	126.15
Credit2	32.49	24.02	4.97	146.57

[a] See Appendix A for definitions and sources of variables

of the dependent variable (output) for the *i*th unit (country) at time t, which depends on K exogenous variables, $(x_{1it}, \ldots, x_{Kit}) = x'_{it},$, namely: capital and labor; and e_{it} is the disturbance term.

If κ_i's are treated as fixed representing the effects of those variables peculiar to the *i*th individual country in a more or less the same fashion over time, and if the error terms are independently identically distributed random variable with mean zero and variance σ_u^2, then Eq. 4 may be estimated using the least squares dummy variable estimation (LSDV) since the observed values of the variable for the coefficient κ_i takes the form of dummy variables. With the models using panel data, the generalization of the constant-intercept-and-slope model is to introduce dummy variables to allow for the effects of those omitted variables that are specific to individual cross-sectional units but stay constant over time, and the effects that are specific to each time period but are the same for all cross-sectional units (see Hsiao 2003).[2] The LSDV procedure is equivalent to the OLS applied to the model using the deviations of the variables from the mean. On the other hand, if κ_i's are considered random variables, then the residual e_{it} will have different components. If the usual assumptions on the errors are applicable, then the resulting error-components model may be estimated, for example, using the generalized least squares (GLS) estimation method.[3]

The model in Eq. 4 was estimated using observations from a cross section of 35 African countries from a period of 1981–2000, using 5-year non-overlapping averages, a total of 140 panel observations.[4] The data on output and labor force were taken from the World Development Indicators (WDI), World Bank database. Output is measured by the gross domestic product (GDP) and labor force is comprised of economically active population. Capital stock was sourced from the work of Tahari et al. (2004), constructed using the perpetual inventory method. Since the coefficients to be estimated are elasticities, the units are inconsequential.[5] Table 1 gives the means, standard deviations and other statistical indicators for each of the variable for the sample African countries during the 1981–2000 period. The sample averages for the African countries showed that the region has much lower output and factors of production compared to the industrialized countries. However, the sample values for each of the variable are highly heterogeneous as shown by the standard deviations and by the gap between the minimum and maximum values. For example, the difference in output between a small poor country like Comoros and a relatively big and developed country like South Africa is enormous.

In estimating the empirical model in Eq. 4, a number of issues have to be taken into consideration such as the specification of the individual effects; the choice of the functional form, and the inclusion of the technology variable. Moreover, the variables were also tested for stationarity using panel unit root tests namely, Levin, Lin & Chu (LLC) test and Im, Pesaran and Shin (IPS) test. The former assumes common unit root process while the latter assumes individual unit root process. We found that none of the variables in this model has unit root (see Appendix B).[6] The Hausman test statistics, $\chi^2_{(2)} = 18.70$ rejects the hypothesis of correlated random effect at $\alpha = 0.01$, and thus, favors the fixed-effects specification. As to the second issue, we estimated both the Cobb-Douglas technology and the translog function, and found that the former is more

[2] Here, we use data that are in 5-year non-overlapping averages, thus, we do not expect that the variable varies with time.

[3] The LSDV and GLS methods will give BLUE for the fixed-effects and random-effects models, respectively (see Hsiao 2003 for details).

[4] We used the non-overlapping averages to minimize effects of business cycles and other noise in the data. See for example the panel data model estimation in Islam (1995).

[5] We thank Dhaneswar Ghura for sharing with us their data on capital stock for Sub-Saharan Africa.

[6] We thought that IPS is more applicable to the African panel data.

consistent with our data set.[7] In the Cobb-Douglas form, the restriction of constant returns to scale was not rejected at 5% level of significance. The technology variable (T) representing the Harrod-neutral and Hicks-neutral technical progress was also tested in this exercise. The Harrod and Hicks neutralities are equivalent when using Cobb-Douglas production function (e.g. see Wells 1995; Njuguna 1999). Here, we found that the technology variable does not have significant impact in the African production processes. This result reiterates the stagnation or little technical progress in many African countries. For example, in Njuguna et al. (2003), they found that the total factor productivity in Kenya has been contributing very little to economic growth and its growth has been declining in the last decade.

In the estimation of the translog production function, we found that the coefficients characterizing this function are not statistically significant (see Appendix C). These are the squares of the logs of capital and labor. Several restrictions imposed on this model were tested such as (a) the constant return to scale, (b) the constant elasticity of substitution (CES), and (c) the joint significance of the coefficients of the squares and product of the factors of production as well as the technology variables. We found that the second and the third restrictions are not binding. However, although the third restriction was not rejected, in the estimated results, only the product of the logs capital and labor is statistically significant. The time trend representing technology is also found not significant in this model. Therefore, based on these results, we are convinced that the Cobb-Douglas form of technology is more consistent with our sample data.

The final results estimated using fixed-effects model are presented in Table 2.[8] The estimated equation gave an estimate of $\hat{\alpha} = 0.37$ for the share of capital and $\hat{\beta} = 0.63$ for share of labor. These estimates are in the same range to the estimated values of other studies such as the ones of Berthélemy and Soderling (2001) and Tahari et al. (2004).

With the estimated values of the shares of capital and labour, the contributions of production factors and TFP to growth were estimated using Eq. 2. The results from the growth accounting exercises for individual countries for 5-year averages from 1981–2000 are presented in Appendix D, Table D.1 and D.2. The first table shows the contribution of labor, capital and total factor productivity (TFP) to output growth in various African countries while the second table gives the proportional contribution of the three sources of growth in each of the economies. Looking at both these tables however, the results confirm that economic growth in Africa is driven by the accumulation of the factors of production. The average contribution of TFP to growth is negative for the majority of the African countries with the exception of a few countries such as Botswana, Burkina Faso, Cape Verde, Chad, Equatorial Guinea, Ethiopia, Gabon, Guinea-Bissau, Malawi, Mauritius, Mozambique, Senegal, Swaziland, Uganda, Zambia and Zimbabwe.

Another important observation worth noting is that in majority of the countries, the contribution of TFP to growth was positive in the 1980s, especially for the period 1981–1985 and it is the early 1990s mainly when most of them experienced negative contributions from TFP. In deed, even for a country like Botswana, which exemplifies economic success in Africa, saw a negative contribution by TFP during the first half of the 1990s (see e.g. Rodrik 1998 for discussion). There was therefore a reversal in the sources of growth in the continent in that the TFP contribution declined significantly from the second half of the 1980s. In a good proportion of the countries, TFP contributed at least 30% of the growth, and in some cases more than half of the total growth, but this clearly changed

Table 2 Panel data estimates of the growth equation

Dependent variable: log of income	Coefficient (t-value)
Constant	2.123***
	(9.66)
Elasticity of output with respect to capital	0.371***
	(8.25)
Elasticity of output with respect to labour	0.629***
	(13.98)
Adjusted R-squared	0.99
Number of cross-sections	35
Number of observations	140
Hausman test (Ho: correlated random effect)	$\chi^2(2) = 18.70$***
Test of restriction: Ho: $\alpha + \beta = 1$, critical $F_{(1,\ 103)} = 3.92$ at $\alpha = 5\%$	F-stat = 2.51
White test (Ho: no heterokedasticity): critical $\chi^2_{(5)} = 11.07$ at $\alpha = 5\%$	$\chi^2(5) = 4.87$

The figures in parentheses are t-values

*** Significance at 1%

[7] We estimated the translog function: $\ln Y = \log A + \alpha_k \ln K + \alpha_L \ln L + \alpha_{kk}[\ln K]^2 + \alpha_{LL}[\ln L]^2 + \alpha_{LK} \ln K \ln L$,
using LSDV method and found that the coefficients of the squared variables are not statistically significant. The translog function may be use as a representation (linear approximation) of the constant elasticity of substitution (CES) production function, where the hypothesis of CES is tested using the restriction $\alpha_{KK} = \alpha_{LL} = -\frac{1}{2}\alpha_{LK}$ (see Thomas 1993; Hoff 2004). This restriction is not consistent with our data set (see Appendix C).

[8] The residuals were tested for the presence of heteroskedasticity using White test. The null hypothesis of no heteroskedasticity, that is $Ho: \pi_2 = \pi_3 = \pi_4 = \pi_5 = \pi_6 = 0$, from the equation $\hat{e}^2_{it} = \pi_1 + \pi_2 \ln K + \pi_3 \ln L + \pi_4[\ln K]^2 + \pi_5[\ln L]^2 + \pi_6 \ln K \cdot \ln L + v_{it}$, is not rejected at 5% level of significance (see Table 2).

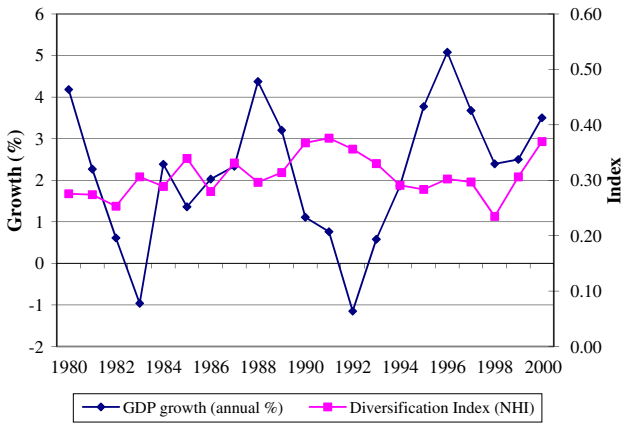

Fig. 1 Sub-Saharan Africa GDP growth and diversification, 1980–2000

especially in the beginning of the 1990s and to a significant extent in the second half of the 1980s. Thus in Botswana, except for the period 1991–1995, TFP contributes more than one-third of the growth. For Burkina Faso, in 1981–85 and 1991–95, TFP contributed half of the growth. Another important observation worth pointing out is that the period 1996–2000 has witnessed a return to positive contribution by TFP to growth. This contribution is however lower when compared to TFP's contribution in the period 1981–1985.

How can one explain the transition of the contribution of the TFP to economic growth from positive to negative? As indicated here, it is in the late 1980s and early 1990s that the transition to negative contribution of TFP occurred. To provide the intuition to the causes of this transition, it is worth noting that the diversification efforts of the 1970s were yielding favourable results as we entered the 1980s. The favourable, though fragile results of the diversification efforts that were registered in the early 1980s were correlated with the relatively favourable growth results of the same period as shown in Fig. 1. Thus, the positive and significant contribution of the TFP in the early 1980s explains the better diversification results at the time. However, these gains could not be sustained in the later years of the 1980s. Two explanations come to mind. First is the direct impact of the economic crises of the early 1980s itself and second is the adjustment measures addressing this crises started to bite.

The adjustment measures that needed to be instituted to deal with the economic crises required stringent macroeconomic policies. The stringent policies took the form of fiscal and monetary conservativeness.[9] This meant on the fiscal front that countries had to make hard choices. Some of the choices that had to be made meant cutting development expenditures and curtailing the rate of growth of private sector credit. Reduced development spending by the public sector and weak private sector investments could have led to the weakening of the contribution of the TFP to growth. The tight macroeconomic policies reduced the flexibilities that countries had to pursue diversification-enhancing programmes and this may have contributed to the transition from positive to negative contribution to growth by the TFP. Empirical evidence suggests that in all countries public expenditure causes growth in national income either in the short or long run through the TFP (Fölster and Henrekson 2001). Various types of government spending have differential impacts on economic growth, implying greater potential from improving efficiency in government spending. And as a corollary, reducing the public investment can create negative incentive to foster economic diversification and growth (Miles et al. 2003).

In the next section, the empirical link between diversification and growth through the TFP is explored. The significance of this transmission mechanism is that if established, it will be possible to validate the propositions made here that the hard macroeconomic choices that countries had to make to deal with the economic crises invariably affected the role of TFP in Africa's growth by undermining the diversification efforts at the time. Diversification efforts in this context mean ability of countries in Africa to invest in sound policies aimed at diversifying their production.[10]

[9] Harnessing the benefits of investment is essential to global prosperity and stability. Work in the growth accounting tradition of Solow (1957) has typically concluded that capital accumulation accounts for only a relatively small fraction of productivity growth. The assumption underlying growth accounting calculations that capital is paid its marginal product implies that increasing the rate of capital accumulation can make only a modest contribution to accelerating growth. In all countries public expenditure causes growth in national income either in the short or long run through the TFP (Fölster and Henrekson 2001). Various types of government spending have differential impacts on economic growth, implying greater potential to improve efficiency of government spending. And as a corollary, reducing the public investment can create negative incentive to foster economic diversification and growth. (Miles et al. 2003).

[10] By low diversification efforts, we mean that countries need to invest more in sound policies aims at diversifying their production. We think particularly in good governance structures and institution. Governance institutions that countries would have to strengthen should cut across rule of law, public order, and a judiciary that effectively deals with commercial disputes, tax administration institutions that contribute to a predictable investment climate among other areas. In a more global way, key recommendation that can be derived from this study relates to the role of economic policies aimed at highest diversification situation. For example, one area in which the African countries could have diversified production is through agricultural transformation. However, in Africa, there was only limited structural transformation. Agriculture exports remain concentrated in a narrow band of primary commodities (Ben Hammouda et al. 2006b; Ndulu and O'Connell 2008).

3 Economic growth and diversification: exploring the TFP link in Africa

In this section, the results from panel data estimation that sought to explore the link between TFP and diversification are reported. The motivation behind these empirics is the theoretical proposition that diversification could influence economic growth through one of two links if not both at the same time. These links highlighted earlier are via increasing total factor productivity (as in Romer 1990) or by risk minimization through spreading of investment portfolios (as argued in Acemoglu and Zilibotti 1997). The focus of this section is in the TFP link while recognizing that the neoclassical growth model and its competing endogenous growth model are one and the same to some extent, only that the latter attempts to disaggregate potential components of the TFP.[11] Risk minimization and its influence on growth, leading to diversified exports could reasonably be captured through its possible influence on TFP.

In investigating whether there is a significant link between diversification and total factor productivity, we assume that TFP is a function of several variables namely: an index of diversification, human capital, some policy and institutional variables such as openness, financial development and conflict. The regression model may be expressed as:

$$\mathrm{TFP}_{it} = \beta_0 + \beta_1 I1_{it} + \beta_2 \mathrm{Human}_{it} + \beta_3 \mathrm{Open}_{it} + \beta_4 \mathrm{FD}_{it} + \beta_5 \mathrm{Conflict} + \varepsilon_{it} \quad (5)$$

Where $I1$ = index of diversification, Human = human capital, Open = trade openness, FD = financial development, Conflict = dummy for the presence of conflict or war, βs are the parameters to be estimated and ε is the regression error term, i and t are respectively, the individual and time indices.

3.1 Diversification

The theoretical justification for having diversification as an exogenous variable in this model has already been discussed. Two routes have been identified. First, diversification positively affects growth through improved total factor productivity. Second, diversification plays a major role in economic growth through the stabilization of export revenues. In the context of this study, it is the first link that appeals to the empirical investigation at hand whereby the level of diversification is expected to have a significant influence on the productivity of capital and labour in the economy. Works on endogenous growth have emphasized the importance of diversification and it is such studies that provide good theoretical arguments justifying the inclusion of diversification as an exogenous variable. For instance, the Romer (1990) model introduced a beneficial effect of diversification, which is expressed through the availability of inputs within an economy and can contribute to increasing labour productivity and human capital (which is introduced independently in the model as explained below).

3.2 Human capital

Borrowing from the endogenous growth literature, human capital is assumed to be different to other forms of capital. As a result, the level of investment in a country on human capital is expected to have a bearing on the productivity of both labour and capital in the economy. In our model, the level of enrolment in secondary schools measures human capital.

3.3 Openness

Openness to trade has been one of the most studied issues in economic literature in recent times. Accordingly, the influence of TFP from openness are assumed to derive from external effects such as exposure to foreign competition, transfer of technology and economies of scale, also in some extent from increased speed of convergence toward richer countries. The level of openness depends much on the kind of trade policy a country pursues. Opposing schools of thought put different weights to the significance of trade liberalization in promoting growth. In our model, the objective was to capture the influence of openness to TFP. In the literature, as captured in the critical work of Rodrik and Rodriguez (1999), there are different measures of openness (also see Berthélemy and Soderling 2001). Thus, in our model, two of these measures: exports as a proportion of GDP and the sum of exports plus imports as a proportion of GDP were tested, to see which gives the most plausible results.

3.4 Financial deepening

According to the literature, financial development may influence growth positively in two ways. Firstly, a more developed financial structure allows a better mobilization of savings and thus may support more investment and secondly, within a more developed financial sector, available information on investment projects will be treated

[11] Using bootstrap J test, Fingleton (2005) shows that the neoclassical growth model does not reject the new economic geography specification (an extension akin to standard endogenous growth models). This implies the new specifications could actually be nested in the neoclassical orthodox models through the TFP or more aptly the Solow residual.

more efficiently and then boost investments in productive sectors (see Berthélemy and Chauvin 2000; and Berthélemy and Varoudakis 1996).

Moreover, the lack of access to credit has been identified as one of the impediments to growth in Africa. The arguments in favour of financial markets liberalisation were mainly based on the premise that the binding capital constraint to African economies could be undone by liberalizing not just the money markets, but also the financial markets in broad sense. Thus, the full potential of the banking, insurance, development finance, stock and bond markets needed to be unleashed by dismantling the controls and restrictive controls that hampered the development and the deepening of the financial sector. Studies such as Tahari et al. (2004) have even provided results to show that the performance of the countries whose programmes with the IMF were adjudged to be on track was better. While this has been an issue of major empirical investigation and debate, it was instructive to find out whether financial deepening has a significant influence on total factor productivity in the case of African countries. There are several ways through which financial deepening has been captured in empirical work. First, the credit to the private sector has been one of the indicators. Second, in some cases, the combined total of the credit by the banking sector (implying both credit to the private and public sectors) has been another popular indicator. Third, the broad money supply (M3) as a proportion of GDP is another widely used measure of financial deepening. In our model, all these three measures of financial deepening were explored alternately.

3.5 Conflict

Economic growth in Africa has been variously linked to the presence or absence of conflict.[12] Significant work has been undertaken on the economics of conflict and post-conflict countries. In deed, in recent times, most empirical works have been considered incomplete if they fail to take account of conflict. Collier (2007) identified the presence of conflict as one of the poverty traps. In Africa, one in five African lives in countries severely disrupted by conflict or political strife (World Bank 2000). Weak growth could be attributed to the presence of conflict in a country. Conflict could influence this growth performance either directly or indirectly. In the more direct route, adverse effects on populations (hence labour force) and capital destruction could undermine the obvious sources of growth through factor accumulation. In the more indirect route, conflict could affect the TFP, leading to its declines and hence its contribution to growth. In our model, a dummy representing the presence or absence of conflict was introduced.

The values of the TFP were derived using the estimated coefficients from Eq. 4 and used as the dependent variable in Eq. 5. The other data are taken from UNCTAD and World Development Indicators. The diversification index was calculated using the Normalized-Hirschman Index (see Ben Hammouda et al. 2006b), using UNCTAD data on exports products at the 3-digit SITC classification. As the index is between zero and one with zero being perfect diversification and an index of one representing specialisation on one commodity, a negative sign in relation to the TFP is the a priori expectation.

Human capital is represented by the secondary school enrollment as percent of gross enrollment. This is one of the alternative measures that are accepted in the literature as an indicator of human capital development (see e.g. Ghura and Hadjimichael 1996). Trade openness was measured by the sum of exports and imports as percent of GDP, or alternatively, total exports of goods and services as percent of GDP (see Berthélemy and Soderling 2001). Intuitively, in the first measure, both exports and imports allow the spillover and imitation of technology and thus, enhance productivity. Financial deepening is the domestic credit to private sector as percent of GDP (Credit1), or alternatively, the domestic credit provided by banking sector (Credit2) (see Berthélemy and Chauvin 2000; and Berthélemy and Varoudakis 1996). Conflict is a dummy variable, which is equal to one (1) if there is a presence of conflict or war during the period, zero (0) otherwise. Again, the observations used are from period of 1981–2000, using 5-year non-overlapping averages. The number of cross-section units or countries included in the estimation varies depending on the availability of observation for the different variables. The means, standard deviation, and other statistical indicators for each of the variable used in Eq. 5 are provided in Table 1. The variables included in the model were tested for stationarity. All except the series on exports as percent of GDP do not have unit root (see Appendix B).

The regression model in Eq. 5 was again estimated using panel data for sub-Saharan African economies under a fixed effect assumption, as described in Sect. 2.[13] The results are reported in Table 3. The results from three of the estimated models are shown. The difference between

[12] By conflict we mean coups and civil wars (see discussion of conflict trap in Africa in Collier 2007, Chapter 2).

[13] The growth model upon which the TFP data was derived included African countries other than North Africa. The capital stock data for North African economies was not available at the time of the empirical estimations. The fixed effect model was estimated using weighted least squares (WLS) since some variability in the residuals were observed. If the weights $w_i = 1/\sigma_{ui}^2 = w$, which means $\sigma_{ui}^2 = \sigma_u^2$, then WLS is equal to OLS (Gujarati 1995, ch. 11).

Table 3 Economic growth and diversification—the TFP link

Endogenous variable: TFP	Model I	Model II	Model III
Constant	25.495***	23.731***	22.473***
	(26.91)	(30.406)	(54.435)
Diversification	−2.048*	−2.121**	−1.113*
	(−1.78)	(−2.32)	(−1.65)
Human capital	−0.037	0.032*	−0.007
	(−1.63)	(1.75)	(−0.68)
Openness: (exports + imports)/GDP	0.010*	–	0.005*
	(1.67)		(1.77)
Financial deepening: Credit2	−0.011	−0.002	–
	(−1.42)	(−0.27)	
Conflict (dummy = 1 if war/strife is present)	−0.532*	−1.194**	−0.388
	(−1.75)	(−4.28)	(−1.61)
R-squared (adjusted)	0.99	0.99	0.99
Number of cross-sections	20	24	22
Number of observations	80	96	88

The figures in parentheses are *t*-values

*** Significance at 1%,
** Significant at 5%,
* Significant at 10%

the three models is driven by the fact that there are different indicators for some of the explanatory variables under study. The first model included all regressors from Eq. 5. The other two models (II and III) are alternative models, which try firstly, the robustness of the relationship between TFP and diversification, and secondly, eliminate the regressors, which are not relevant from the first estimation. Meanwhile, none of the coefficients for the measures for financial deepening were significant in any of the estimated models. Moreover, since the export series is nonstationary, it is dropped from the estimation as a measure of trade openness.

The following are notable with respect to the empirical results. Firstly, the expected sign with respect to total factor productivity and diversification was achieved in the three models, indicating the robust nature of this relationship. Essentially, increasing level of diversification leads to higher total factor productivity. The statistically significant negative relationship in all the three models between diversification and TFP simply indicates that as an economy moves from high level of specialization to becoming more diversified, the total productivity of both labor and capital rises.

The results from the estimation exercise imply that diversification significantly drives growth in the total factor productivity. In other words, a significant empirical link between diversification and growth does indeed exist with regards to the African economies via the total factor productivity. If a country wishes to raise the level of growth, on the basis of the empirical results in Table 3, pursuing diversification-deepening policies could actually help achieve this objective. Ben Hammouda et al. (2006a) found that the key determinants of diversification in Africa are physical variables such as per capita incomes and investment, policy variables such as trade and industrial strategies policies, macroeconomic stability especially fiscal policy stance, and institutional variables such as governance and conflict. The significance of the results in Table 3 is that they suggest that even for African economies in general, if capital and labor are binding, countries can unlock growth potential by pursuing diversification-enhancing policies.

Whereas the objective of this study was to establish the significance of the empirical link between diversification and growth via TFP, it is worthwhile to discuss briefly the rest of the results. Human capital is also an important explanatory variable to TFP performance however, its results are not robust in our data set and only a weak relationship to TFP was observed in one of the estimated models. However, while economic policies could be oriented at deepening diversification through the determinants already discussed, we believe that social policy that dictates higher investments in human capital ought also to be defined. We suggest that a deeper exploration on this relationship in the African context should be further investigated.

Trade openness also emerged as a robust determinant of TFP in the analysis, although the coefficients are only weakly significant. It is important to note at this juncture that the conventional definition of openness, combining both exports and imports as a proportion of GDP, was used in the two models. Berthélemy and Soderling (2001) in a similar analysis aimed at exploring the link between diversification and total factor productivity relied on a measure of openness based on the ratio of exports only to GDP. Yet the important point from this analysis is that for

the African economies in the sample, openness has significant impact on productivity. Does this mean that trade liberalisation which has led to substantial openness in the African economies has catalysed technological spill-overs, which lead to increases in the share of TFP to growth? Apparently these results could be pointing to the possibility that openness in Africa, especially in terms of imports, have resulted also in technology enhancing imports. The imports compression that the liberalization aimed at addressing was undone leading probably to the importation of not only the final consumption goods but also capital and intermediate imports which have embodied technologies that would have led to the positive and significant influence on the TFP.

The other important result that is noteworthy in terms of influence on TFP is conflict. Presence of conflict has a negative and significant influence on TFP. It was noted above that conflict could affect economic growth either directly through destruction of the factors of production, or indirectly through their combined productivity. The results indicated in Table 3 imply that the indirect link through the TFP is also significant. Policies aimed at enhancing growth by deepening diversification that would be transmitted through the TFP could easily become neutralized by the presence of conflict.

Financial deepening appears to have failed to catalyze increase in TFP. What are the possible motivations for this result? It is important to note that in some countries, as the money markets were liberalized, the interest rates spread remained significantly high, meaning that the intermediation role of the commercial banks that would have been expected to channel savings to the private sector leading to investments that would raise TFP failed to materialize. In the same vein, it is possible that investment opportunities in majority of these African countries are thin and the private sector credit growth that has been witnessed as the financial sector has been liberalized has been directed at personal consumption rather than to investments by private firms towards renewing their technologies or investing in research and development.

4 Diversification regimes: a further link to productivity

In the previous section, we have empirically explored the link between growth and diversification via the TFP as the transmission path. In this section, we intend to deepen the understanding of this link by revisiting the diversification regimes. The econometric estimations using pooled panel data in the previous section hide useful insights that could be derived by asking the question, is there a clear link between the diversification regimes and the total factor productivity contribution to growth? We therefore analyze the sources of growth of a few African countries and relate them to different diversification regimes.

The first diversification regime is described as those countries with little economic diversification. Many African countries belong to this regime. From Table 4, the examples of countries in this regime are Benin, Burkina Faso, and Malawi. It can be observed that these countries have on average positive growth for the period 1981–2000. Benin, Burkina Faso and Malawi have average annual growth rates of 3.8, 3.7 and 3.0%, respectively. The main source of growth is the factor accumulation rather than the TFP. However, it is interesting to note that the contribution of productivity to growth in these countries is positive in almost all but one period, even though they have not diversified much. However, even though the growth in these countries are positive over the 20 year period under observation, their growths are not in the level where their economies can take off as compared to the high growth performing economies of the new industrialized economies (NIE) in East Asia.

The second regime composed of those countries that started the process of diversification but have not made any significant breakthroughs. From Table 4, the examples of these countries are Kenya, Senegal and Zimbabwe. It may be observed that all the three countries have shown a slowing down trend in production from the period 1981–2000, except for Senegal, which has recovered in 1996–2000. However, growths are positive despite of the setbacks. Kenya is growing at an annual average of 2.9%; Senegal is growing at 3.3% while Zimbabwe is growing at 3.1%. Again, the main source of growth is the factor accumulation rather than the TFP. It is noted, however, that the average contribution of TFP to growth in Senegal and Zimbabwe is positive. The main question is the following. Could it be that these countries experience slackening of growth due to the fact that they have failed to deepen their diversification process and remained in their level for a long time?

The third regime is one with countries of deepened diversification process. Countries like Mauritius, Tunisia and South Africa exemplify this regime. For example, Tunisia has managed to achieve horizontal diversification into higher-value exports, which means, the country has been able to see the emergence of completely new sectors both in production and exports. Mauritius on the other hand has achieved deep vertical diversification, which has led to more textiles related exports (see Ben Hammouda et al. 2006b). Through vertical diversification, Mauritius has been able to move higher up in the

Table 4 Growth accounting for selected African countries

Countries	Growth in GDP	Contribution of labor	Contribution of capital	Contribution of TFP
Regime 1: Little economic diversification				
Benin				
1981–1985	4.66	1.49	2.57	0.60
1986–1990	0.89	1.61	1.75	−2.47
1991–1995	4.25	1.82	2.22	0.20
1996–2000	5.34	1.79	2.65	0.90
Burkina Faso				
1981–1985	4.18	1.23	0.55	2.40
1986–1990	2.64	1.16	0.72	0.75
1991–1995	3.84	1.18	0.69	1.97
1996–2000	4.32	1.26	1.70	1.37
Malawi				
1981–1985	2.17	1.89	0.19	0.09
1986–1990	2.32	1.90	−0.02	0.44
1991–1995	3.52	0.81	−0.07	2.78
1996–2000	3.92	1.33	−0.87	3.46
Regime 2: Early diversification but no major breakthrough				
Kenya				
1981–1985	2.53	2.39	0.81	−0.68
1986–1990	5.64	2.18	1.01	2.45
1991–1995	1.61	2.22	0.81	−1.42
1996–2000	1.79	1.97	0.95	−1.12
Senegal				
1981–1985	3.23	1.61	−0.01	1.62
1986–1990	3.22	1.62	0.27	1.33
1991–1995	1.53	1.61	0.67	−0.76
1996–2000	5.30	1.56	1.50	2.25
Zimbabwe				
1981–1985	4.36	2.64	−0.07	1.78
1986–1990	4.60	2.42	0.63	1.54
1991–1995	1.39	1.38	1.69	−1.68
1996–2000	2.07	1.23	0.25	0.59
Regime 3: Deepened diversification process				
Mauritius				
1981–1985	4.33	1.57	1.03	1.74
1986–1990	7.39	1.36	2.51	3.52
1991–1995	5.13	1.12	2.88	1.12
1996–2000	5.27	1.05	2.41	1.81
South Africa				
1981–1985	0.91	1.81	1.33	−2.23
1986–1990	1.81	1.68	0.29	−0.15
1991–1995	0.89	1.49	0.17	−0.77
1996–2000	2.65	1.69	0.66	0.30
Tunisia[a]				
1981–1990	3.72	1.28	2.48	−0.04
1991–1997	4.30	1.36	2.12	0.82
Regime 4: Backsliders in the diversification process				
Gabon				
1981–1985	2.56	1.52	1.26	−0.22
1986–1990	1.73	1.56	0.06	0.11
1991–1995	3.13	1.55	0.08	1.50
1996–2000	1.76	1.14	0.65	−0.03
Nigeria				
1981–1985	−2.75	1.76	2.67	−7.19
1986–1990	5.42	1.61	0.80	3.01
1991–1995	2.50	1.72	1.50	−0.72
1996–2000	2.84	1.70	0.14	1.00
Regime 5: Conflict and post-conflict countries				
Congo, DR				
1981–1985	1.86	1.51	1.53	−1.18
1986–1990	0.01	1.63	0.67	−2.29
1991–1995	−7.12	2.12	−1.73	−7.51
1996–2000	−3.93	0.83	−1.78	−2.99
Liberia				
1981–1985	−1.88	1.76	−0.26	−3.38
1986–1990	−1.79	1.65	−1.17	−2.28
1991–1995	−1.51	1.50	−1.62	−1.39
1996–2000	−1.53	1.35	−1.87	−1.01

Source: Authors' calculation

[a] Sekkat (2003, p. 9)

textiles value chain, which is from primary to manufactured exports.[14]

Meanwhile, the countries in this regime are characterized with relatively high growth, except South Africa, whose growth has since picked up with the dawn of a new political dispensation. Mauritius and Tunisia in particular have grown an average of 5.5 and 4% per annum, respectively for the period 1981–2000. In both of these countries, it may be observed that the contribution of capital is much higher than the contribution of labor. Moreover, in Mauritius, the contribution of the total factor productivity to economic growth is positive with an annual average of 2% in the same period, a relatively high figure for an African country.[15]

The fourth regime is composed of countries that registered early positive diversification gains but later tended to specialize in few products. Countries like Nigeria and

[14] It is frequently suggested that export diversification contributes to an acceleration of growth in African countries. Horizontal export diversification into completely new export sectors may generate positive externalities on the rest of the economy as export oriented sectors gain from dynamic learning activities due to contacts to foreign purchasers and exposure to international competition. Vertical diversification out of primary into manufactured exports is also associated with growth since primary export sectors prevalently do not exhibit strong spillovers.

[15] The highest contribution of TFP to growth in the data set is in Uganda with 3.36%, followed by Botswana with 2.37% and then Mauritius (see Appendix D).

Gabon exemplify this regime. These countries are both rich in oil; hence this product dominates their exports. As for their growth performance, both countries GDP growths, although mostly positive were characterized by fluctuations over the period 1981–2000. On average, Nigeria is growing at 2% per annum while Gabon is growing at 2.3% per annum. As most of the African economies, they are also labor intensive with a minimal contribution of total factor productivity. Nigeria's TFP contribution to growth on average is even negative for the period under study. On average their economic growths in the 1981–2000 are relatively low compared to the countries in the third regime such as Mauritius and Tunisia.

The fifth group is those countries within the conflict and post-conflict regime. The countries that belong to this regime are neither diversified nor highly specialized. Examples are Liberia and Democratic Republic of Congo. Economic growth in these countries was stunted by wars and conflict and therefore, expected to be negative. Consequently, the contribution of TFP to economic growth is also negative. These countries depend much on their labor force for production as the contribution of capital to growth is also deteriorating.

5 Conclusion

In this article, we have sought to establish empirically the presence and significance of a link between diversification and economic growth for African economies. The results have shown that deepening diversification leads to improvements in total factor productivity among other determinants in African economies. The significance of the link between diversification and economic growth in the case of African economies cannot be gainsaid. It means that African countries can scale up their economies' growth by raising their total factor productivity through pursuing policies that enhance diversification.

The most important policy implication in this paper is that pursuing economic and non-economic policies that lead to exports and product diversification can go a long way to overcoming the growth constraints emanating from factor accumulation. African countries should aim at raising their levels of investments, improving governance, eliminating conflicts, adopting non-conservative fiscal policies and ensuring macroeconomic stability in addition to pursuing industrial and trade policies that foster economic diversification. The overall results of such policies will be to enhance exports diversification, which will eventually lead to increasing contribution of TFP to economic growth.

Acknowledgments The authors are respectively, Director of the Institute of Training and Technical Cooperation Division of the WTO, staff member of the Trade, Finance and Economic Development Division of the UNECA and economist with the WTO. This paper should be attributed to the authors. It is not meant to represent the position or opinions of the United Nations, WTO or its Members, nor the official position of any UN/WTO staff member. The authors of the paper would like to thank the two anonymous referees for their valuable comments and suggestions.

Appendix A

See Tables 5

Table 5 Definitions and sources of variables

Output	Measured using gross domestic product (GDP). Regression data are expressed in local currency units (in billions). Source: World Development Indicators (WDI), World Bank CD-ROM 2004
Capital stock	Constructed using perpetual inventory method (PIM). Regression data are expressed in local currency units (in billions). Source: Tahari et al. (2004)
Labor force	Total labor force consists of people who meet the ILO definition of the economically active population (in millions). Source: WDI, World Bank CD-ROM 2004
Diversification index	Calculated using normalized-hirschman index using UNCTAD data on exports products at the 3-digit SITC classification. The index values range from 0 to 1; 0 implies perfect diversification and 1 represents extreme concentration. Source of basic data: UNCTAD CD-ROM 2004
Human capital	Secondary school enrollment over gross enrollment (in percent). Source: WDI, World Bank CD-ROM 2004
Openness	Two measures of trade openness were considered (1) the sum of imports and exports as percent of GDP (in percent); and (2) exports as a proportion of GDP. Source: WDI, World Bank CD-ROM 2004
Financial development	Two measures of financial development were considered: Credit1 is the domestic credit to private sector as percent of GDP (in percent); and Credit2 is the domestic credit provided by banking sector as percent of GDP (in percent). Source: WDI, World Bank CD-ROM 2004
Conflict	Is a dummy variable = 1 if there is a presence of conflict or war during the period; conflict = 0 otherwise

Appendix B

See Tables 6

Table 6 Panel unit root tests

Variables	Panel unit root tests[a]	
	Levin, Lin & Chu Stat[b]	Im, Pesaran & Shin W-Stat[c]
Log of output (GDP)	−1539.90***	−4.E + 156***
Log of capital (capital stock)	−14.98***	−7.E + 155***
Log of labor (labour force)	−11.88***	−1.E + 155***
Diversification index (normalized-Hirschman index)	−49.35***	−2.E + 155***
Human capital (secondary school enrollment)	−11.97***	−2.E + 156***
Trade openness (export + imports as % of GDP)	4.18	−9.E + 156***
Trade openness (exports as % of GDP)	15.36	3.E + 159
FD: Credit1	−2.07***	−3.E + 156***
FD: Credit2	−0.98	−2.E + 156***

*** Significant at 1% (Rejects the null of unit root)

[a] The statistics are calculated using E-views 6

[b] Assumes common unit root process; test equation include individual intercept

[c] Assumes individual unit root process; test equation include individual intercept

Appendix C

See Tables 7

Table 7 Estimation of the translog production model and tests of restrictions

Dependent variable: log of income	Coefficient	*P*-value
Constant	2.140 (7.32)	0.0000***
LK = log of capital	0.391 (3.32)	0.0013***
LL = log of labor	0.744 (2.78)	0.0065***
LK_SQR = square of LK	0.002 (0.15)	0.8839
LL_SQR = square of LL	0.052 (1.52)	0.1318
LL × LK = product of LL and LK	−0.083 (−2.22)	0.0284**
T = Time trend	0.025 (0.95)	0.3467
Test of restrictions		
(a) Ho : $\alpha_K + \alpha_L = 1$	F-stat, $df(1, 99) = 0.380$	0.539
(b) Ho : $\alpha_{KK} = \alpha_{LL} = -1/2\alpha_{LK}$	F-stat, $df(2, 99) = 8.363$	0.0004***
(c) Ho : $\alpha_{KK} = \alpha_{LL} = -1/2\alpha_{LK} = \alpha_T = 0$	F-stat, $df(4, 99) = 4.52$	0.0021***
(d) Ho : $\alpha_K + \alpha_L = 1$	F-stat, $df(3, 99) = 5.83$	0.0010***
$\alpha_{KK} = \alpha_{LL} = -1/2\alpha_{LK}$		
Adjusted R-squared = 0.99		
Number of cross-sections = 35		
Number of observations = 140		
White test (Ho: no heterokedasticity): computed $\chi^2_{(5)} = 5.50$; critical $\chi^2_{(5)} = 11.07$ at $\alpha = 5\%$		

The figures in parentheses are t-values

*** Significant at 1%; ** Significant at 5%

Appendix D: Growth accounting results

See Tables 8 and 9

Table 8 Growth accounting for Sub-Saharan African countries

Countries	Growth in GDP	Contribution of labor	Contribution of capital	Contribution of total factor productivity growth
Angola				
1986–1990	3.28	1.16	0.33	1.79
1991–1995	−3.78	1.67	1.57	−7.02
1996–2000	6.46	1.67	2.96	1.84
Benin				
1981–1985	4.66	1.49	2.57	0.60
1986–1990	0.89	1.61	1.75	−2.47
1991–1995	4.25	1.82	2.22	0.20
1996–2000	5.34	1.79	2.65	0.90
Botwana				
1981–1985	10.01	2.26	3.78	3.97
1986–1990	11.87	2.12	5.04	4.70
1991–1995	4.07	2.16	3.12	−1.21
1996–2000	6.28	1.57	2.70	2.01
Burkina Faso				
1981–1985	4.18	1.23	0.55	2.40
1986–1990	2.64	1.16	0.72	0.75
1991–1995	3.84	1.18	0.69	1.97
1996–2000	4.32	1.26	1.70	1.37
Burundi				
1981–1985	5.35	1.63	3.54	0.19
1986–1990	3.73	1.65	1.77	0.30
1991–1995	−2.23	1.38	0.97	−4.58
1996–2000	−1.02	1.61	1.49	−4.12
Cameroon				
1981–1985	9.40	1.53	4.65	3.22
1986–1990	−2.22	1.62	1.48	−5.32
1991–1995	−1.86	1.85	−0.26	−3.46
1996–2000	4.75	1.62	0.03	3.10
Cape Verde				
1986–1990	3.50	2.04	2.51	−1.04
1991–1995	5.23	2.14	1.98	1.11
1996–2000	6.40	2.31	0.53	3.56
Central African Republic				
1981–1985	2.29	1.32	−0.40	1.37
1986–1990	0.04	0.89	0.27	−1.13
1991–1995	1.09	1.51	0.12	−0.53
1996–2000	0.40	1.65	−0.29	−0.96
Chad				
1981–1985	9.18	1.51	−0.11	7.78
1986–1990	1.94	1.46	1.98	−1.49
1991–1995	2.36	1.78	1.04	−0.47
1996–2000	2.28	2.04	2.31	−2.07

Table 8 continued

Countries	Growth in GDP	Contribution of labor	Contribution of capital	Contribution of total factor productivity growth
Comoros				
1981–1985	4.29	1.47	2.17	0.66
1986–1990	1.62	1.56	1.43	−1.37
1991–1995	0.89	1.80	1.35	−2.25
1996–2000	0.97	1.77	0.00	−0.81
Congo, Dem. Republic				
1981–1985	1.86	1.51	1.53	−1.18
1986–1990	0.01	1.63	0.67	−2.29
1991–1995	−7.12	2.12	−1.73	−7.51
1996–2000	−3.93	0.83	−1.78	−2.99
Congo, Republic				
1981–1985	10.57	2.00	2.47	6.11
1986–1990	−0.26	2.06	1.94	−4.26
1991–1995	0.70	1.93	2.20	−3.44
1996–2000	2.52	2.02	0.86	−0.36
Côte d'Ivoire				
1981–1985	0.32	2.04	1.26	−2.98
1986–1990	1.18	1.90	0.67	−1.40
1991–1995	1.51	2.60	0.21	−1.30
1996–2000	3.46	1.88	1.25	0.34
Equatorial Guinea				
1986–1990	1.36	1.26	0.97	−0.87
1991–1995	7.05	1.45	4.78	0.82
1996–2000	35.74	1.67	10.76	23.31
Eritrea				
1996–2000	1.15	1.78	3.18	−3.81
Ethiopia				
1986–1990	5.32	2.08	1.67	1.57
1991–1995	1.53	1.03	0.57	−0.07
1996–2000	5.27	1.41	1.66	2.21
Gabon				
1981–1985	2.56	1.52	1.26	−0.22
1986–1990	1.73	1.56	0.06	0.11
1991–1995	3.13	1.55	0.08	1.50
1996–2000	1.76	1.14	0.65	−0.03
Gambia				
1981–1985	3.23	1.94	3.76	−2.46
1986–1990	4.10	2.59	0.96	0.54
1991–1995	2.11	2.45	1.26	−1.60
1996–2000	4.80	1.95	1.25	1.60
Ghana				
1981–1985	−0.25	2.20	0.18	−2.63
1986–1990	4.81	1.75	6.94	−3.89
1991–1995	4.28	1.80	5.06	−2.57
1996–2000	4.32	1.60	2.57	0.15
Guinea				
1991–1995	3.74	1.45	2.03	0.26
1996–2000	4.18	1.34	2.55	0.30

Table 8 continued

Countries	Growth in GDP	Contribution of labor	Contribution of capital	Contribution of total factor productivity growth
Guinea-Bissau				
1981–1985	6.45	1.19	0.48	4.77
1986–1990	3.78	1.37	0.45	1.96
1991–1995	3.18	1.82	0.45	0.91
1996–2000	1.06	1.71	−0.62	−0.03
Kenya				
1981–1985	2.53	2.39	0.81	−0.68
1986–1990	5.64	2.18	1.01	2.45
1991–1995	1.61	2.22	0.81	−1.42
1996–2000	1.79	1.97	0.95	−1.12
Lesotho				
1981–1985	3.16	1.26	4.01	−2.12
1986–1990	5.86	0.82	3.40	1.63
1991–1995	3.96	0.82	4.08	−0.95
1996–2000	3.01	0.80	2.27	−0.06
Liberia				
1981–1985	−1.88	1.76	−0.26	−3.38
1986–1990	−1.79	1.65	−1.17	−2.28
1991–1995	−1.51	1.50	−1.62	−1.39
1996–2000	−1.53	1.35	−1.87	−1.01
Madagascar				
1981–1985	−1.55	1.43	−0.34	−2.65
1986–1990	2.75	1.52	0.61	0.62
1991–1995	−0.28	1.66	0.25	−2.19
1996–2000	3.84	2.10	1.78	−0.04
Malawi				
1981–1985	2.17	1.89	0.19	0.09
1986–1990	2.32	1.90	−0.02	0.44
1991–1995	3.52	0.81	−0.07	2.78
1996–2000	3.92	1.33	−0.87	3.46
Mali				
1981–1985	−2.25	1.31	0.51	−4.06
1986–1990	3.86	1.57	3.45	−1.16
1991–1995	2.99	1.35	2.04	−0.40
1996–2000	3.88	1.42	1.56	0.90
Mauritius				
1981–1985	4.33	1.57	1.03	1.74
1986–1990	7.39	1.36	2.51	3.52
1991–1995	5.13	1.12	2.88	1.12
1996–2000	5.27	1.05	2.41	1.81
Mozambique				
1981–1985	−4.62	1.16	1.06	−6.84
1986–1990	5.62	0.28	1.55	3.79
1991–1995	3.46	1.21	1.62	0.63
1996–2000	7.98	1.36	3.34	3.27
Namibia				
1981–1985	−0.19	1.20	1.27	−2.65
1986–1990	2.68	2.42	0.45	−0.19

Table 8 continued

Countries	Growth in GDP	Contribution of labor	Contribution of capital	Contribution of total factor productivity growth
1991–1995	4.96	1.90	1.41	1.64
1996–2000	3.48	1.76	1.71	0.01
Niger				
1981–1985	−2.32	1.83	0.42	−4.58
1986–1990	2.60	1.84	−0.17	0.92
1991–1995	0.81	1.85	−0.78	−0.26
1996–2000	2.92	2.05	0.19	0.68
Nigeria				
1981–1985	−2.75	1.76	2.67	−7.19
1986–1990	5.42	1.61	0.80	3.01
1991–1995	2.50	1.72	1.50	−0.72
1996–2000	2.84	1.70	0.14	1.00
Rwanda				
1981–1985	2.68	2.17	3.60	−3.10
1986–1990	1.50	1.87	1.87	−2.24
1991–1995	−3.96	−1.53	0.57	−3.00
1996–2000	9.80	4.48	0.89	4.43
Senegal				
1981–1985	3.23	1.61	−0.01	1.62
1986–1990	3.22	1.62	0.27	1.33
1991–1995	1.53	1.61	0.67	−0.76
1996–2000	5.30	1.56	1.50	2.25
Sierra Leone				
1981–1985	0.87	1.07	0.89	−1.09
1986–1990	1.09	1.18	−0.25	0.17
1991–1995	−5.05	1.50	−1.01	−5.54
1996–2000	−3.33	1.42	−1.27	−3.48
South Africa				
1981–1985	0.91	1.81	1.33	−2.23
1986–1990	1.81	1.68	0.29	−0.15
1991–1995	0.89	1.49	0.17	−0.77
1996–2000	2.65	1.69	0.66	0.30
Swaziland				
1981–1985	2.61	1.67	4.02	−3.08
1986–1990	11.15	1.68	3.13	6.34
1991–1995	2.83	2.54	2.15	−1.86
1996–2000	3.30	2.31	−0.73	1.71
Tanzania				
1991–1995	1.80	1.89	2.41	−2.50
1996–2000	4.22	1.65	1.00	1.58
Togo				
1981–1985	−0.24	1.87	0.11	−2.21
1986–1990	2.51	1.65	0.87	−0.01
1991–1995	0.61	1.28	−0.43	−0.24
1996–2000	2.29	2.10	0.25	−0.06
Uganda				
1986–1990	5.09	2.17	0.26	2.65
1991–1995	7.05	1.76	0.83	4.46

Table 8 continued

Countries	Growth in GDP	Contribution of labor	Contribution of capital	Contribution of total factor productivity growth
1996–2000	6.49	1.47	2.05	2.97
Zambia				
1981–1985	0.53	1.84	−0.66	−0.65
1986–1990	1.64	1.77	−0.88	0.74
1991–1995	−1.28	1.84	−1.29	−1.83
1996–2000	2.84	1.70	−0.88	2.02
Zimbabwe				
1981–1985	4.36	2.64	−0.07	1.78
1986–1990	4.60	2.42	0.63	1.54
1991–1995	1.39	1.38	1.69	−1.68
1996–2000	2.07	1.23	0.25	0.59

Table 9 Proportion of the contribution of labour, capital and TFP in African economies growth

Countries	Growth in GDP	Proportion of labor contribution over growth	Proportion of capital contribution over growth	Contribution of TFP contribution over growth
Angola				
1986–1990	3.28	35.26	10.06	54.68
1991–1995	−3.78	−44.11	−41.64	185.76
1996–2000	6.46	25.80	45.77	28.43
Benin				
1981–1985	4.66	32.02	55.13	12.85
1986–1990	0.89	181.37	197.50	−278.86
1991–1995	4.25	42.90	52.33	4.78
1996–2000	5.34	33.45	49.61	16.94
Botwana				
1981–1985	10.01	22.59	37.74	39.67
1986–1990	11.87	17.88	42.49	39.63
1991–1995	4.07	53.01	76.82	−29.83
1996–2000	6.28	24.99	42.92	32.09
Burkina Faso				
1981–1985	4.18	29.45	13.15	57.40
1986–1990	2.64	44.06	27.39	28.55
1991–1995	3.84	30.78	17.93	51.29
1996–2000	4.32	29.14	39.24	31.62
Burundi				
1981–1985	5.35	30.36	66.14	3.50
1986–1990	3.73	44.36	47.61	8.02
1991–1995	−2.23	−61.89	−43.62	205.51
1996–2000	−1.02	−158.82	−146.98	405.80
Cameroon				
1981–1985	9.40	16.31	49.48	34.21
1986–1990	−2.22	−72.77	−66.30	239.07
1991–1995	−1.86	−99.60	13.85	185.75
1996–2000	4.75	34.07	0.54	65.39
Cape Verde				
1986–1990	3.50	58.24	71.52	−29.76
1991–1995	5.23	40.99	37.78	21.23
1996–2000	6.40	36.02	8.28	55.69

Table 9 continued

Countries	Growth in GDP	Proportion of labor contribution over growth	Proportion of capital contribution over growth	Contribution of TFP contribution over growth
Central African Republic				
1981–1985	2.29	57.50	−17.27	59.77
1986–1990	0.04	2509.26	767.51	−3176.77
1991–1995	1.09	138.22	10.58	−48.80
1996–2000	0.40	409.86	−72.11	−237.75
Chad				
1981–1985	9.18	16.48	−1.21	84.73
1986–1990	1.94	74.99	101.91	−76.91
1991–1995	2.36	75.56	44.20	−19.76
1996–2000	2.28	89.67	101.27	−90.94
Comoros				
1981–1985	4.29	34.22	50.45	15.33
1986–1990	1.62	96.36	88.40	−84.77
1991–1995	0.89	200.67	151.21	−251.88
1996–2000	0.97	183.61	0.06	−83.67
Congo, Dem. Republic				
1981–1985	1.86	81.25	82.35	−63.60
1986–1990	0.01	28197.37	11540.47	−39637.84
1991–1995	−7.12	−29.85	24.27	105.57
1996–2000	−3.93	−21.22	45.22	75.99
Congo, Republic				
1981–1985	10.57	18.91	23.32	57.77
1986–1990	−0.26	−788.33	−743.00	1631.33
1991–1995	0.70	276.26	314.87	−491.13
1996–2000	2.52	80.16	34.06	−14.22
Côte d'Ivoire				
1981–1985	0.32	635.71	394.60	−930.31
1986–1990	1.18	161.42	56.96	−118.38
1991–1995	1.51	172.16	13.71	−85.87
1996–2000	3.46	54.26	35.97	9.77
Equatorial Guinea				
1986–1990	1.36	92.41	71.41	−63.82
1991–1995	7.05	20.54	67.88	11.58
1996–2000	35.74	4.66	30.10	65.23
Eritrea				
1996–2000	1.15	154.43	275.49	−329.92
Ethiopia				
1986–1990	5.32	39.07	31.49	29.43
1991–1995	1.53	67.19	37.40	−4.59
1996–2000	5.27	26.66	31.51	41.83
Gabon				
1981–1985	2.56	59.38	49.18	−8.56
1986–1990	1.73	90.27	3.37	6.36
1991–1995	3.13	49.48	2.66	47.86
1996–2000	1.76	64.64	36.81	−1.45
Gambia				
1981–1985	3.23	59.96	116.24	−76.20
1986–1990	4.10	63.32	23.54	13.14

Table 9 continued

Countries	Growth in GDP	Proportion of labor contribution over growth	Proportion of capital contribution over growth	Contribution of TFP contribution over growth
1991–1995	2.11	116.34	59.62	−75.96
1996–2000	4.80	40.53	26.09	33.38
Ghana				
1981–1985	−0.25	−880.87	−71.91	1052.78
1986–1990	4.81	36.42	144.44	−80.86
1991–1995	4.28	41.90	118.12	−60.02
1996–2000	4.32	37.08	59.47	3.45
Guinea				
1991–1995	3.74	38.78	54.24	6.98
1996–2000	4.18	31.99	60.94	7.07
Guinea-Bissau				
1981–1985	6.45	18.51	7.48	74.02
1986–1990	3.78	36.29	11.91	51.80
1991–1995	3.18	57.37	14.10	28.53
1996–2000	1.06	161.01	−58.22	−2.79
Kenya				
1981–1985	2.53	94.58	32.22	−26.80
1986–1990	5.64	38.59	17.90	43.51
1991–1995	1.61	138.16	50.47	−88.63
1996–2000	1.79	109.59	53.04	−62.63
Lesotho				
1981–1985	3.16	39.95	126.95	−66.90
1986–1990	5.86	14.06	58.11	27.83
1991–1995	3.96	20.83	103.08	−23.92
1996–2000	3.01	26.77	75.37	−2.14
Liberia				
1981–1985	−1.88	−93.59	13.88	179.71
1986–1990	−1.79	−92.21	65.00	127.21
1991–1995	−1.51	−99.91	107.37	92.55
1996–2000	−1.53	−87.77	121.86	65.90
Madagascar				
1981–1985	−1.55	−92.60	21.66	170.94
1986–1990	2.75	55.33	22.08	22.59
1991–1995	−0.28	−600.05	−91.04	791.09
1996–2000	3.84	54.61	46.48	−1.09
Malawi				
1981–1985	2.17	87.07	8.91	4.02
1986–1990	2.32	81.89	−0.98	19.09
1991–1995	3.52	22.99	−1.99	79.00
1996–2000	3.92	33.84	−22.14	88.30
Mali				
1981–1985	−2.25	−58.09	−22.63	180.72
1986–1990	3.86	40.73	89.31	−30.04
1991–1995	2.99	45.21	68.16	−13.38
1996–2000	3.88	36.53	40.31	23.15
Mauritius				
1981–1985	4.33	36.14	23.81	40.05
1986–1990	7.39	18.43	33.91	47.66

Table 9 continued

Countries	Growth in GDP	Proportion of labor contribution over growth	Proportion of capital contribution over growth	Contribution of TFP contribution over growth
1991–1995	5.13	21.94	56.13	21.93
1996–2000	5.27	19.89	45.69	34.43
Mozambique				
1981–1985	−4.62	−25.17	−22.90	148.07
1986–1990	5.62	4.98	27.65	67.36
1991–1995	3.46	35.00	46.89	18.11
1996–2000	7.98	17.08	41.89	41.03
Namibia				
1981–1985	−0.19	−630.81	−667.71	1398.51
1986–1990	2.68	90.22	16.79	−7.01
1991–1995	4.96	38.40	28.51	33.08
1996–2000	3.48	50.66	49.15	0.18
Niger				
1981–1985	−2.32	−78.88	−18.08	196.96
1986–1990	2.60	70.98	−6.46	35.49
1991–1995	0.81	228.46	−96.75	−31.71
1996–2000	2.92	70.17	6.45	23.38
Nigeria				
1981–1985	−2.75	−64.00	−96.87	260.86
1986–1990	5.42	29.71	14.70	55.59
1991–1995	2.50	68.95	59.93	−28.88
1996–2000	2.84	60.04	4.82	35.14
Rwanda				
1981–1985	2.68	81.17	134.45	−115.62
1986–1990	1.50	124.71	124.49	−149.19
1991–1995	−3.96	38.76	−14.53	75.77
1996–2000	9.80	45.75	9.06	45.19
Senegal				
1981–1985	3.23	50.04	−0.33	50.29
1986–1990	3.22	50.35	8.32	41.33
1991–1995	1.53	105.44	44.09	−49.53
1996–2000	5.30	29.37	28.23	42.39
Sierra Leone				
1981–1985	0.87	123.26	102.10	−125.35
1986–1990	1.09	107.45	−22.83	15.37
1991–1995	−5.05	−29.66	19.93	109.73
1996–2000	−3.33	−42.57	38.01	104.56
South Africa				
1981–1985	0.91	198.97	146.81	−245.78
1986–1990	1.81	92.48	15.75	−8.23
1991–1995	0.89	168.40	19.01	−87.40
1996–2000	2.65	63.94	24.78	11.28
Swaziland				
1981–1985	2.61	64.18	154.12	−118.30
1986–1990	11.15	15.11	28.06	56.84
1991–1995	2.83	89.94	75.99	−65.93
1996–2000	3.30	70.25	−22.14	51.89

Table 9 continued

Countries	Growth in GDP	Proportion of labor contribution over growth	Proportion of capital contribution over growth	Contribution of TFP contribution over growth
Tanzania				
1991–1995	1.80	105.10	133.90	−139.00
1996–2000	4.22	39.01	23.66	37.33
Togo				
1981–1985	−0.24	−777.05	−43.89	920.95
1986–1990	2.51	65.79	34.60	−0.39
1991–1995	0.61	209.58	−70.94	−38.65
1996–2000	2.29	91.63	11.00	−2.63
Uganda				
1986–1990	5.09	42.70	5.18	52.13
1991–1995	7.05	24.92	11.83	63.25
1996–2000	6.49	22.65	31.56	45.79
Zambia				
1981–1985	0.53	345.65	−123.15	−122.50
1986–1990	1.64	108.46	−53.92	45.46
1991–1995	−1.28	−143.37	100.37	143.00
1996–2000	2.84	59.79	−31.13	71.34
Zimbabwe				
1981–1985	4.36	60.68	−1.62	40.94
1986–1990	4.60	52.69	13.78	33.53
1991–1995	1.39	99.21	121.18	−120.40
1996–2000	2.07	59.33	12.10	28.58

References

Acemoglu D, Zilibotti F (1997) Was Prometheus unbound by chance? Risk diversification and growth. J Political Econ 105:709–751

Al-Marhubi F (2000) Export diversification and growth: an empirical investigation. Appl Econ Lett 7:59–562

Ben Hammouda H, Karingi S, Njuguna A, Sadni-Jallab M (2006a) Diversification: towards a new paradigm for Africa's development, ATPC Work in Progress No. 35, African Trade Policy Centre, Economic Commission for Africa

Ben Hammouda H, Karingi S, Njuguna A, Sadni-Jallab M (2006b) Africa's (Mis)fortunes in global trade and continent's diversification regimes. J World Invest Trade 7(4):562–587

Berthélemy JC, Chauvin S (2000) Structural changes in Asia and growth prospects after the crisis, Working Paper No.00-09, CEPII

Berthélemy J, Soderling L (2001) The role of capital accumulation, adjustment and structural change for economic take-off: empirical evidence from African growth episodes. World Dev 29(2):323–343

Berthélemy JC, Varoudakis A (1996) Financial development policies and growth, OECD, Development Centre Study (Long-Term Growth Series), Paris

Collier P (2007) The bottom billion: why the poorest countries are failing and what can be done about it. Oxford University Press, New York

Fingleton B (2005) Beyond neoclassical orthodoxy: a view based on the new economic geography and UK regional wage data. Pap Reg Sci 84(3):352–375

Fölster S, Henrekson M (2001) Growth effects of Government expenditure and taxation in rich countries. Eur Econ Rev 45(8):1501–1520

Ghura D, Hadjimichael M (1996) Growth in Sub-Saharan Africa. IMF Staff Pap 43:605–634

Gujarati D (1995) Basic econometrics, 3rd edn. McGraw-Hill International edition, New York

Hoff A (2004) The linear approximation of the CES function with n input variables. Mar Res Econ 19:295–306

Hsiao C (2003) Analysis of panel data, 2nd edn. Cambridge University Press, Ch. 8.4 and 8.6

Islam N (1995) Growth empirics: a panel data approach. Quart J Econ 110:1127–1170

Miles D, Myles G, Preston I (2003) The economics of public spending. Oxford University Press, New York

Ndulu B, O'Connell S (2008) Policy plus: African growth performance. In: Ndulu B, O'Connell S, Bates R, Collier P, Soludo C (eds) The political economy of economic growth in Africa 1960–2000, vol 1, African Economic Research Consortium, Cambridge University Press

Njuguna A (1999) Growth and convergence in a disequilibrium solow-swan model: the case of ASEAN countries, 1960–1995, Unpublished PhD Thesis, University of New England, Australia

Njuguna A, Karingi S, Kimenyi M (2003) Alternative methodologies for measuring Kenya's potential output and output gaps, KIPPRA Discussion Paper No. 23, KIPPRA, Nairobi

Rodrik D (1998) Trade policy and economic performance in Sub-Saharan Africa, NBER Working Paper No. 6562

Rodrik D, Rodriguez F (1999) Trade policy and economic growth: a sceptic's guide to the cross- national evidence, Working paper 7081, National Bureau of Economic Research, (NBER), New York

Romer P (1990) Endogenous technological change. J Political Econ 98(5):S71–S102

Sekkat K (2003) The sources of growth in Morocco: an empirical analysis in a regional perspective, Dulbea. University of Brussels and the ERF, Mimeo, Brussels

Solow R (1957) Technical change and the aggregate production function. Rev Econ Stat 39:312–320

Stanley DL, Bunnag S (2001) A new look at the benefits of diversification: lessons from Central America. Appl Econ 33:1369–1383

Tahari A, Ghura D, Akitoby B, Brou Aka E (2004) Sources of growth in Sub-Saharan Africa, IMF Working Paper W/04/176

Thomas R (1993) Introductory econometrics: theory and application. Longman, London

Wells G (1995) Macroeconomics. Thomas Nelson, South Melbourne

World Bank (2000) Can Africa claim the 21st century. Oxford University Press, New york