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Keeping track of agricultural TFP growth in Sub-Saharan Africa: Is there light at the end of the tunnel?

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Abstract

This paper revisits TFP growth in Sub-Saharan Africa (SSA) during 1971-2003 and analyzes the recent evolution and performance of different sub-regions and individual countries. Agriculture TFP growth is determined by the estimation of a Malmquist index. Our estimates show that there is a clear improvement in the performance of the agricultural sector in Sub-Saharan Africa starting in 1993, improvement that has been sustained for 10 years. This growth is explained mainly by an increase in efficiency, which can be interpreted as catching up that the region is doing after 20 years of poor performance and decreased efficiency. The fact that most countries are recovering from periods of negative growth and only catching up to TFP levels they had in the late 1960s and early 1970s, and that technical change has been slow are warning signs that indicate that growth will need to be extended to technical change to make TFP growth sustainable in the long run.

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Introduction

At the beginning of the twenty-first century, Sub-Saharan Africa continues to be outperformed by all other developing regions. This poor economic performance resulted in its progressive marginalization from the world economy despite two decades of donor-sponsored reform efforts during which almost all African states have been engaged in some kind of economic reform program. These programs, supported by international financial institutions, attempted the implementation of stabilization and structural adjustment programs seeking macroeconomic equilibrium in the short-run and accelerated growth in the long-run. After more than two decades of, in most cases, partial implementation of economic reform programs, results are still to be seen in a continent where most people are poorer today than they were twenty years ago. However, and as discussed by van de Walle: "An improvement in economic indicators throughout Africa in the mid-1990s led some observers to argue that the region had finally solved its economic conundrums and could now expect sustained economic growth." This optimism was supported by the end of several civil wars, the acceleration of economic growth and a wave of democratization in several countries, which made possible the creation of NEPAD and the possibility of a new agenda for development.

What happened with agriculture during this period? Has agriculture contributed to this wave of optimism that started in the late 1990s? Are there signs that this key sector in the continent's economy is changing? Previous studies have shown that on average, Sub-Saharan Africa's agricultural TFP grew at rates between 0.8 and 1.27 from 1961 until the 1990s. Some studies estimated also negative TFP growth rates for a similar period (see Yu, Fulginiti and Perrin, 2001 for a discussion of these results). More recently Coelli and Rao (2006) estimated TFP for 93 countries of which 18 are Sub-Saharan African countries. Their results show six African countries with TFP growth above 2% during 1980-2000 (Burundi, Angola, Nigeria, Ghana, Malawi and Senegal) but no specific analysis of Africa's growth is performed and no measures of TFP growth in most recent years are presented. Dias Avila and Evenson estimate productivity growth of 37 African countries for two periods: 1961-1980 and 1981-2001. The average TFP growth for Africa, estimated by Dias Avila and Evenson, including North Africa, is 1.68 percent, higher than the one the authors find for 1961-1980 (1.20 percent), but no information of growth in the most recent years is presented. None of these recent studies looked specifically to TFP growth in the 1990s and early 2000. This paper analyzes the evolution of Sub-Saharan Africa's agriculture production and productivity in the last 35 years, looking for evidence of recent changes in growth patterns. The next section of the paper presents the methodology employed and the data used to estimate TFP. Results and analysis are presented in section three, and the last section summarizes main findings and concludes.

Productivity measure and methodology

A natural measure of performance of a production process that converts inputs into outputs is productivity: the ratio of outputs to inputs, where larger values of this ratio are associated with better performance. At an aggregated level, productivity estimates can be obtained to analyze performance of an industry (e.g. maize), a sector (e.g. agriculture) or the whole economy, or to compare performance of an industry across geographical regions: districts, states or provinces, countries, etc. Interpretation of productivity measures needs to bring into consideration the level of aggregation in the analysis. For example, agricultural productivity is affected by the level of output of the different crops and livestock activities but also by the composition of outputs. This means that changes in the structure of production can alter the overall output/input ratio.

The measure of productivity as defined above involves all inputs used in the production process and is referred to as total factor productivity (TFP). Other traditional measures of productivity are partial factor productivity (PFP) measures, the ratio of output to one particular input. Examples of PFP measures applied to agriculture are yields: the ratio of output to land in crop production or of output to animal stock in livestock production. Labor productivity is also used extensively to analyze performance of agriculture and other sectors. These partial measures can provide useful information when used to complement the analysis of TFP but they can give a misleading indication of overall productivity when considered in isolation.

Total factor productivity (TFP) growth shows the relationship between growth of output and growth of input, calculated as a ratio of output to input. In other words, productivity is raised when growth in output outpaces growth in input. Productivity growth increases without an increase in inputs is the best kind of growth to aim for rather than an attaining a certain level of output by increasing inputs, since these inputs are subject to diminishing marginal returns. However, how to measure the total input and total output is both conceptually and empirically difficult. Methods to estimate TFP can be classified in four major groups: a) least-squares econometric production models; b) total factor productivity indices; c) data envelop analysis (DEA); and d) stochastic frontiers (Coelli et al. 1998). The first two methods are normally used with times series data and assume that all production units are technically efficient. Methods c) and d) can be applied to a cross-section of firms, farms, regions or countries to compare their relative productivity. If panel data are available, DEA and stochastic frontiers can be used to measure both technical change and efficiency improvement.

The Malmquist index, pioneered by Caves, Christensen and Diewert (1982) and based on distance functions, has become extensively used in the measure and analysis of productivity after Färe, Grosskopf, Norris and Zhang (1994) showed that the index can be estimated using DEA (non-parametric approach). The non-parametric Malmquist index has been especially popular since it does not entail assumptions about economic behavior (profit maximization or cost minimization) and therefore does not require prices for its estimation. Also important is its ability to decompose productivity growth into two mutually exclusive and exhaustive components: changes in technical efficiency over time (catching-up) and shifts in technology over time (technical change).

To define the output-based Malmquist index we assume, as in Färe, Grosskopf, Norris and Roos (1998), that for each time period t = 1,…., T the production technology describes the possibilities for the transformation of inputs x^t into outputs y^t. This is the set of output vectors that can be produced with input vector x. For the technology in period t and with $y^t \in R_+^m$ outputs and $x^t \in R_+^n$ inputs:

$$P^t(x) = \{y^t: \text{such that } x^t \text{ can produce } y^t\} \tag{3}$$

The frontier of the output possibilities for a given input vector is defined as the output vector that cannot be increased by a uniform factor without leaving the set. In our analysis we will refer to these production units as countries. The output distance function is defined at t as the reciprocal of the maximum proportional expansion of output vector y^t given input x^t

$$D_0^t(x^t, y^t) = \inf\left\{\theta : \left(x^t, \frac{y^t}{\theta}\right) \in P_{(x)}^t\right\} \tag{4}$$

where θ is the coefficient dividing y^t to get a frontier production vector at period t given x^t. The distance measure equals 1 when the production point in period t is on the frontier for period t.

The Malmquist index measures the TFP change between two data point (e.g. those of a country in two different time periods) by calculating the ratio of the distance of each data point relative to a common technological frontier. Following Färe et al. (1994), the Malmquist output oriented index between periods t and t+1 is given by:

$$M_o = \left[M_o^t \times M_o^{t+1}\right]^{1/2} = \left[\frac{D_o^t(x^{t+1}, y^{t+1})}{D_o^t(x^t, y^t)} \times \frac{D_o^{t+1}(x^{t+1}, y^{t+1})}{D_o^{t+1}(x^t, y^t)}\right]^{1/2} \tag{5}$$

This index is estimated as the geometric mean of two Malmquist indices, one using as a reference the technology frontier in t and a second index that uses frontier in t+1 as the reference.

Färe, Grosskopf, Norris, and Zhang (1994) showed that the Färe index could be decomposed into an efficiency change component and a technical change component, and that these results applied to the different period-based Malmquist indices.

$$M_o = \frac{D_o^{t+1}(x^{t+1}, y^{t+1})}{D_o^t(x^t, y^t)} \times \left[\frac{D_o^t(x^{t+1}, y^{t+1})}{D_o^{t+1}(x^{t+1}, y^{t+1})} * \frac{D_o^t(x^t, y^t)}{D_o^{t+1}(x^t, y^t)}\right]^{1/2}$$

The ratio outside the square brackets measures the change in technical efficiency between priods t and t+1. The expression inside brackets measures technical change as the geometric mean of the shift in the technological frontier between t and t+1 evaluated using frontier at t and at t+1 respectively as the reference. The efficiency change component of the Malmquist indices measures the change in how far observed production is from maximum potential production between period t and t+1 and the technical change component captures the shift of technology between the two periods. A value of the efficiency change component of the Malmquist index greater than one means that the production unit is closer to the frontier in period t+1 than it was in period t: the production unit is catching-up to the frontier. A value less than one indicates efficiency regress. The same range of values is valid for the technical change component of total productivity growth, meaning technical progress when the value is greater than one and technical regress when the index is less than one. The method has been applied in many microeconomic studies at the firm or sector level. It was also applied to the international comparison of productivity using aggregate data for the whole economy or for the agricultural sector.

To estimate TFP growth in Sub-Saharan Africa, the only internationally comparable data base available to us is that of the Food and Agriculture Organization of the United Nations (FAO). It provides national time series data from 1961-2003 for the total quantity of different inputs and output volumes measured in international dollars. When trying to use this dataset to estimate TFP for SSA countries, results appeared not to be robust. For example, the inclusion of fertilizer as an input would result in large changes in TFP values with some countries showing unexpected high productivity growth. Also, the output series for some countries show differences in production values between years that cannot be explained by changes in the use of inputs, resulting in unlikely productivity increases.

To reduce the incidence of the problems mentioned above, productivity is estimated using agricultural value added (AgVA) from the World Development Indicators database of the World Bank instead of FAO output values. Productivity is measured relating Value Added to the use of production factors (capital, labor and land) in each country.

Total Horse Power (HP) and animal stock are used as proxies for capital. Total HP for a country is estimated by defining an average HP per tractor and per country and multiplying the total number of tractors in each country from FAO database by this coefficient. The average HP per tractor for each country was defined as a function of the land/labor ratio, assuming that countries with higher land/labor ratio use bigger tractors in terms of HP. In the case of SSA countries, HP has two components: HP from tractors and HP from draft animals including a share of total cattle stock. This share is estimated as a function of the extraction rate in each country, that is, the proportion of animals slaughtered annually in total stock. Based on different observed extraction rates and assuming mortality and birth rates, different age structures of the animal stock are estimated including draft and production animals and the most likely structure is assigned to each country based on the country's extraction rate. It is assumed that the extraction rate is negatively related to the proportion of draft animals in the animal stock.

Both land under crops and pasture land from FAO are used as inputs in order to capture, at least partially, land quality differences between countries. Rural economically active population also from FAO is used as a proxy for labor in agriculture.

One output (AgVA) and five inputs (labor, horse power, animal stock, land under crops and pasture land for 106 countries, including 38 Sub-Saharan African countries were used to estimate the Malmquist index in order to measure TFP growth of Sub-Saharan African countries. Results are obtained for Sub-Saharan Africa as a whole (the 38 countries included in our analysis), 5 sub-regions (East, Southern, Central, West Coastal and West Sahel)[1] and individual countries.

Results

Figure 1 presents estimates of Sub-Saharan Africa's agricultural TFP growth for the period 1970-2003. Average annual growth for that period was 0.61%, a total of 23 percent growth in 34 years, with most of this growth occurring in the last 10 years. It is only after 1993 that agricultural value added started growing faster than factors allocated to agricultural production. The differences between agricultural value added and TFP growth rates in 1970-1993 and in 1994-2003 are shown in figure 2.

The decomposition of the Malmquist TFP index shows that an improvement in efficiency is the main factor explaining increased TFP growth after 1994 (figure 3). This seems to indicate that during 1994-2003 Sub-Saharan Africa started recovering from the

[1] East Africa: Burundi, Ethiopia, Kenya, Madagascar, Rwanda, Sudan, Tanzania, Uganda; Central Africa: Cameroon, Central African Rep. (CAR), Republic of Congo; Democratic Rep. Of Congo (DRC), and Gabon; Southern Africa: Angola, Botswana, Lesotho, Malawim, Mauritius, Mozambique, Namibia, Swaziland, Zambia, Zimbabwe; West Coastal countries: Benin, Cote d'Ivoire, Ghana, Guinea, Nigeria, Sierra Leone, Togo; and West Sahel: Burkina Faso, Chad, Gambia, Guinea-Bissau, Mali, Mauritania, Niger, Senegal.

poor performance of 1974-1983, where efficiency declined at an average rate of -1.78 percent. While TFP grew at an average rate of 2.81 percent between 1994 and 2003, efficiency increased at 2.11 percent, explaining 75 percent of total TFP growth. The speed of technical change seems to be still low, only 0.71 percent in 1994-2003.

Within Sub-Saharan Africa (figure 4 and 5), most regions show a similar TFP growth pattern, with a period of stagnation or negative growth as is the case of the West coastal countries between 1970 and 1985, a period of acceleration during 1985-1993 and faster growth in the last ten years. Faster TFP growth occurred in Central and West Coastal regions, explained mostly by efficiency improvements. Technical change is low in all regions, with the highest value in East Africa (1 percent in 1994-2003). Central and Coastal West Africa, the fastest growing regions show at the same time the lowest rates of technical change (0.31 and 0.56 percent respectively). The Sahel is the region with the lowest TFP growth and this is explained by the poor performance of the region in terms of efficiency growth. However, a TFP growth of 1.7 on average for the period 1994-2003 is significant and the highest in the whole period covered by this study. In 1974-1983 TFP growth was 0.11 percent on average, and average growth in 1984-1993 was negative and close to zero.

Figure 6 shows the contribution of the different regions to agricultural value added and to total Sub-Saharan Africa TFP growth. West Coastal countries and East Africa are the most important agricultural production regions contributing with 2/3 of total value added in Sub-Saharan Africa. With the largest share in Ag value added, the West Coast region is the major contributor to TFP growth and its performance has a significant impact in the overall performance of SSA. More than 50% of total TFP growth during 1994-2003 is explained by growth in West coastal countries.

Agricultural value added and TFP growth rates are estimated at the country level and presented in table 1. Cameroon, Mozambique, Chad, Nigeria and CAR show average TFP growth rates above 3% during 1994-2003[2]. Countries with relatively high TFP growth (above 2%) are also Malawi, Benin, Ghana, Uganda, Madagascar, Rwanda, Cote d'Ivoire, Republic of Congo, Namibia and Senegal. These same countries had also a good performance during 1994-2003 in terms of labor and land PFP growth.

In order to better measure the productivity growth performance of the different countries, TFP and PFP growth rates are estimated by regressing the logarithms of the estimated productivity (the cumulated productivity index in the case of TFP) data series for two periods: 1994-2003, and 1999-2003 as follows: $Ln(y_i) = a + b_i T$; where y_i are productivity values for country *i*, T is a time trend and b_i is the productivity growth rate (TFP or PFP). Coefficient b_i, the productivity growth rate, can then be tested statistically with the null hypothesis being $b_i = 0$. This allows us to classify countries in different groups according to their performance measured in terms of TFP growth. A country classification based in the estimated TFP growth rate is presented in table 2 together with estimated coefficients for land and labor PFP growth and productivity levels. Countries with growth rates significantly different from 0 are listed first, and divided in four groups based on growth rates values. Countries in group 1 are those with high TFP

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[2] Angola and Sudan appear as outliers in our estimates showing very high TFP values for the period 1994-2003 (above 7 and 8 percent). Fast TFP growth rate can be expected in the case of Angola, catching-up after a long period of civil war, but these figures could result also from data problems. Some of the productivity values of Central African countries are also high and difficult to justify without better information at the country level. We decided not to report results for Angola and Sudan, and these two countries are not included at the sub-regional level.

growth, showing rates bigger than 3%: Mozambique, Malawi, Rwanda, Cameroon, Nigeria, CAR, and Madagascar. Group 2 includes countries with intermediate to low TFP growth rates (1%-3%): Ghana, Uganda, Benin, Cote d'Ivoire, Lesotho, Gabon, Tanzania, Congo Rep., Burundi, and Guinea. Group 3 includes 16 countries with TFP growth rates not significantly different from zero at the 1% level. Finally, two countries show negative growth rates significantly different from zero at the 1% level: Burkina Faso and Botswana.

Table 3 presents the same information than in table 2 but with countries sorted by region. Southern, West Coastal and Central Africa show the highest levels of productivity (TFP and labor productivity), while the Sahel and East Africa show the lowest levels. In general, higher labor productivity is associated with higher TFP levels, with land productivity being similar in West Coastal, East and Central regions.

Growth rates estimated for the period 1999-2003 (table 4) still show Benin, Cameroon, CAR, Ghana, Nigeria, and Uganda with relatively high (above 1%) and statistically significant growth. Burundi, Republic of Congo, Gabon, Sierra Leone, and Tanzania were not part of these two groups during 1994-2003 but are in this group during 1999-2003. On the other hand, Cote d'Ivoire, Lesotho, Madagascar, Malawi, Mozambique and Rwanda show growth rates significantly different from zero for the period 1994-2003 but zero or negative rates for the period 1999-2003.

Finally, figure 7 shows the contribution of different countries to total TFP growth in 1994-2003. Nigeria contributed with almost 40% of this growth, Cameroon 16% and Tanzania, Cote d'Ivoire, Uganda, Ghana and Mozambique each contributed with 4 to 6% of total TFP growth in the same period.

Conclusions

This study analyzed the performance of the agricultural sector in Sub-Saharan Africa between 1970 and 2003 by estimating productivity growth and its components, efficiency and technical change. Our estimates show that there is a clear improvement in the performance of the agricultural sector in Sub-Saharan Africa starting in 1993 and that has been sustained for 10 years. This growth is explained mainly by an increase in efficiency, which can be interpreted as catching up that the region is doing after 20 years of poor performance and decreased efficiency. The same growth pattern was observed in all regions, with TFP growth being driven by efficiency improvements. Central and West Coastal are the regions showing higher TFP growth, while the Sahel is the slowest growing region, although its growth in 1994-2003 was the highest of the last 35 years. The fact that most countries are recovering from periods of negative growth and only catching up to TFP levels they had in the late 1960s and early 1970s and that technical change has been slow indicate that growth will need to be extended to technical change to make TFP growth sustainable in the long run.

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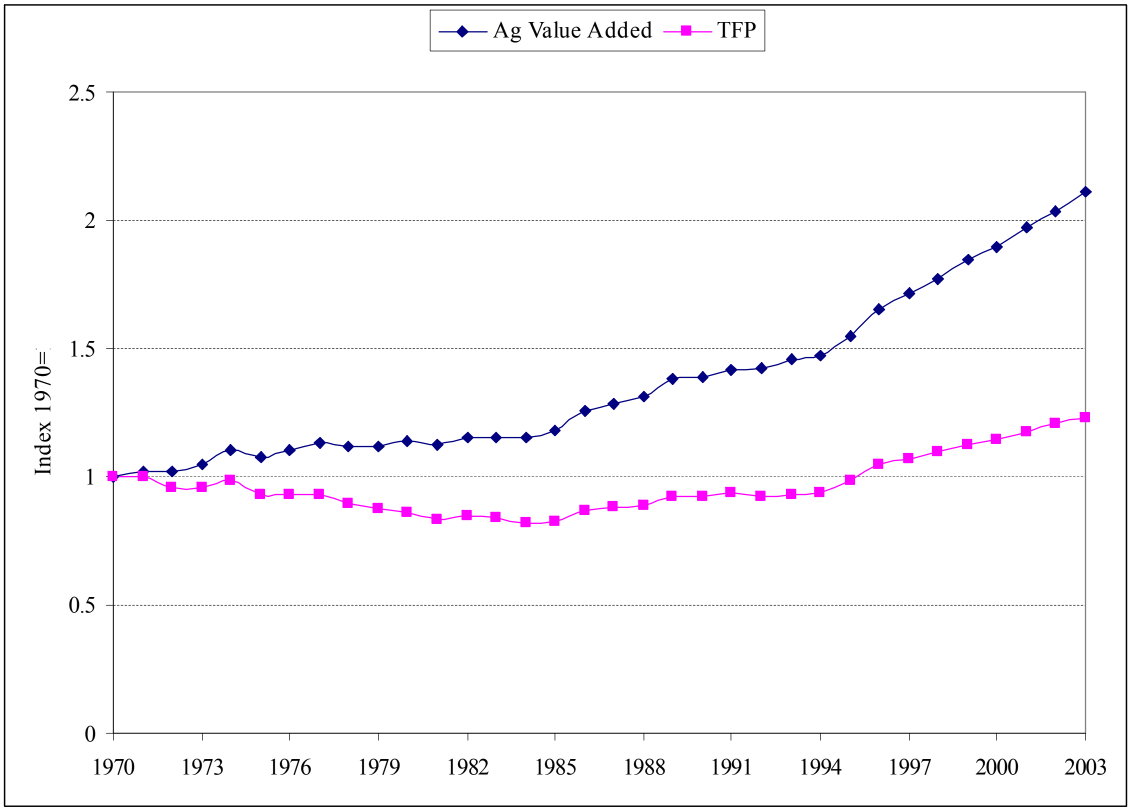

Figure 1. Growth Indices of Ag Value Added, Inputs and Total Factor Productivity (TFP), 1970 = 1.

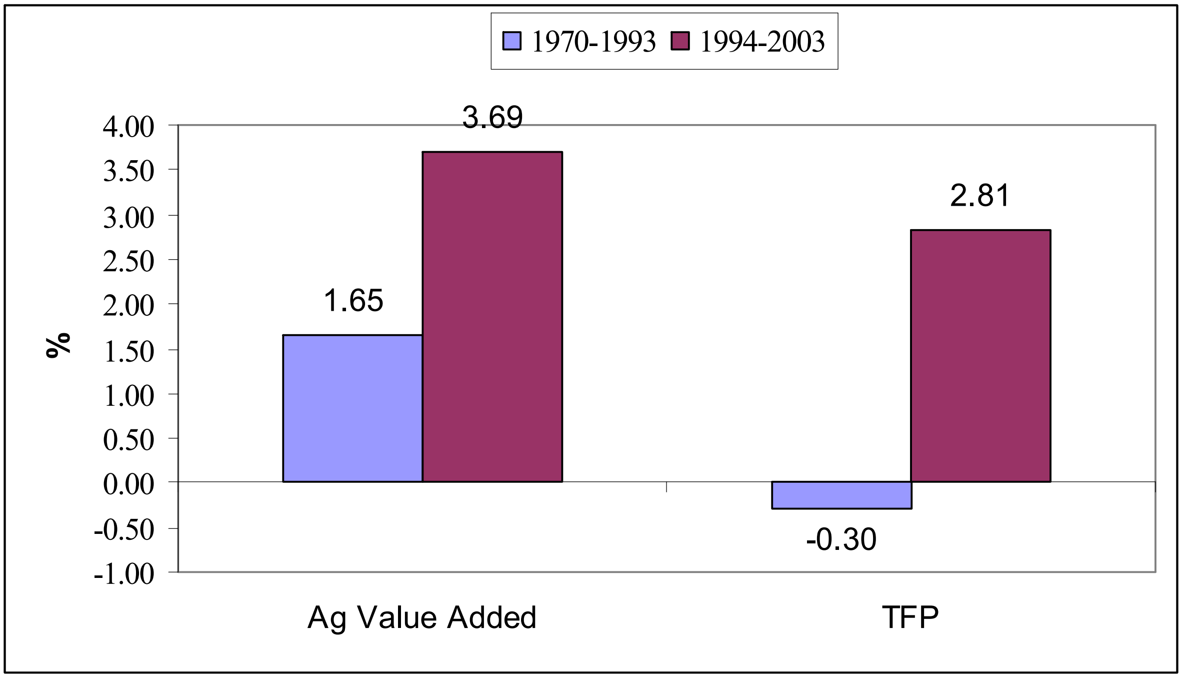

Figure 2. Growth rates of Ag Value Added and Total Factor Productivity (TFP) in Sub-Saharan Africa.

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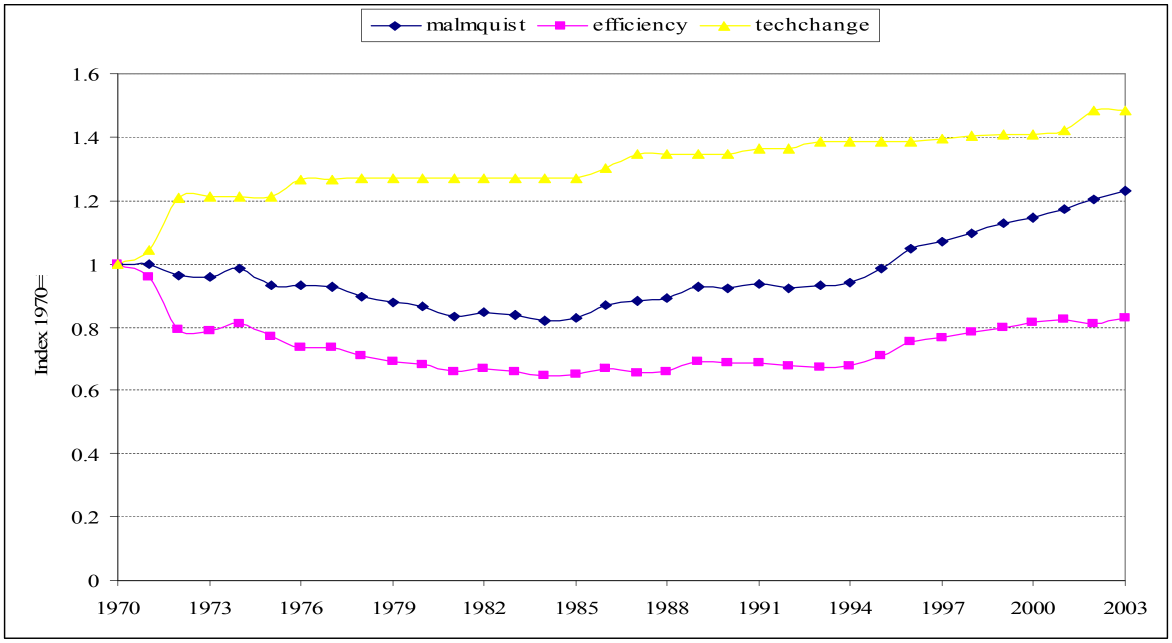
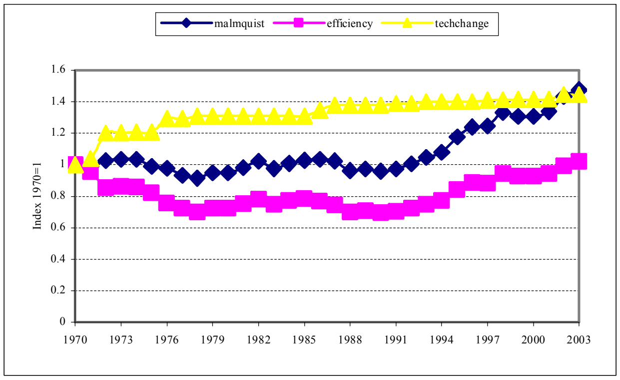
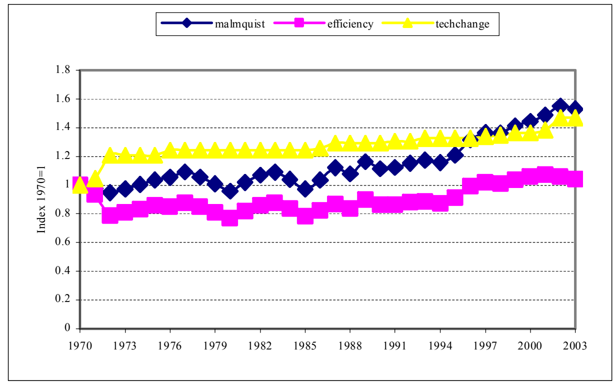


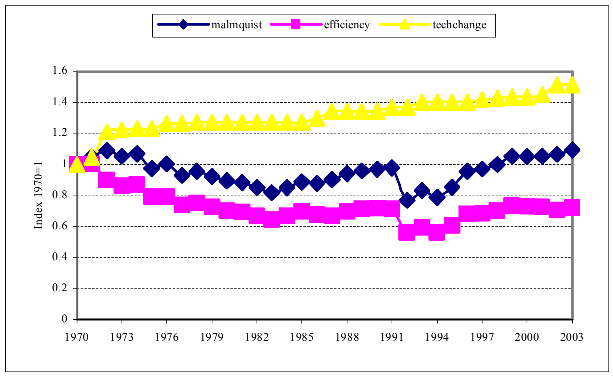
Figure 3. TFP growth and decomposition in efficiency and technical change for Sub-Saharan Africa



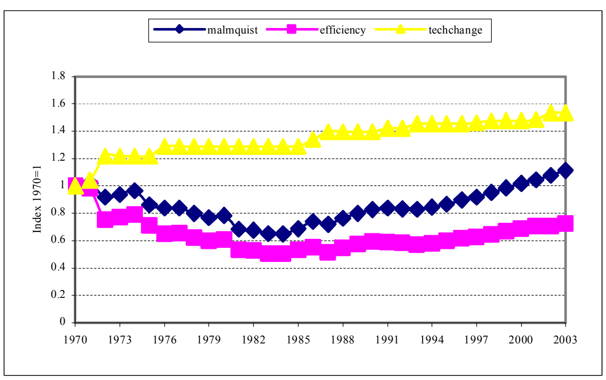
a) Central



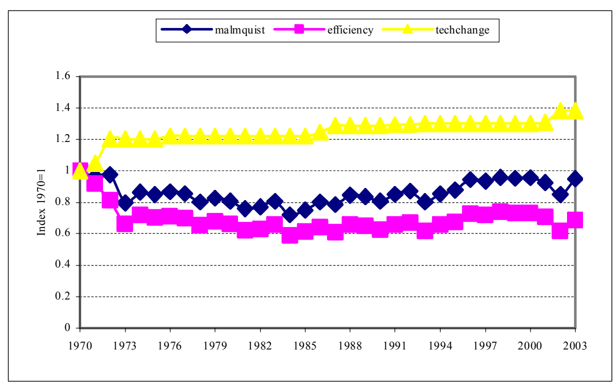
b) East



c) South



West Coastal



West Sahel

Figure 4. TFP growth and decomposition in efficiency and technical change for five regions in Sub-Saharan Africa

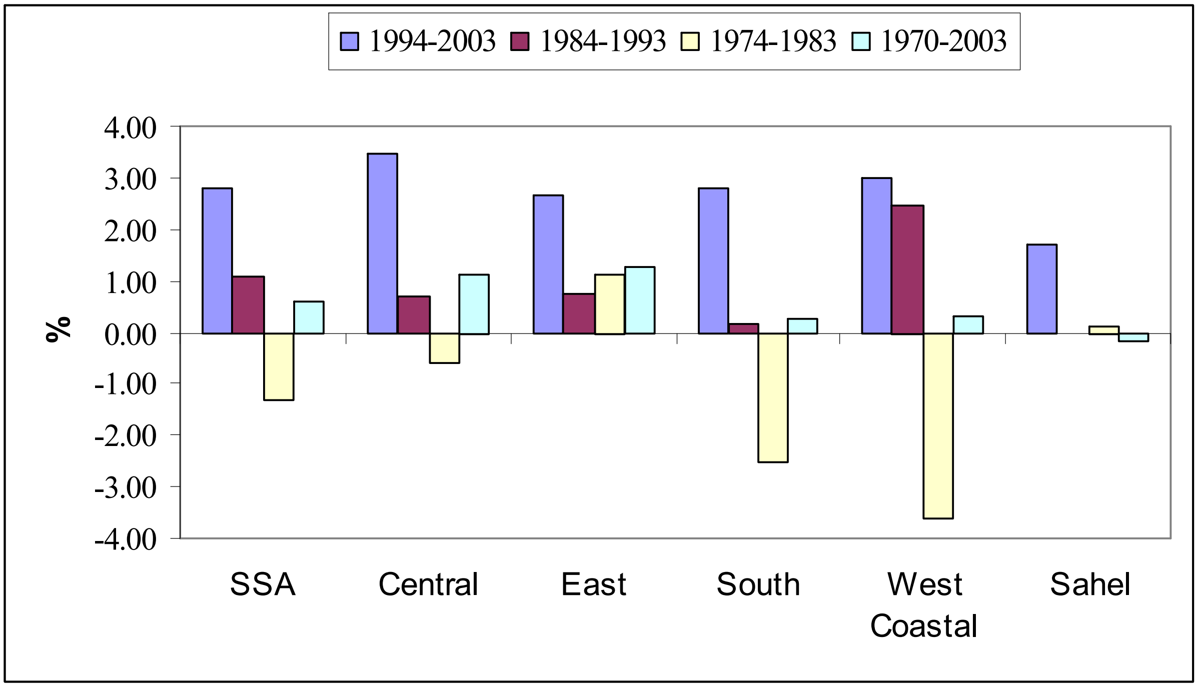
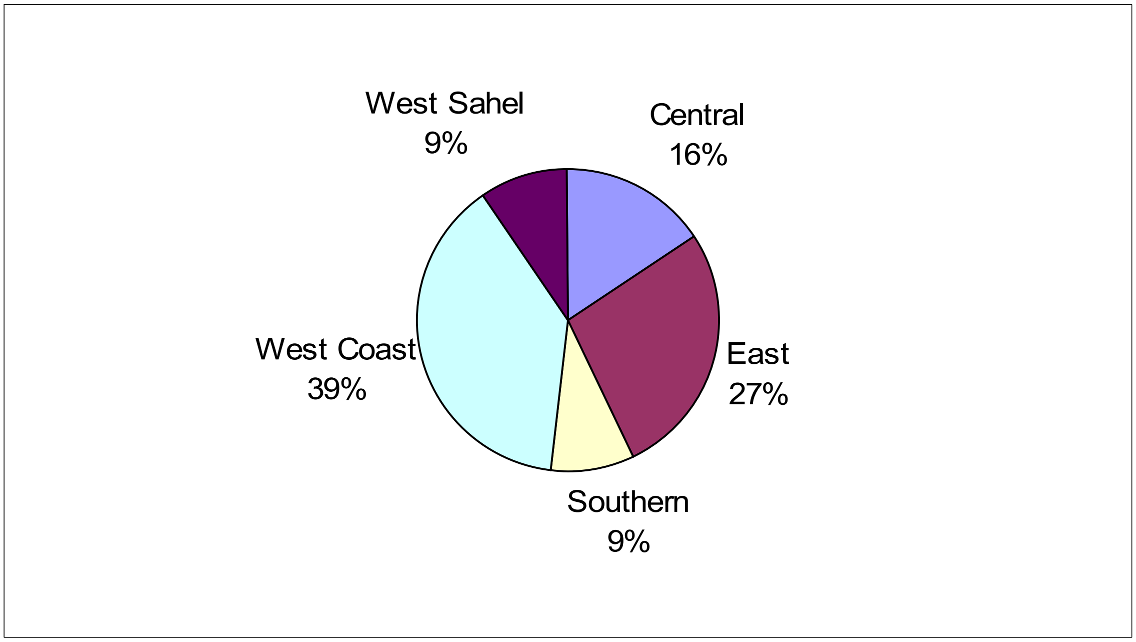


Figure 5. Average TFP growth rates for Sub-Sahara Africa (SSA) and sub-regions (percentage)

6.a Share in Sub-Saharan Africa's agricultural value added (average 1999-2003)



6.b Share in Sub-Saharan Africa's TFP growth

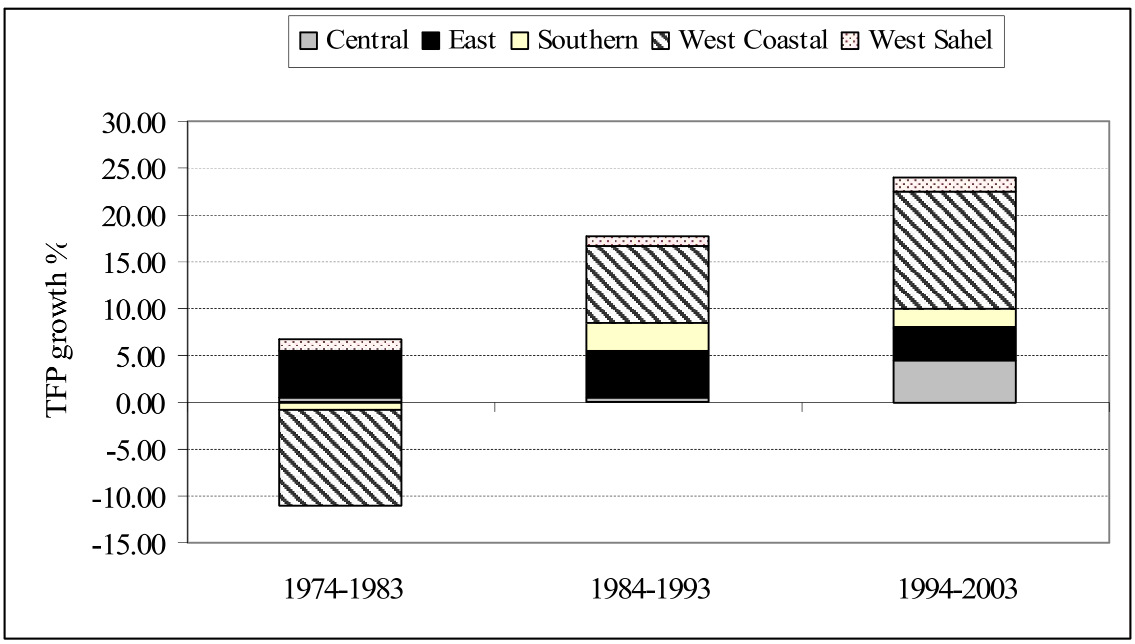


Figure 6. Share of Sub-Saharan Africa's sub-regions in total Ag Value Added and in TFP growth

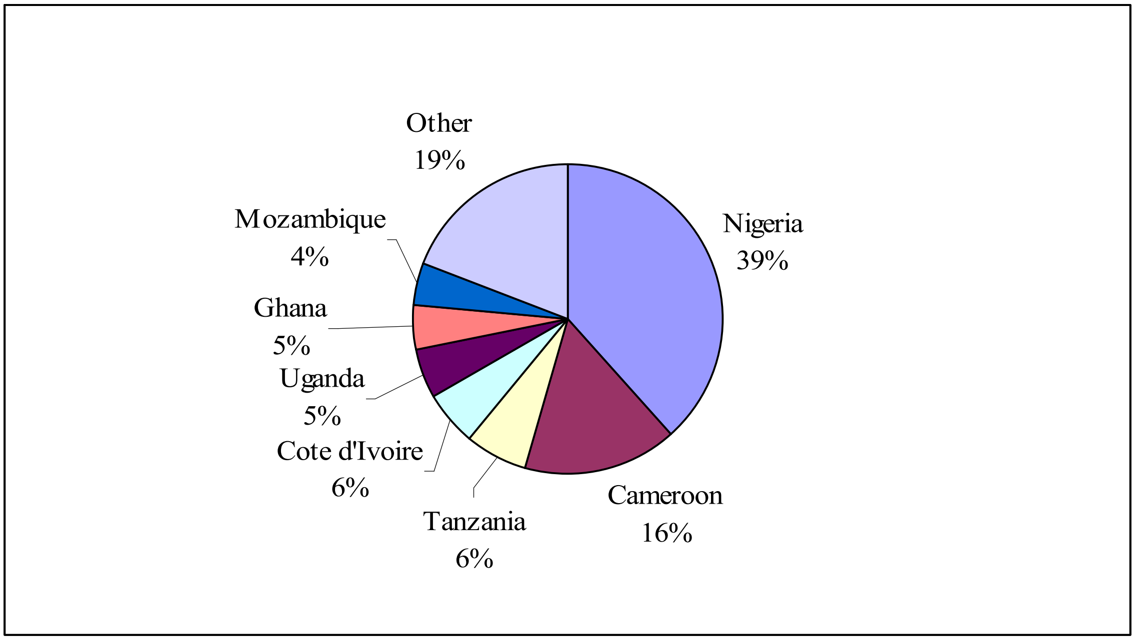


Figure 7. Share of different countries in Sub-Saharan Africa’s total TFP growth during 1994-2003.

Table 1. TFP and Ag Value Added growth rates for SSA countries

	Ag Value Added		TFP	
	1994-2003	1999-2003	1994-2003	1999-2003
Central				
Cameroon	6.34	5.98	4.60	3.42
CAR	4.33	4.44	3.16	3.49
Congo Rep	3.04	2.84	2.45	2.05
DRC	-0.19	-1.96	-0.01	-1.62
Gabon	0.81	4.58	0.79	2.23
East				
Burundi	-0.25	1.50	-0.11	1.06
Ethiopia	0.58	0.20	-1.55	-1.82
Kenya	1.79	0.58	1.39	-0.62
Madagascar/1	1.58	1.57	1.50	1.31
Rwanda	6.19	8.26	2.49	1.18
Tanzania	3.81	4.39	1.71	1.22
Uganda	3.70	4.47	2.68	3.01
Southern				
Botswana	-0.85	-1.02	-2.81	-2.37
Lesotho	1.78	0.60	1.70	0.05
Malawi	4.71	4.38	2.81	1.36
Mauritius	-0.54	-1.02	0.45	0.01
Mozambique	5.91	4.63	4.54	3.57
Namibia	2.88	1.74	2.21	1.38
Swaziland	1.93	-0.30	1.57	-0.96
Zambia	1.50	2.37	1.21	2.68
Zimbabwe	0.96	-3.12	-0.87	-3.42
West Coastal				
Benin	5.81	5.04	2.80	1.87
Cote d'Ivoire	3.05	1.53	2.48	1.26
Ghana	3.93	3.83	2.71	2.40
Guinea	4.49	4.34	0.78	1.22
Nigeria	3.86	4.04	3.32	3.98
Sierra Leone	1.17	2.77	-0.23	0.36
Togo	3.04	1.58	1.23	0.21
West Sahel				
Burkina Faso	2.45	2.32	-1.54	-2.00
Chad	6.62	5.01	4.46	3.31
Gambia	4.11	6.00	1.11	3.09
Guinea-Bissau	3.08	3.75	0.66	1.99
Mali	4.20	4.49	0.33	2.78
Mauritania	2.02	0.61	-0.10	-1.54
Niger	3.98	1.27	1.90	-0.38
Senegal	3.06	3.76	2.06	2.13

Note: /1 A significant reduction of HP and animal stock result from the original FAO data. Using that information, TFP values increase substantially during 2001-2003. We assumed this as a data problem and use 2000 values for HP and stock in 2001-2003 to calculate TFP

Table 2. Growth rates of TFP and PFP obtained by regressing productivity against a trend for the period 1994-2003, countries sorted by TFP growth

	Growth rates %					
	TFP		Labor PFP		Land PFP	
Group 1: High TFP growth						
Mozambique	4.83	*	3.95	*	5.86	*
Malawi	4.62	*	5.27	*	5.19	
Rwanda	4.30	*	3.62	*	7.19	*
Cameroon	4.09	*	5.54	*	6.30	*
Nigeria	3.61	*	3.80	*	4.04	*
CAR	3.58	*	4.17	*	4.28	*
Madagascar	3.21	*	-0.34		1.84	*
Group 2: Intermediate and low TFP growth						
Ghana	2.72	*	1.59	*	2.39	*
Uganda	2.64	*	1.87	*	3.57	*
Benin	2.56	*	4.55	*	1.49	*
Cote d'Ivoire	2.28	*	2.67	*	2.58	*
Lesotho	2.28	*	1.70	*	2.47	*
Gabon	1.58	*	2.56	*	1.65	*
Tanzania	1.52	*	1.89	*	3.58	*
Congo, Rep.	1.39	*	1.17	*	2.04	*
Burundi	1.32	*	0.43	*	0.31	
Guinea	1.16	*	3.12	*	4.25	*
Namibia	1.15	*	1.36	*	1.81	*
Group 3: TFP growth rate not different from 0						
Zambia	1.95		1.68		2.46	
Mauritius	1.70		2.79		0.86	*
Southern	1.51		1.72		2.16	
Gambia	1.33		1.88		1.91	
Niger	1.18		0.19		2.32	
Chad	1.04		1.63		3.24	*
DRC	0.92		-2.51		-1.28	
Kenya	0.87		-0.90		1.10	
Swaziland	0.77		1.11		0.98	*
Senegal	0.72		-0.09		1.76	
Togo	0.57		0.61		1.58	
Mauritania	-0.31		-0.35		1.88	*
Mali	-0.36		1.37		2.68	*
Sierra Leone	-0.51		-0.57		0.38	*
Zimbabwe	-0.76		0.53		0.94	*
Ethiopia	-0.93		-0.57		1.19	
Guinea-Bissau	-1.13		-0.49		0.59	
Group 4: negative growth						
Burkina	-1.38		0.61		1.23	*
Botswana	-2.90		-2.90		-1.09	*

Note: Growth rates with an '*'are significantly different from zero at the 5% level
Labor and land PFP and in TFP levels are in 1000 of US$ (2000) per worker, per hectare and per unit of aggregate input, respectively.

Table 3. Growth rates of TFP and PFP obtained by regressing productivity against a trend for the period 1994-2003, countries sorted by region

	Growth rate %					
	TFP		Labor PFP		Land PFP	
Central						
Cameroon	4.09	*	5.54	*	6.30	*
CAR	3.58	*	4.17	*	4.28	*
Congo Rep.	1.39	*	1.17	*	2.04	*
DRC	0.92		-2.51		-1.28	
Gabon	1.58	*	2.56	*	1.65	*
East						
Burundi	1.32	*	0.43	*	0.31	
Ethiopia	-0.93		-0.57		1.19	
Kenya	0.87		-0.90		1.10	
Madagascar	3.21	*	-0.34		1.84	*
Rwanda	4.30	*	3.62	*	7.19	*
Tanzania	1.52	*	1.89	*	3.58	*
Uganda	2.64	*	1.87	*	3.57	*
Southern						
Botswana	-2.90		-2.90		-1.09	
Lesotho	2.28	*	1.70	*	2.47	*
Malawi	4.62	*	5.27	*	5.19	
Mauritius	1.70		2.79		0.86	*
Mozambique	4.83	*	3.95	*	5.86	*
Namibia	1.15	*	1.36	*	1.81	*
Swaziland	0.77		1.11		0.98	*
Zambia	1.95		1.68		2.46	
Zimbabwe	-0.76		0.53		0.94	*
West Coastal						
Benin	2.56	*	4.55	*	1.49	*
Cote d 'Ivoire	2.28	*	2.67	*	2.58	*
Ghana	2.72	*	1.59	*	2.39	*
Guinea	1.16	*	3.12	*	4.25	*
Nigeria	3.61	*	3.80	*	4.04	*
Sierra Leone	-0.51		-0.57		0.38	*
Togo	0.57		0.61		1.58	
West Sahel						
Burkina	-1.38		0.61		1.23	
Chad	1.04		1.63		3.24	*
Gambia	1.33		1.88		1.91	
Guinea-Bissau	-1.13		-0.49		0.59	
Mali	-0.36		1.37		2.68	*
Mauritania	-0.31		-0.35		1.88	*
Niger	1.18		0.19		2.32	
Senegal	0.72		-0.09		1.76	

Note: Labor and land PFP and in TFP levels are in 1000 of US$ (2000) per worker, per hectare and per unit of aggregate input, respectively.

Table 4. Growth rate of TFP and PFP obtained by regressing productivity against a trend for the period 1999-2003

	TFP		Labor PFP		Land PFP	
Group 1: High TFP growth						
Cameroon	5.13	*	5.24	*	5.64	*
Gabon	4.78	*	5.63	*	4.48	*
Congo Rep.	4.40	*	4.51	*	4.90	*
Nigeria	3.69	*	3.69	*	2.71	*
Tanzania	3.46	*	2.84	*	4.34	*
CAR	3.44	*	4.37	*	4.35	*
Group 2: Intermediate and low TFP growth						
Uganda	2.65	*	1.90	*	3.67	*
Ghana	2.35	*	1.37	*	2.86	*
Burundi	2.22	*	0.26	*	1.78	*
Sierra Leone	2.20	*	2.14	*	3.98	*
Benin	2.04	*	4.16	*	2.43	*
Group 3: TFP growth rate not different from 0						
Chad	4.10		4.42		5.91	
Mozambique	3.72		3.64		5.07	
Mauritius	3.25		4.25		2.24	*
Niger	2.20		0.61		2.92	
Mali	1.92		1.49		3.29	
Cote d'Ivoire	1.50		1.90		1.54	*
Guinea Bissau	1.48		-0.01		2.02	
Rwanda	1.31		4.84		4.35	
Madagascar	0.95		-1.20		1.07	
Zambia	0.62		-0.40		-0.01	
Guinea	0.62		2.88		3.49	
Kenya	0.11		-1.02		0.38	
Togo	0.09		-0.46		1.32	
Botswana	-0.16		0.28		0.97	
Namibia	-0.28		-0.08		-0.33	
Lesotho	-0.52		-0.68		-0.65	
Senegal	-0.57		-1.09		0.60	
DRC	-0.80		-2.76		-1.12	
Malawi	-1.41		0.52		-0.60	
Swaziland	-2.44		-2.50		-2.69	
Burkina	-2.87		-0.39		-0.31	
Gambia	-3.19		-4.40		-4.06	
Ethiopia	-3.31		-1.79		-0.26	
Group 4: negative growth						
Mauritania	-2.76		-2.96		-0.63	
Zimbabwe	-5.27		-5.90		-6.02	

Note: Growth rates with an '*'are significantly different from zero at the 5% level