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Evidence on trends in the single factoral terms of trade in African agricultural commodity production

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Abstract

The ability of African countries to achieve sustained improvements in agricultural incomes depends on their ability to generate total factor productivity (TFP) change in their agricultural sectors and adjust to movements in agricultural output and input prices. The single factoral terms of trade index measures these changes, calculated as changes in the product of TFP and the agricultural terms of trade.

Estimates of the single factoral terms of trade index for the selected commodities over the period 1970-2002 are reported and discussed for 33 African countries for which data sets are available. The index is estimated for producers of coffee, cocoa, copra, palm kernel oil, coconut oil, palm oil, rice, cotton and sugar using annual agricultural sector data. Few countries managed to achieve an increase in the index over this period and it declined in many countries. In the light of the empirical evidence assembled, three broad strategic options are considered, covering agricultural trade reform, economic diversification strategies and strategies to improve total factor productivity in commodity production.

The results reported, along with much of the discussion, in this paper are from a research report prepared for the Commonwealth Secretariat. The financial assistance of the Commonwealth Secretariat in carrying out this study is gratefully acknowledged.

Background to the study

The international community accepts that a long-term decline has occurred in the terms of trade of most commodities produced by developing countries, a trend that is confirmed in this study. Yet it has been more or less indifferent to the fate of commodity producers in these countries, particularly since the collapse of most international commodity agreements. Attempts have been made, albeit not very successfully, to reduce the degree of commodity price fluctuations. But the problem of an enduring decline in commodity prices has not been tackled in earnest.

UNCTAD (2003, p. 22) observed that the 'net effect of the secular decline in prices depends on the extent to which world market prices are transmitted to producers and whether higher export volumes (for example, through productivity and yield improvements) make up for falling prices'. In this context, there is a need for evidence of the problem of declining prices faced by commodity-exporting developing countries, and evidence that increases in productivity have compensated for the decline in producer and export prices of commodities.

The greatest and most consistent concern about the ability of the developing world to achieve significant productivity gains in agriculture has focused on the African continent and, in particular, sub-Saharan Africa. The problems faced by agricultural producers in this region are well known. They include: unreliable rainfall and irrigation systems; low investment in agriculture; a heterogeneous set of crop and livestock activities; gaps in the knowledge needed to make decisions and generate production and marketing innovations; declining soil fertility; poor to non-existent infrastructure in many areas; widespread disease and malnutrition in the rural population; and civil disturbances affecting commerce in the rural areas of many countries at different times. These obstacles are coupled with apparently declining real prices of agricultural commodities on which many African countries rely to achieve agricultural development.

Because comprehensive data do not exist on input costs or enterprise mix at the individual farm level in the countries under study, a definitive statement cannot be made on the existence or otherwise of a decline in real farm incomes resulting from long-term declines in commodity prices. But inferences can be drawn on the potential immiserising

impacts of commodity price declines at the agricultural sector level under a set of assumptions about agricultural production costs and enterprise mix. The central proposition to test in this study is whether productivity change in agricultural commodity production in the selected African countries has been high enough to offset declines in commodity prices received by producers.

Production and export of agricultural commodities in Africa

The focus of our study is a set of commodities of particular relevance to Africa, namely coffee, cocoa, lauric oils (comprising copra, palm kernel oil and coconut oil), palm oil, cotton and sugar. Rice is also included. Considerable differences exist in the importance of the selected commodities in the domestic economies of the countries under review. These differences are illustrated in Table 1, which shows countries in which the value of selected commodity exports was at least one per cent of the value of total exports in 2002. A number of countries, notably Burundi, Côte d'Ivoire, Ghana, Rwanda and Uganda, have relied heavily on the commodities to contribute to both total export earnings and agricultural output. In other countries, such as Nigeria, the commodities have contributed little to export earnings but have been especially important to their large agricultural sectors. In no country is there the situation where the commodities contribute substantially to export earnings but not to agricultural output.

Table 1

Contributions by Selected Commodities to Export Values and Agricultural Output

Country	Export values of selected tropical commodities in 2002 as a proportion of:	
	FOB exports (%)	Agricultural output (%)
Uganda	79.24	81.50
Burundi	77.72	81.48
Rwanda	66.27	70.93
Ghana	40.15	87.23
Côte d'Ivoire	34.88	62.96
Kenya	17.84	28.29
Cameroon	15.40	59.11
Madagascar	13.21	23.91
Sierra Leone	9.76	80.10

Central African Republic	8.44	28.01
Congo, Republic of	8.17	81.54
Togo	6.71	28.83
Malawi	2.69	2.90
Zimbabwe	1.35	3.35
Guinea	1.09	26.67
Nigeria	1.01	59.99

We began by assembling evidence on the extent to which declines occurred in real world commodity prices over the period from 1970 to 2002. Prebisch (1950) and Singer (1950) contended that two factors were reinforcing technological change differentials between developed and developing nations and domestic and international market structures, namely substantially higher income elasticities of demand for manufactured products than for primary products and a low propensity to import in USA (Cypher and Dietz 2004, pp. 166-167). In respect of the former, one could add that substantially higher income elasticities of demand also tend to be associated with services involved in the marketing of commodities.

The validity of the Prebisch-Singer hypothesis has been the subject of controversy over many decades. This controversy continues today, but the evidence is accumulating that the terms of trade for commodities produced by developing countries are deteriorating. Cypher and Dietz (2004, pp. 168-169) collated recent empirical evidence based on trends in real commodity prices from two sources not known for their support of the Prebisch-Singer hypothesis, the World Bank and the International Monetary Fund. First, they used data compiled by the World Bank (2002) to show markedly declining real prices of commodities (excluding petroleum products) between 1980 and 2001 for developing countries, as a whole, and sub-Saharan African countries, in particular. The price index fell from 100 in 1980 to a little above 50 for the former and just above 40 for the latter in 2001 (Cypher and Dietz 2004, p. 168). Second, IMF (1994) reported increased magnitudes of the average annual decline in the terms of trade for raw materials: 0.78 per cent between 1957 and 1987; 1.52 per cent between 1968 and 1987; and, for 33 commodities, between 3.6 per cent and 4.2 per cent from 1979 to 1993 (Cypher and Dietz 2004, p. 169).

Coffee provides a stark example of these factors at play in bringing about deteriorating terms of trade in commodity markets in that virtually all coffee beans are produced in the

developing world whereas most of the value-adding activities and consumption take place in the developed world. Recent trends in the world coffee market reveal a dramatic decline in the share of the consumer price of coffee claimed by producing countries. McCorriston, Sexton and Sheldon (2005, p. 1) reported that, in 'key export markets such as Europe and the United States, global coffee buyers, roasters and retailers … account for almost 60 percent of the share of final sales value of coffee'. Choraria (2005) presents evidence of compression of the value chain for coffee and cocoa between the farm-gate and retail levels (that is, a decreasing share of the retail value going to the farmer), with the compression occurring overwhelmingly between the export and retail levels.

The sources of data used in the study and their manipulation are the topics of the next section. Details are then provided of the empirical evidence on commodity export and producer price trends of the selected agricultural commodities. They are followed by details of estimation procedures and empirical estimates of productivity change in agriculture in sampled African countries. The results of two analytical approaches are then reported. The first approach is a comparison of export unit value trends and productivity trends for sampled African countries and the second is an analysis of trends in the single factoral terms of trade. The paper concludes with an outline of the strategic options for agricultural development in Africa.

Data

The source of all production, producer price and export unit value data is the FAOSTAT-Agriculture website, supported by the Statistics Division of the Food and Agriculture Organization of the United Nations (FAO) (www.fao.org/faostat). The proportions of the output mix contributed by the selected tropical commodities were also derived using the FAOSTAT-Agriculture data.

In African countries, the production cycle is very long for numerous agricultural commodities including some of special interest in this study (coffee, cocoa, palm oil and lauric oils). Therefore, it is desirable to make the study period as long as possible to allow for changes made in agricultural technologies to take effect in these industries. The study period chosen is from 1970 to 2002.

The study was conducted on 36 African countries with significant proportions of the selected commodities in their agricultural product mix. Two countries initially selected for inclusion on the basis of FAO data were omitted: Ethiopia did not have a full set data and Réunion was excluded because it is part of a developed country (France). South Africa has little in the way of tropical agriculture and a significant component of the agricultural sector shares attributes with developed agricultural sectors. It was nevertheless included because of the contrast that we expect in the ability of their farms to generate substantial productivity gains. It allows us to undertake an admittedly limited test that extends the proposition put forward by Gallup and Sachs (2000, p. 731), that agricultural productivity is lower in the tropics, to propose that productivity growth in temperate agriculture is higher than in tropical agriculture.

The 36 countries included in the analysis are listed in Table 2 along with the selected commodities for which they have substantial exports. The commodities reported for each country were not always produced consistently throughout the study period. Some that were important exports in the early years for a particular country but were not exported in the latter years of the period were omitted.

Output aggregates were obtained from Rao (1993, Table 5.4) and constructed using international 1990 prices denominated in US dollars. For most countries, both crop and livestock data are available for the study period. For some countries where livestock activities are relatively unimportant, however, separate livestock data were unavailable so productivity estimates were based on crop production only. The proportions of the value of output of the selected tropical commodities to the total value of crop output in each country vary markedly.

The number of inputs was dictated by data availability. Five categories were included: land area, tractors, labour, fertiliser and livestock (in dry sheep equivalents). While it would have been desirable to have tree inputs given our interest in a number of tree crops, data on the cost of seedlings were not available and, if they were, would not have been accurate given the common policy of subsidising their dissemination to farmers. In any event, the two most important inputs in the establishment and maintenance of tree crops are labour and fertiliser, which are both included in the input set.

Table 2
Significant Export of Selected Commodities by Country

Country	Significant export of selected commodities
Angola	Coffee; cotton
Benin	Cocoa; cotton; palm oil
Burkina Faso	Cotton
Burundi	Coffee; cotton
Cameroon	Cocoa; coffee; cotton; palm oil
Central African Republic	Coffee; cotton
Chad	Cotton
Congo, Democratic Republic	Cocoa; coffee; palm oil; palm kernel oil
Côte d'Ivoire	Cocoa; coffee; cotton; coconut oil; palm oil; palm kernel oil; sugar
Egypt	Cotton; rice
Gabon	Cocoa; coffee; palm oil
Gambia, The	None
Ghana	Cocoa; coffee; palm oil
Guinea	Cocoa; coffee; cotton
Guinea-Bissau	None
Kenya	Coffee; sugar
Liberia	Cocoa; coffee; palm oil
Madagascar	Cocoa; coffee; rice; sugar
Malawi	Coffee; cotton; sugar
Mali	Cotton
Mauritania	None
Mauritius	Sugar
Mozambique	Copra; coconut oil; cotton; sugar
Niger	Cotton
Nigeria	Cocoa; cotton; palm oil; palm kernel oil
Rwanda	Coffee
Senegal	Cotton
Sierra Leone	Cocoa; coffee; palm kernel oil
South Africa	Cotton; rice; sugar
Sudan	Cotton; sugar
Swaziland	Cotton; sugar
Tanzania	Cocoa; coffee; cotton, sugar
Togo	Cocoa; coffee; cotton
Uganda	Coffee; cotton
Zambia	Coffee; cotton; sugar
Zimbabwe	Coffee; cotton; sugar

A Fisher index was constructed to obtain an agricultural output index for each country. The index was initially estimated for output data in 1990, following the approach adopted by Coelli and Rao (2004). FAO production indices were then used to calculate crop and livestock output data for each year in each country back to 1970 and from 1991 onwards. Some but not all data were available for the years 2003 and 2004, which meant the study period had to end in 2002.

Price data are obtainable from the FAO website for more than 150 commodities at the producer, export and global levels. It would be a mammoth task to construct an aggregated commodity price series for every country under study so we confined our

attention to the eight commodities of special interest. Producer equivalent values were extracted for the exports of paddy rice equivalent (the broad rice category was used), coffee green beans, cocoa beans, raw sugar equivalent, cotton lint, copra, palm kernel oil and coconut oil (comprising the lauric oil category), and palm oil as the first step to calculate export unit values.

The export unit value index was then constructed by extracting export quantities for the same group of commodities, and dividing export value by export quantity for each commodity. Once the export unit value series was established for each commodity, an aggregate Fisher index was constructed for all commodities.

A similar procedure was followed to construct the producer price index for these commodities, also using the FAO AGROSTAT data series. Again, a Fisher price index was constructed for each country. The FAO data series for producer prices is incomplete in every country, unlike the export unit value data. Therefore, most emphasis is placed on the latter series in undertaking the analyses in the next section. But the producer price data provide useful comparisons and some additional information on price trends that is used to construct single factoral terms of trade indices.

Estimated trends in commodity prices

Export unit values

Indices of export unit values of the selected tropical commodities aggregated across all countries in the sample for the period 1970-2002 are summarised in Table 3. Annual rates of price change with standard errors were estimated by taking the logarithm of the dependent variable, export unit values, and regressing it on a trend variable. As with trends in export quantities, price trends are described separately for all selected commodities, tree crops (coffee, cocoa, palm oil and lauric oils) and field crops (rice, cotton and sugar).

Table 3
Estimates of Trends in Export Unit Values of Selected Commodities, 1970 to 2002

Variable	Coefficient	Standard error	*t*-statistic	*P*-value
Total commodities:				
Intercept	1.282	0.104	12.295	1.86E-13
Trend	-0.033	0.004	-8.825	5.8E-10
R square	0.715		Standard error	0.206
Tree crops:				
Intercept	1.571	0.153	10.252	1.76E-11
Trend	-0.037	0.006	-6.755	1.46E-07
R square	0.595		Standard error	0.303
Field crops:				
Intercept	0.673	0.078	8.655	8.96E-10
Trend	-0.023	0.003	-8.131	3.49E-09
R square	0.681		Standard error	0.154

Export unit values of all selected tropical commodities, selected tree crops and selected field crops are presented in Figure 1 for all countries in the sample. The overall rate of price decline of 3.32 per cent corresponds closely to that for 83 developing countries (Fleming, Rao and Fleming 2006) but the annual rate of price decline for field crops of 2.28 per cent is quite a bit lower than the rate for all countries of 3.46 per cent. Of the sample, unit export data were only available for 33 of the 36 sampled countries. Only three countries (Gabon, Mauritius and Zambia) experienced upward trends in their export unit value index.

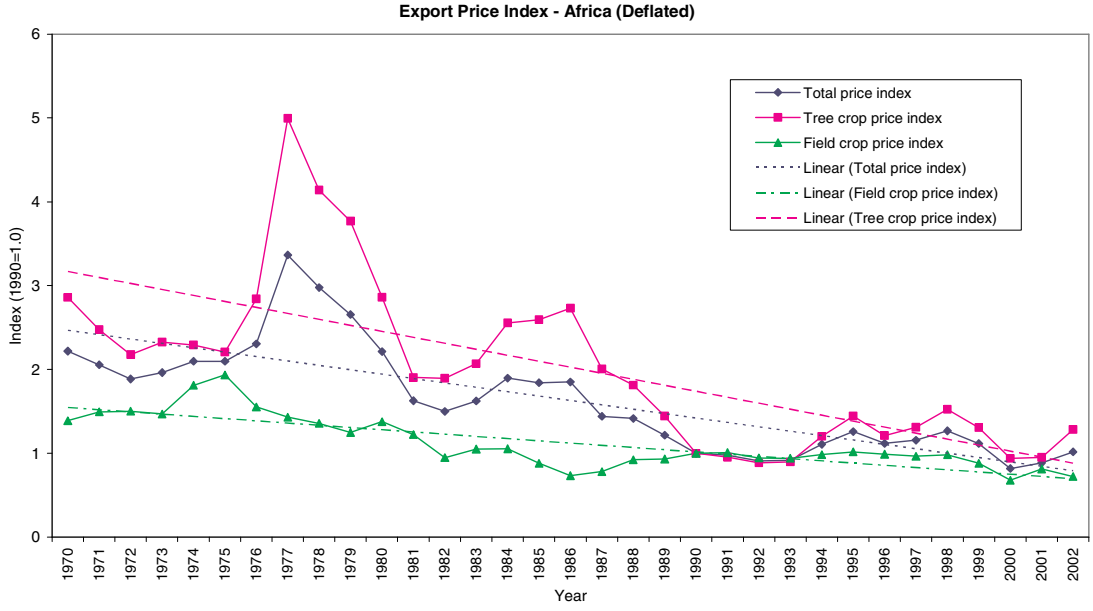

Figure 1 Export price index for selected commodities in sampled African countries, 1970-2002.

Producer prices

An index of producer prices of the selected tropical commodities was estimated for each country. Because the time period for the series varies from one country to the next, there is little to be gained in estimating aggregate price series, and their trends, as done above for export unit values.

Trends in producer prices for individual countries are not always consistent with those for export unit values. Exogenous factors such as extreme climatic variations can lead domestic prices to vary from world prices but more often than not there are systemic factors at work in the domestic agricultural economies. Hertel and Winters (2005), Winters, McCulloch and McKay 2004), Nicita (2005) and von Braun, Bouët, Cororaton, Mengistu and Orden (2005) identified the main sources of discrepancy between border prices and producer prices arising from imperfect price transmission as:

- variations in infrastructure and transport costs
- market imperfections
- domestic fiscal policies and regulations.

Trends in the two series for each country were checked to see if they display reasonable correspondence. Evidence covering varied time periods between 1970 and 2002 provides little support for similar trend magnitudes in indices of export unit values and producer prices. A 10 per cent increase in the annual export unit value index led to at least a 5 per cent increase in the annual producer price index in relatively few of the countries for which it was possible to regress the producer price index on the export unit value index. For some countries, even the direction of change differs: the coefficient on the export unit value index is actually negative. This overall result suggests that there are major obstacles to the effective transmission of commodity prices back along the value chain from the point of export to the point of agricultural production. The varied influences of government economic policies, especially those influencing agricultural export industries, make this finding unsurprising. Where they were in operation for substantial parts of the study period, agricultural commodity stabilisation schemes would have greatly reduced fluctuations in producer prices in many countries. While short-term fluctuations are not

correlated, the long-term trends in the two price indices that are of interest in this study are broadly similar.

Estimation of productivity change in African agriculture

Method

Productivity is measured as total factor productivity (TFP), the ratio of all outputs to all inputs used to produce that output in an agricultural sector. Not all agricultural inputs are included in analyses in this study. Nevertheless, they are sufficiently comprehensive to capture overall changes in input usage. TFP change is an amalgam of technological change, change in technical efficiency and change in scale efficiency (that is, efficiency gains from changing the scale of production operations).

Because exports from African countries are dominated by crop products, the focus of the analysis is on productivity in crop production. The main processes bringing about changes in TFP in tropical cropping systems are:

- Improved production technologies, including improved crop varieties
- Improved quality of agricultural output
- Improvements in the technical efficiency with which agricultural production is undertaken
- Changes in the scale of production operations on the farm
- Changes in environmental factors, such as infrastructure, soil structure and fertility, pesticide residues, desertification and salinity.

Most of the inputs used in African agriculture are fixed in the short run, offering limited opportunity to producers to alter their resource mix in production. The best examples of these types of inputs are land, operator and family labour, irrigation equipment and most other plant and machinery items. To this list should be added those stocks of tree plantations that are of special interest in this study: coffee trees, cocoa trees, coconut palms, oil palms and, to some extent, sugar crops that tend to be ratooned for a few years. For this reason, an output orientation is preferred for applying data envelopment analysis that allows us to calculate TFP indices.

Malmquist indices were calculated to measure changes in TFP in the agricultural sector in each selected African country over the study period. In this respect, we followed the same methodological path for calculating agricultural TFP change in African countries as, first, Coelli and Rao (2004) and, later, Nkamleu (2004). One of the major advantages of estimating a Malmquist index is that it assumes an underlying translog production function that allows flexibility in the relations between outputs and inputs in production technology. Our study period extends one year beyond the period chosen by Coelli and Rao and Nkamleu.

We suspect that the productivity growth of tree crops has lagged behind other crops, for four main reasons. First, the genetic and other research work carried out on the production of these crops has tended to make less progress than that made in other parts of agriculture. Second, many tree crops have been planted on previously forested land. High yields from initially fertile soils in the 1960s and 1970s have not been sustained as soils in many areas have deteriorated with continuous production over a number of decades in humid tropical climates (Gallup and Sachs 2000). Third, many tree plantations are getting older and trees have not been replaced, leading to declining yields. Finally, a number of countries have experienced increased incidences of pests and diseases affecting the yields of tree crops, especially cocoa producers.

On the other hand, considerable technological advances have been made in the production and protection of rice and cotton crops. Rice producers have benefited from Green Revolution research outputs and the widespread diffusion of improved and sustainable production methods in the post-Green Revolution era, while cotton producers have benefited from technology spillovers from developed agriculture, in countries such as USA and Australia.

Sugar production, on the other hand, has suffered in many major sugar-producing countries. There are two reasons for expecting this result. The first is an absence of technology spillovers from international research centres and the developed world compared with the other selected field crops. Second, the land on which sugar is grown has been showing distinct signs of degradation in recent times in a number of countries. In summary, we expect rice and cotton production to record above-average productivity

gains and tree crops and sugarcane production to record below-average productivity gains.

Estimated trends in TFP

Three-year moving averages were estimated of the change in TFP in the agricultural sector by country for the period from 1961 to 2001. In one country, Burundi, TFP estimates proved unreliable due to the erratic recording of data on tractors and fertilisers. Labour productivity estimates were used as a proxy for TFP in this case because these inputs tended to increase at around the same rate as labour over the study period.

Examination of the cumulative TFP index from the base year of 1970 (TFP index = 1.0) until 2002 for the 36 sampled countries shows that 17 countries did not experience overall TFP growth during the period. Of the 19 that did achieve TFP growth, 7 achieved a cumulative TFP growth rate of less than 20 per cent, which translates to an annual TFP growth rate of less than 0.6 per cent. TFP at least doubled over the study period in only two countries in the sample (Central African Republic and South Africa), which means their annual TFP growth rate was less than 2.2 per cent per annum. These two countries with high productivity growth rates provide contrasting situations: the former is an example of catch-up from a low level of initial productivity while the latter is largely a temperate country with a relatively advanced agricultural sector. Brief comments follow on the experiences of some of the countries.

Uganda was one of the countries that experienced a low annual productivity growth rate for the whole study period. Its agricultural sector has gone through a chequered process with substantial increases in TFP prior to 1970s that continued throughout that decade at a moderate rate before stagnating in the 1980s and declining in the 1990s. Its TFP trend largely mirrors the fortunes of the coffee industry, with TFP gains in the 1960s and 1970s turning to a slight decline thereafter. APEP (2005, p. 1) reported that several factors had contributed to a decline in productivity in the coffee industry, including 'Diseases and pests, notably coffee wilt disease … Old coffee trees … Poor crop management practices … Poor soil fertility management [and] Poor post-harvest handling practices'.

Countries that experienced a decline in their TFP index during the whole study period (with percentage annual decline in parenthesis) included Ghana (-0.24), Cameroon (-

0.92), Sierra Leone (-1.04), Zambia (-1.21), Mozambique (-1.47) and Burkina Faso (-1.69). Two countries in this group—Sierra Leone and Mozambique—experienced periods of civil war during the study period. In the case of Sierra Leone, this period was towards the end of the study period and its effects are shown by the decline in the cumulative TFP index from 0.94 in 1998 to 0.72 in 2002. Mozambique experienced protracted conditions of civil war earlier in the study period. The cumulative TFP index plummeted from 1.0 in 1970 to 0.47 in 1994 when it reached its nadir. Recovery has been steady since that date following the implementation of a structural adjustment program following the cessation of hostilities in 1992. Recovery was delayed by a bad drought that coincided with peace (Arndt 2005, p. 3). The index averaged 0.66 in the final five years of the study period, but declined slightly in the final two years.

Ghana and Cameroon present interesting cases that illustrate the need to scrutinise trends for break points over the 32-year study period. From the start of the period (and indeed back to the early 1960s), Ghana experienced substantial declines in TFP in its major cash crop industries due to economic mismanagement. The cumulative index slumped to 0.48 in 1983, less than half the index in 1970. The situation began to improve from the mid-1980s, a trend clearly seen from the fact that the cumulative TFP index more than doubled to 0.99 by 2000. Ominously, TFP decline re-emerged in 2001 and the index closed at 0.93 in 2002.

TFP performance in Cameroon between 1970 and 2002 closely followed the macroeconomic policy adopted by the government. Amin, Douya and Mbeaoh (2002, p. 155) characterised government policy until the mid-1980s as ‘a protectionist policy [that] was combined with state intervention in all spheres of the economy and strict price controls that effectively prohibited the development of a viable market system’. Despite some impressive growth statistics during this period, TFP in the agricultural sector almost halved between 1970 and 1985. The adverse effects on TFP of this economic policy were augmented, first, in the early 1980s by the presence of ‘Dutch disease’ effects induced by the petroleum industry that caused stagnation in the agricultural sector and, second, by a financial crisis that caused economic decline between 1985 and 1988 (Amin, Douya and Mbeaoh 2002, p. 155). The implementation of economic reforms from 1988 entailing ‘liberalization of trade in agricultural products; privatization of agricultural production

and dissolution of state-owned agroindustrial corporations' (Amin, Douya and Mbeaoh 2002, p. 157) coincided with a noticeable revival in TFP, which grew continuously from 1989 to 2002. The cumulative TFP index in 2002 was 49 per cent higher than the 1989 level but still below the level in 1970.

With their heavy reliance on cotton as a source of cash income from exports, many smallholders in Zambia suffered from a moribund industry until reforms were instituted in 1994 (Balat and Porto 2005). By this time, the cumulative TFP index had slumped to 0.65 from 1.17 in 1978. Reforms were implemented in the cotton sector in 1994 as part of a market liberalisation program but, as Balat and Porto (2005) observed, they experienced difficulties. Although TFP showed signs of improvement in the latter part of the 1990s, the cumulative TFP index stood at only 0.68 in 2002.

Burkina Faso exemplifies the problems many countries have had in maintaining, let alone improving, TFP. Its agricultural sector suffered an annual decline in TFP of 1.9 per cent over the study period, with desertification and locust plagues hindering efforts to raise TFP. Henao and Baanante (1999, p. 2) reported that it 'would have to increase its NPK consumption more than 11 times to maintain crop production levels without depleting nutrients'.

It was surprising that a number of countries experienced declines in TFP between 1986 and 2002 in a period when the fruits of scientific endeavour and improved economic policies would have been expected to be enjoyed through progress in agricultural production technology and productivity growth. A handful of these countries might have suffered productivity setbacks as a result of civil wars and extended periods of drought, but a disturbingly high number are classified as least developed countries. At least as many others enjoyed productivity gains simply by catching up with technology adoption that had been delayed by the same factors earlier in the study period.

Regression analyses undertaken to determine whether there were different rates of TFP changes according to the relative importance of the selected commodities in the product mix of the agricultural sector in each country accord closely to prior expectations. An increase in tree crops in the product mix results in lower rates of TFP growth. The only exception to this result is coffee production where the TFP growth rate does not

significantly alter for a change in the proportion of coffee output in the product mix. Elasticities are very low for all forms of commodity production.

Of the field crops, sugar production was expected to show a result similar to that for tree crops. That is, a higher proportion of sugar in the agricultural output mix was thought to be associated with a lower rate of productivity growth. The estimated coefficient does not support this proposition. Like coffee production, the proportion of sugar in the product mix has no significant effect on the rate of TFP growth. A possible explanation of this result is that sugar is such a dominant crop in many of the countries where it is exported that the overall agricultural productivity index largely reflects the sugar productivity index.

Both cotton production and rice production in African countries should have benefited from substantial international research gains (although the latter is a relatively minor crop in most countries). Their proportions in the agricultural product mix were expected to show significant and positive coefficients. Indeed, both coefficients are positive but neither was significant at the ten per cent significance level (although the estimated coefficient for cotton only narrowly fails this test).

In conclusion, it appears safe to conclude that only the tree crops other than coffee have TFP growth rates substantially different from the average rates estimated for each country. While this result might not be valid for some countries, the low elasticities suggest that assuming average TFP growth rates for coffee, sugar, rice and cotton production is a sound way to proceed. But lower than average growth rates for cocoa, coconut and oil palm production mean that caution should be taken in inferring higher TFP growth rates than price declines for any country in which these commodities comprise a major proportion of agricultural output. On the other hand, they strengthen any finding for these countries of lower TFP growth rates than price declines.

Has productivity change counteracted declining commodity producer prices?

In this section, a comparison is made between the rate of change in agricultural productivity and the rate of change in commodity prices, measured as export unit values. TFP is chosen as the best measure of productivity for this assessment. Two methods are

followed. In the first approach, export unit values are selected because they best reflect border prices to measure the true economic values of exports. The world export unit value index is used as a deflator to ensure constant prices. Second, we estimated the single factoral terms of trade at the producer level using an index of producer prices and general consumer prices for each country. These estimates provide a useful check on the consistency of results with those we obtained using country-level export unit values and the world export unit value index. Both indices have their advantages and disadvantages. In particular, export unit values are likely to be more accurate for the selected commodities under study but include price changes between the farm gate and the point of export, the rates of change for which might be different from those facing producers.

Given our particular interest in producer welfare, the comparison between rates of TFP and export unit values could be couched in terms of an approximation to the single factoral terms of trade for producers supplying agricultural export markets. Interpreted in this way, it is assumed first that the world export unit value index is a good approximation of the import price index for each country. Second, it is assumed that either the rate of change in TFP in productive activities beyond the farm to the point of export for the selected commodities is the same as that for productive activities on the farm (unlikely) or (much more likely) those firms undertaking post-farm activities are able to capture the benefits of any differential between the higher TFP rate of change that they achieve and the rate of TFP change achieved by agricultural producers.

Comparison of the rates of change in agricultural productivity and export unit values

The crudest way to assess the revenue-enhancing or revenue-reducing effects of changes in commodity outputs and prices is to compare the annual mean rates of change in productivity and real unit export values over the study period. The estimate of TFP change for all African countries in the sample is +0.16 per annum (or only +0.09 per cent if South Africa is excluded). The estimated change in the export unit value index is -3.32 per cent per annum.

Net barter terms of trade for primary commodities have been traditionally measured as the price index of primary products relative to the price index of exports of manufactured

products from developed countries (Duncan 1994, p. 56). The United Nations export unit value index for manufactures has typically been used as the denominator in this index. A problem with this denominator, pinpointed by Lipsey (1994) and referred to by Duncan (1994, p. 56), is that its growth can be over-estimated by up to 1 per cent per annum because of failure to account for quality improvements in manufactures exported to developing countries and a lower rate of price increase in manufactured exports to developing countries than to all countries. (The latter is a trivial proportion of the discrepancy.) Lipsey (1994, p. 1) conceded, however, that 'no conceivable estimate of bias in measures of manufactured goods prices would reverse the picture of declining relative primary product prices during the 1980s'. To limit the extent of these biases, export unit values are deflated by the world export unit value index compiled by IMF (2004), which covers all exported products and not just manufactures.

The contrast between the aggregate rates of change in TFP and export unit values is stark, with low rates of advance in TFP dwarfed by substantial rates of decline in export unit values. Even allowing for variations in the rates of decline in the two commodity groups in the different country groups, there is still a gulf between price declines and TFP growth rates.

The low rate of TFP growth in African countries is consistent with the frequently expressed concern about Africa's lack of success in achieving its own brand of Green Revolution technological progress. Aggregate figures, however, can hide more than they reveal. It is therefore necessary to examine rates of price and TFP change in individual countries. As indicated above, rates of change in TFP varied widely over the study period and a few countries did manage to achieve growth rates comparable to the price decline they experienced.

Thirty-three of the sampled countries produced at least one of the selected commodities and had a full set of data on export unit values for the period from 1970 to 2002. There were only two countries (Gabon and Mauritius) for which the productivity growth rate in agriculture equalled or exceeded the rate of decline in the producer price index of selected tropical commodities (or in which the rate of productivity decline was less than the rate of price decline) (see Table 4).

Table 4

Comparison of Rates of Change in TFP and Selected Commodity Prices

Countries with a rate of TFP growth greater than the rate of commodity price decline:		
Gabon	Mauritius	
Countries with a TFP growth rate at least one-half the rate of commodity price decline:		
Benin	Central African Republic	Nigeria
South Africa	Swaziland	Zambia
Countries with a TFP growth rate less than one-half the rate of commodity price decline:		
Côte d'Ivoire	Egypt	Kenya
Madagascar	Malawi	Mali
Rwanda	Tanzania	Uganda
Zimbabwe		
Countries with a negative rate of TFP change:		
Angola	Burkina Faso	Burundi
Cameroon	Chad	Congo, Democratic Republic
Ghana	Guinea	Liberia
Mozambique	Niger	Senegal
Sierra Leone	Sudan	Togo

Estimated trends in the single factoral terms of trade for producers of selected commodities

In this section, we provide estimates of the single factoral terms of trade for each country under study for the period from 1970 to 2002. As indicated above, it was not possible to get full sets of data for the 33 years for any country because of deficiencies in either producer price or consumer price data, especially for the period from 1999 to 2002. Nevertheless, we have managed to compile a data set that provides a reasonably comprehensive picture of trends in the single factoral terms of trade for 33 countries.

The single factoral terms of trade index is a measure of the returns to the factors engaged in the production of an agricultural commodity or group of commodities. The advantage of using the single factoral terms of trade index is that it incorporates changes in inputs and outputs, through changes in TFP, and changes in the net barter terms of trade. Estimates of productivity, output price and import price changes are needed to calculate the single factoral terms of trade in each country. An increase in this measure means that 'more [goods and services] can be purchased for a given amount of employment time of the factors of production' (Appleyard and Field 1998, p. 120).

We define the single factoral terms of trade using the definition and notation of Perkins, Radelet and Lindauer (2006, p. 672). Perkins et al. begin by defining the net barter terms of trade (T_n) in the usual manner as the ratio of an index of export prices (P_e) and an index of import prices (P_m). They then use the net barter terms of trade to define the single factoral terms of trade as $T_S = (P_e/P_m)Z_e$, where Z_e is total factor productivity. This equation simplifies to $T_S = T_nZ_e$.

> The single factoral terms of trade, T_S, measures factor income relative to factor inputs and import prices, or $T_S = (P_e/P_m)Z_e$, $= T_nZ_e$. Note that a rise in either the income or single factoral terms of trade implies an improvement in income or welfare relative to a country's previous situation.
>
> (Perkins et al. 2006, p. 672)

Perkins et al. observed that, although the index is intuitively appealing, it is rarely used because of a lack of data on productivity. We plan to overcome this deficiency by estimating trends in agricultural productivity for the selected tropical commodities in order to calculate their single factoral terms of trade. This measure enables us to determine whether the decline in the prices producers receive for their exports is less than the percentage rise in productivity in their production, in which case, given the definition by Perkins et al. above, returns to the factors engaged in their production would increase. If the price decline is greater, returns to the factors engaged in their production would fall.

The single factoral terms of trade index as defined above covers all activities in producing a product or group of products to the point of export. As our purpose lies in examining welfare implications for producers as a specific group, we define the single factoral terms of trade in terms of output prices (P_f) rather than export prices and farm-level productivity (Z_f). The appropriate index to use as the denominator is the consumer price index (P_c), which is the equivalent 'import price index' for participants in the agricultural economy as the import price index is for participants in the national economy. Our measure of the single factoral terms of trade is therefore defined as $T_S = (P_f/P_c)Z_f$.

Table 5 contains a list of the six countries in the sample for which the single factoral terms of trade in the selected tropical commodities improved over the study period. Five

of the countries in this group rely at least to a moderate extent on the production and export of the selected commodities: Central African Republic (coffee and cotton); Chad (cotton); Madagascar (cocoa, coffee, rice and sugar); Nigeria (cocoa, cotton, palm oil, palm kernel oil); and Togo (cotton, cocoa and coffee).

Table 5

Trends in the Single Factoral Terms of Trade

Countries with a positive trend in the single factoral terms of trade:		
Central African Republic	Chad	Madagascar
Nigeria	South Africa	Togo
Countries with no significant trend in the single factoral terms of trade:		
Gabon	Malawi	Mali
Mauritania	Mauritius	Mozambique
Swaziland		
Countries with a negative trend in the single factoral terms of trade:		
Botswana	Burkina Faso	Burundi
Cameroon	Congo, Democratic Republic	Côte d'Ivoire
Egypt	Gambia, The	Ghana
Guinea	Guinea-Bissau	Kenya
Liberia	Niger	Rwanda
Senegal	Sierra Leone	Sudan
Zambia	Zimbabwe	

Two of the countries in the group, Central African Republic (selected commodity exports of coffee and cotton) and Nigeria (the main selected commodity exports being cocoa, cotton and palm oil), are shown in Table 4 to have TFP growth rates approaching the rate of decline in export unit values. In Nigeria, domestic commodity prices increased at a much faster rate than inflation in the first half of the 1990s, a trend vividly illustrated in Figure 2. The situation changed from 1995 to 1998 when the consumer price index increased substantially while domestic commodity prices stagnated. The polynomial trend line shown in Figure 2 demonstrates this effect, tipping the index downwards towards the end of the study period.

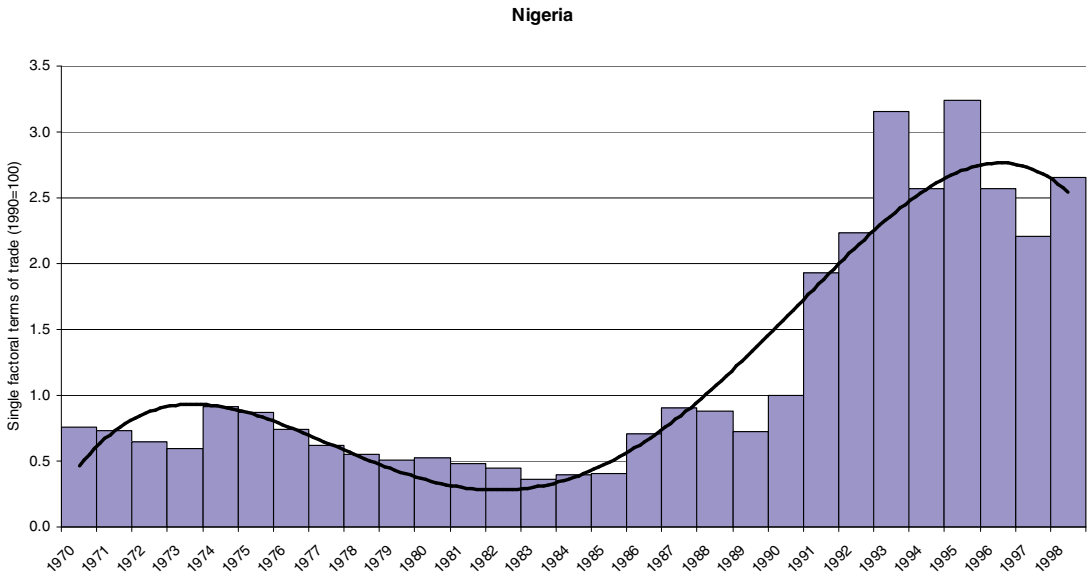

Figure 2 Trends in the single factoral terms of trade in Nigeria, 1970 to 2002.

A full data set was only available for a relatively short period for the Central African Republic (1980-1998) (see Figure 3) and Chad (1983-1998). During this period, the agricultural sector in Chad performed much better in terms of TFP growth than for the whole study period, and also experienced a slight increase in domestic prices of the selected commodities (whereas export unit values fell slightly). The Central African Republic had a relatively high rate of TFP growth over the whole study period, albeit from a very low base, and domestic prices increased relative to the consumer price index. The picture is probably less rosy for the full period because TFP declined by 10 per cent between 1997 and 2002.

Producers of the selected commodities in Madagascar achieved low to moderate rates of TFP growth, but also benefited from domestic prices that rose much more quickly than either the consumer price index or the index of export unit values at various stages of the 1990s. Domestic prices increased particularly fast in relation to the consumer price index in that decade. They increased by 83 per cent in 1994 while the consumer price indices increased by only 39 per cent.

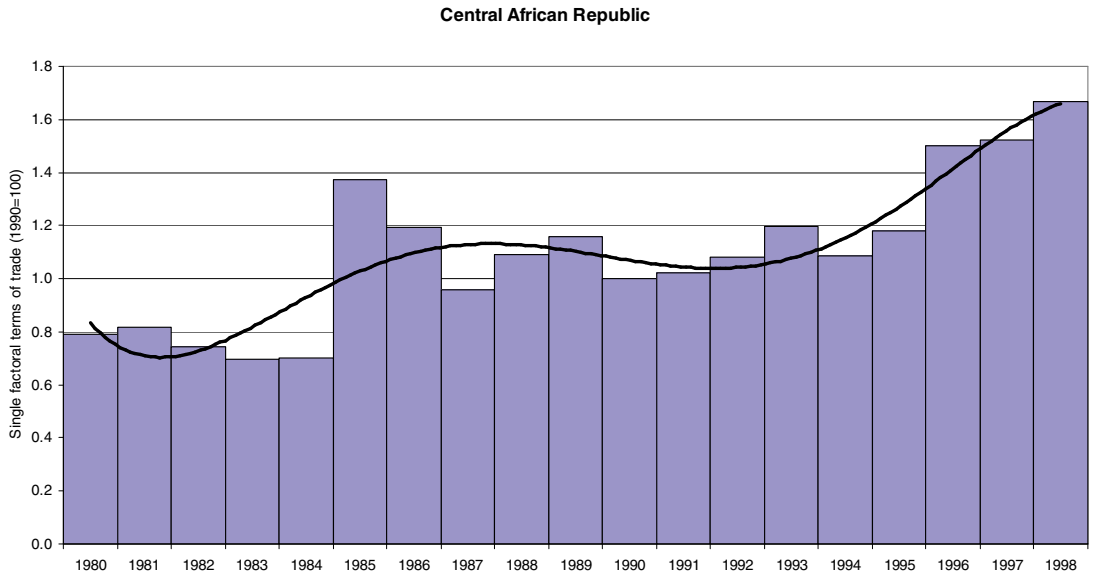

Figure 3 Trends in the single factoral terms of trade in the Central African Republic, 1970 to 2002.

Of the countries that experienced rates of TFP growth insignificantly different from the rate of change in the domestic prices of the selected commodities, five have significant exports of the selected commodities: Gabon (cocoa, coffee, palm oil); Malawi (coffee, cotton, sugar); Mali (cotton); Mauritius (sugar); and Mozambique (copra, coconut oil, cotton, sugar). A feature of most of these countries is an increase in the domestic commodity price index relative to the consumer price index in the early to mid-1990s followed by a decline later in the decade.

This set of circumstances was typically associated with devaluation of the local currency, usually as part of an economic reform program, that fed through to higher commodity export prices in local currency terms. However, these gains were soon eroded by a rise in the consumer price index in response to higher import prices in local currency terms. The decline in the ratio of commodity prices to the consumer price index was slighter in Mauritius, as indicated in Figure 4, but sugar producers in this and other ACP countries face an uncertain future in the wake of any loss of their privileged access to European sugar markets. The key role of commodity export prices is demonstrated in Figure 4, with a spectacular price-induced improvement occurring during the commodity boom of the mid-1970s followed by an equally spectacular decline in the late 1970s.

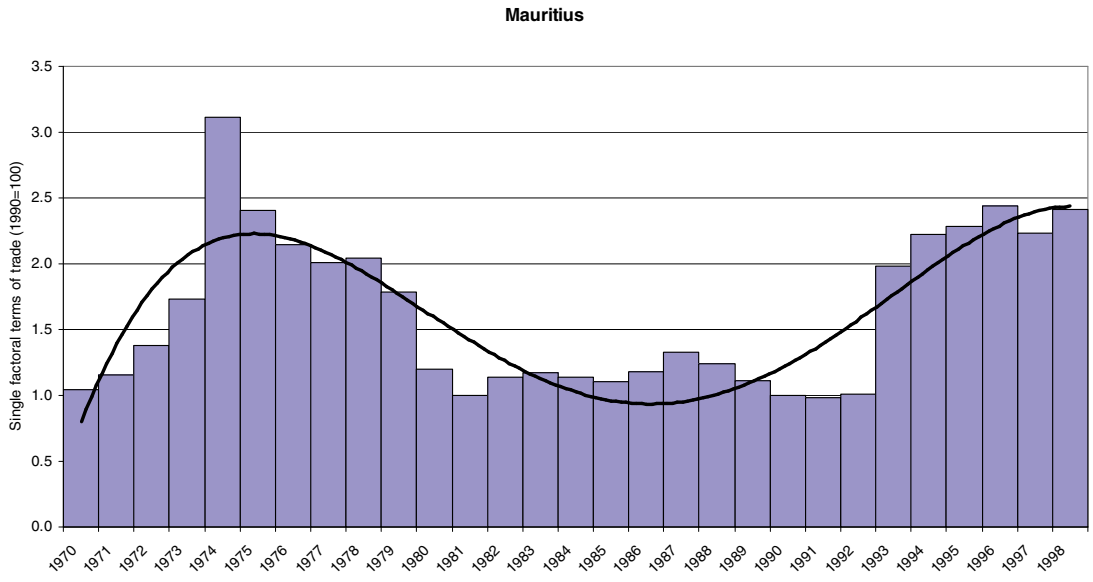

Figure 4 Trends in the single factoral terms of trade in Mauritius, 1970 to 2002.

In Mozambique, producer prices increased moderately over the period while the export unit value declined substantially. The result provides a contrast with that obtained when comparing TFP growth with change in unit export values.

Table 5 also contains a list of countries in the sample for which the single factoral terms of trade in selected tropical commodities deteriorated over the study period. Trends in the single factoral terms of trade in Kenya (a slight decline of 1.4 per cent per annum) are typical of many countries suffering deterioration (Figure 5).

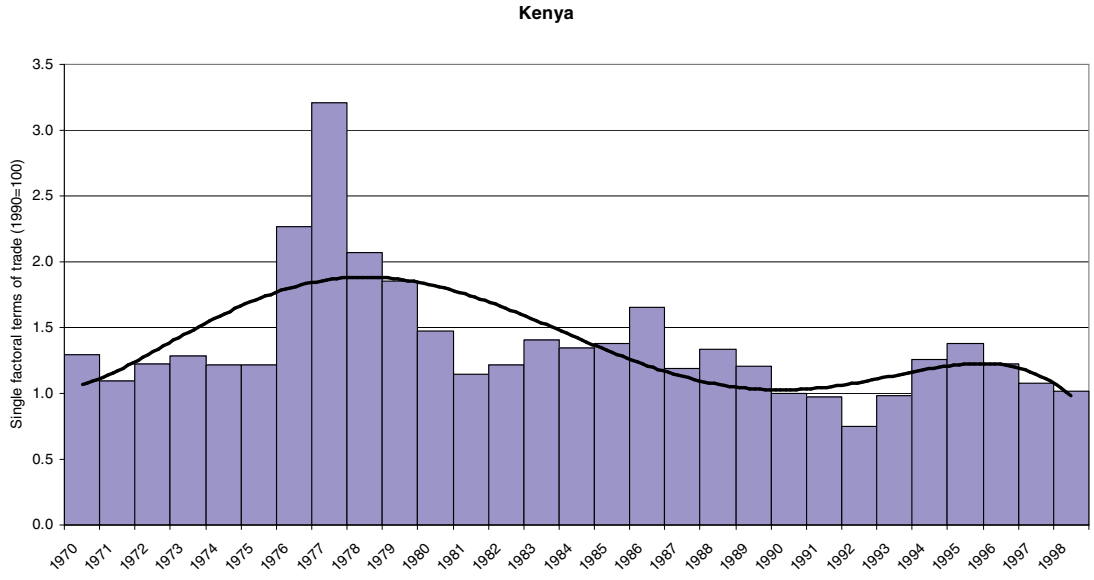

Figure 5 Trends in the single factoral terms of trade in Kenya, 1970 to 2002.

Moderate gains in TFP have been more than offset by a decline in the net barter terms of trade to producers of the selected commodities (principally coffee but also erratic exports of palm oil, sugar, lauric oils and cotton in the case of Kenya). A complicating factor here is that most of the gains in TFP have probably been in horticultural industries while other agricultural industries such as coffee have suffered declining productivity. Shikwati and Okonski (2005, p. 1) recently reported that: The decline in coffee earnings has contributed to low productivity in what was once Kenya's "black gold". Coffee berry diseases, leaf rust, leached soils, high input and marketing costs has made Kenyan farmers invest less in this sector.

A contrasting picture is painted for Sierra Leone where descent into civil war led to a massive decline in the single factoral terms of trade for producers of the major export crops of cocoa and coffee (Figure 6). The rapid decline in the index was caused by the interaction of a gradually declining TFP and rapidly declining net barter terms of trade facing producers during the 1990s.

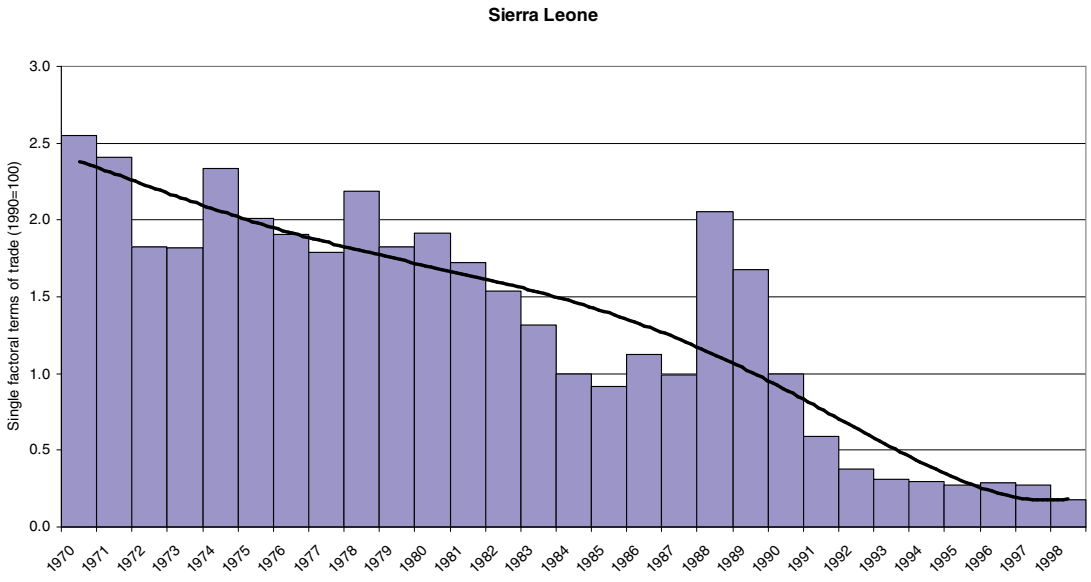

Figure 6 Trends in the single factoral terms of trade in Sierra Leone, 1970 to 2002.

Finally, the trend shown above in the single factoral terms of trade index of a sugar-exporting country, Mauritius, contrasts with a number of other sugar-exporting countries in which producers have faced a persistently declining single factoral terms of trade index despite a secure export market.

Strategic options for African agriculture

In the light of the empirical evidence assembled above, there are three broad strategic options available to those countries that have not been successful in realising productivity gains that counteract the decline in commodity prices. They need not be mutually exclusive:

- Political pressure for agricultural trade reform through the Doha Round of trade negotiations
- Economic diversification strategies to reduce the price effects in the deterioration of the single factoral terms of trade
- Strategies to improve total factor productivity.

The evidence marshalled in the analyses reported in this study confirms strong downward trends in commodity prices denominated in US dollars and deflated by the world export

unit value index over the period from 1970 to 2002. Where such trends have not been observed, notably in sugar prices, a changed world trading environment does not augur well for exporting countries (such as the major cane sugar-producing countries) being able to maintain prices in real terms in the future. Nor does the current impasse in the Doha Round of the Multilateral Trade Negotiations hold much hope of improved access to developed-country markets for commodity-exporting less developed countries. Given the limited scope for product differentiation, the capacity of governments of these countries to assist producers achieve better unit returns is restricted to helping producers shift into higher value-adding agricultural industries that supply less competitive world markets. For many producers, such shifts are outside their control without access to good rural infrastructure, institutional support and favourable edaphic conditions.

Economic diversification options include diversification through industrialisation based on import substitution, diversification into agricultural commodities with high income elasticities of demand and less intense competition, and domestic economic reform that generates greater factor mobility. As the commodities under study tend to have low income elasticities of demand, exporters face limited market development with global economic growth. Yet these commodities have offered little potential for product differentiation, meaning that the scope for producers to undertake value-adding activities has been limited. Consequently, commodity producers and exporters are restricted in their ability to move up-market to increase returns to their resources. Small least developed countries are likely to face particular difficulties in achieving diversification.

Productivity gains therefore remain the primary goal for agriculture in most African countries. A number of export-oriented agricultural sectors in countries with temperate climates have also experienced declining real prices but producers have managed to counter their effects with annual productivity gains above 2 per cent. One country included in this study falls into this category: South Africa. Unfortunately, our results show that the experience of the agricultural sectors in this country has been atypical of that in agricultural sectors in tropical countries as a whole where no significant gains in TFP were made in the study period. Furthermore, TFP changes in many of the commodity industries of interest have been worse than the average changes across all agricultural and livestock production. This trend is evident for sugar and tree crops other

than coffee. On the other hand, there is some evidence that cotton producers have been able to achieve productivity change above the average for the agricultural sector as a whole.

This is not to say that no countries made substantial productivity gains over the study period. Trends were far from uniform among the countries that were included in the analysis. This result suggests that countries that have lagged behind (around one-third of countries experienced productivity declines) should be able to 'catch up' to those countries that have made productivity gains. Unfortunately, there is no evidence from our results of convergence in productivity and some evidence of divergence. This evidence accords with other studies where tropical countries were found to be falling further behind non-tropical countries in their agricultural productivity levels. Furthermore, some of the countries with relatively high rates of productivity growth over the study period were themselves beginning from low productivity levels and catching up to other tropical countries over the period. Few countries managed to achieve rates of productivity gain that matched the rate of change in real prices and some that did only managed to do so because they were major exporters of sugar to a secure European market with guaranteed prices that are likely to be eroded in the future.

The case for governments encouraging TFP growth in commodity production is strong. But there remains a lingering concern among some policy makers that it could result in immiserising growth when it leads to increases in export quantities that depress export prices. This concern should be dispelled on two counts. First, the empirical evidence assembled in this study indicates that export quantities of agricultural commodities have grown strongly over the study period, and have been associated with a decline in export prices in real terms. Yet the contribution of TFP to this growth in export quantities has been minimal and all but a handful of countries are price takers in the world commodity markets. Furthermore, TFP growth within a country need not be output-increasing.

The second case for not avoiding TFP growth in commodity production because of concern about its potential immiserising effects is that the root cause of any such effects would not be the growth in TFP *per se* but a lack of mobility of resources in the economy, especially labour in rural areas. Friction in the flow of resources into those

enterprises in which they will achieve their highest return damages the prospects of economic diversification and can result in an over-reliance on traditional commodity production.

A persuasive argument against immiserising growth along these lines has been in place for a long time, as indicated by Meier (1968, pp. 51-52) whose message is clear (see also IMF 2004). Governments need to focus on removing impediments to resource movements in the domestic economy as a priority rather than worrying about the possible immiserising effects of TFP growth in agricultural commodity industries. It is evident that outputs continue to expand with or without TFP growth, and any increases that do occur are less likely to be immiserising if they originate from increases in TFP in an economy in which resources move freely between enterprises.

The major conclusion of this study, then, is that the recent track record of agricultural sectors in tropical countries relying on traditional commodity exports has not been encouraging. Unless these sectors have the capacity to shift easily into less traditional agricultural industries, facing less global competition and with potential for value-adding, much greater success is needed in the area of productivity gain than has been so far achieved if producers are going to be able to improve returns to the resources they put into farming. The first priority for governments is to remove impediments to resource movements in the domestic economy. Commodity outputs continue to expand with or without TFP growth, and any increases that do occur are less likely to be immiserising if they originate from increases in TFP in an economy in which resources move freely between enterprises.

The areas in need of government intervention to complement this approach have long been clearly delineated by development analysts: greater human capital investment in rural areas; better rural infrastructure; better agricultural research and development; and an improved general economic climate for agricultural production. Most governments have so far failed to rise to the challenge to make these improvements. Unless they do, the prognosis for African agriculture, and particularly for producers of traditional export commodities, is gloomy.

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