Commodity prices, stabilization, and growth in Africa

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ABSTRACT

Many African countries are dependent on the exports of a small number of primary commodities whose prices are extremely volatile. It has often been argued that commodity price fluctuations are poorly dealt with by African policy makers, that effective stabilization is rarely achieved, and that commodity price booms generate irreversible and often unproductive booms in government expenditures. This paper considers the nature of commodity prices, and whether it is possible to use an understanding of their behavior to help design better policies. Neither time-series models nor more elaborate structural models are very helpful for the four commodities examined, and the results suggest that there is little scope for countries to stabilize their domestic consumption levels through compensation funds or through borrowing and lending on international capital markets. Political and fiscal arrangements are also examined as a possible source of poor policy making. The paper reviews the economics and political economy literatures on pricing and taxation in Africa, and presents econometric evidence on the effects of commodity prices on GDP for 35 African countries taken together. Somewhat surprisingly in view of the literature, the evidence shows generally positive effects of commodity price booms; they generate a good deal of economic growth, and do so by stimulating productive investment.

1. Introduction

The exports of many African countries are concentrated in a relatively small number of primary commodities, commodities whose world prices are extremely volatile, and which, in many cases, are now at historically low levels. Fluctuations in commodity prices induce fluctuations in real national incomes and pose problems for macroeconomic management. It is argued, for example by Balassa (1988), Gelb (1988) and Bevan, Collier and Gunning (1989, 1990), that in at least some countries, these problems are badly handled. Booms in government revenue can lead to hastily-executed investment programs that involve low-return and irreversible projects, or to good but over-ambitious projects that are abandoned when revenue falls. In extreme cases, the expenditures so induced have exceeded the windfall gain, leading to an accumulation of debt, and to subsequent cutbacks in more easily controlled but more useful expenditures, such as health or education. Far from stabilizing revenue fluctuations, government responses may actually exacerbate them, even to the extent that windfall price increases hurt sellers as well as buyers. Indeed, Gelb (1988, p. 143) concludes that 'the decade of the oil windfalls has involved the global economy in a massive, negative-sum gain.' This paper looks at the African experience of dealing with commodity price variability, and discusses the nature of the policy problem, whether it is a result of the way in which commodity prices fluctuate, or whether the problems can be traced to internal political and fiscal arrangements. In an attempt to establish the facts, and to cast some light on some of the mechanisms, I also look at pan-African econometric evidence on the effects of commodity price fluctuations on output and its components.

Table 1 presents export unit-values for a number of African countries together with estimates of two measures of variability. Nigeria and Ghana, two notably unsuccessful economies, have experienced large fluctuations in export prices according to both the measures shown. Zaire and Zambia, both largely dependent on copper, have also experienced high variability in the later period, as has Botswana (diamonds), which by contrast is typically regarded as an example of a successfully managed economy. The experience of Tanzania, which has experienced low variability, demonstrates only that the absence of commodity price fluctuations is no guarantee of success.

Much of the variation in unit values can be explained by movements in the world prices of the underlying commodities. Figures 1 through 4 show historical data on the nominal (US dollar) prices for four commodities that are important in Africa, cocoa, coffee, copper, and cotton. Two are tree-crops, one an annual, and one a metal, while cocoa and coffee are important for the two countries, Ghana and Kenya, on whose experience I will draw below. On each graph is super-

Table 1

Growth and variability of unit values of exports and main commodity exports
Selected African countries

	growth rates			coefficient of variation		
	75–80	80–85	86–			main commodity exports
Botswana	11.8	–7.4	22.1	27.5	10.5	diamonds, meat
Cameroon	7.4	–4.5	9.3	17.1	16.4	oil, cocoa, coffee, cotton, logs, palm
Côte d'Ivoire	15.2	–3.4	–4.4	13.0	16.2	cocoa, coffee, cotton, logs, palm, sugar
Ghana	4.4	9.8	4.6	49.1	21.4	cocoa, logs, manganese
Kenya	13.3	–5.1	4.4	10.2	10.6	coffee, sisal, tea
Madagascar	8.5	0.2	–1.6	9.3	16.2	coffee, sugar
Mozambique	.	–0.6	3.6	9.0	.	sugar
Nigeria	9.8	1.6	–8.8	32.7	28.1	oil, cocoa, palm
Rwanda	12.1	–0.3	–3.4	12.3	14.8	coffee, tea
Senegal	2.8	–4.2	9.4	16.4	16.6	groundnuts, phosphates
Sudan	3.9	1.6	2.2	14.0	16.5	cotton, groundnuts
Tanzania	8.8	–3.2	5.5	6.5	10.8	coffee, cotton, sisal, sugar, tea
Zaire	17.6	–12.2	0.8	32.7	9.1	coffee, copper, oil, logs
Zambia	14.2	–6.9	5.0	19.5	10.3	copper
Zimbabwe	13.6	–2.8	–3.3	18.5	3.6	cotton, meat, sugar, tea, tobacco

Notes: The first four columns are taken from Table 5–13 of *African Economic Indicators* (*AEI*) (World Bank, 1992). The unit values are calculated by dividing the US dollar value of exports by the value of exports in constant 1980 US dollars. The first column is taken directly from the Table. The second and third columns (the latter is growth to the latest available date, usually 1990) are calculated from the raw data in the table, since the growth rates reported in *AEI* are not consistent with the raw data there reported. The fourth column, the coefficient of variation, is the coefficient of variation of the unit values from 1980 to latest available date as reported in Table 5–13 of *AEI*. Column 5, the coefficient of variation is the coefficient of variation from 1960–85 of the *real* commodity price series described in Section 3 of the paper. The second estimate differs from the first in being (a) real, (b) calculated over a different time period, (c) probably more reliable, but (d) covering only a selection of major exports.

imposed the U.S. consumer price index; this gives some idea of long-run changes in real purchasing power, both internationally, and if purchasing power parity holds in the long-run, domestically. These graphs have features that are characteristic of many primary commodity prices relevant to LDCs. There are extended periods where the price is relatively stable, punctuated by shorter periods of extreme volatility. During such periods, prices typically flare *upwards*, and flares typically last for several years. With the possible exception of cotton in August 1986, there are no *downward* spikes from periods of quiescence. Volatility has typically been greater since 1970, although some of the increase is simply the mechanical effect of denominating the price in a single currency in an age of fluctuating exchange rates. Although nominal prices exhibit upward trends, these are typically insufficient even to match inflation, so that real prices have been constant or falling. The consumer price index has increased about five-

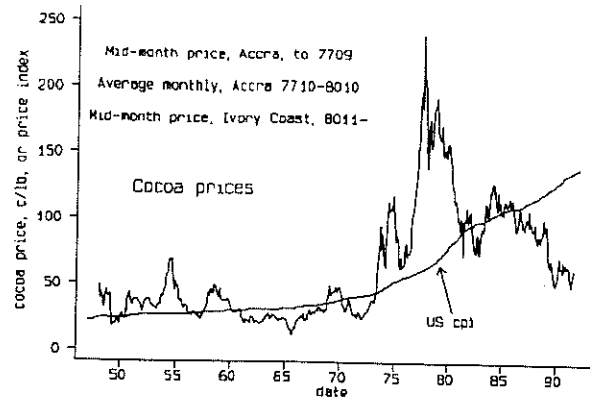

Figure 1: Cocoa prices, Accra and Ivory Coast (Sources: *International Financial Statistics* and Commodity Research Bureau)

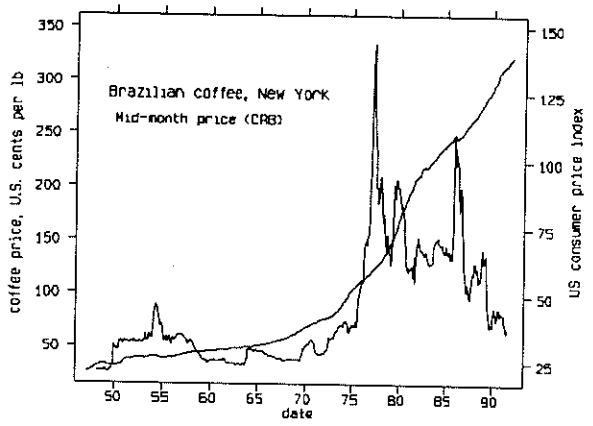

Figure 2: Brazilian coffee prices, mid-month. (Source, Commodity Research Bureau)

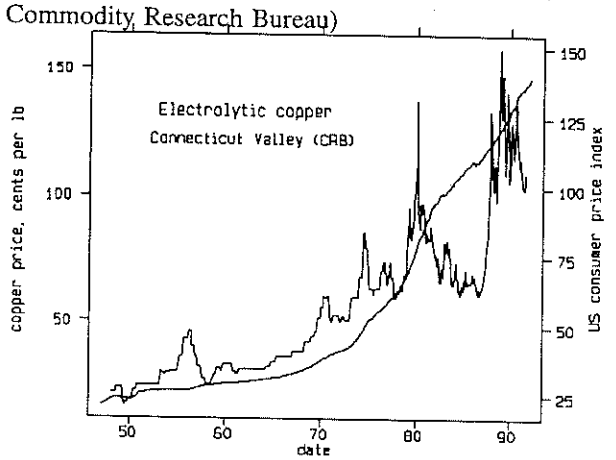

Figure 3: Copper prices, mid-month. (Source: Commodity Research Bureau)

fold since the mid-1950s. By contrast a pound of cocoa or coffee fetches the same in nominal dollars now as it did in 1955, while copper and cotton prices have approximately tripled. The presence of a long-term downward trend in the real prices of primary commodities in general— the Prebisch-Singer hypothesis—has been much investigated and remains controversial; variability is large relative to trend and the results can be sensitive to the period investigated. Current prices are low by any standards and recent investigations tend to find downward trends, Cuddington and Urzúa (1987, 1989), Grilli and Yang (1988), Ardeni and Wright (1992).

Although I shall have something further to say about trends, this paper focuses on variability, and on the associated stabilization problems. Section 1 is concerned with the design of stabilization policy and with what a government needs to know about commodity prices, on the supposition that stabilization and growth are its goals. If reliable forecasts of future prices are available, booms and slumps can be treated for what they are, and policy set accordingly. Less precise information is also useful, and an understanding of the general nature of specific commodity prices, while not delivering precise dates on which booms will start or end, can predict the average length of booms and slumps, and can be used to calculate the costs and benefits of the various possible stabilization policies.

Much of the criticism of African policy

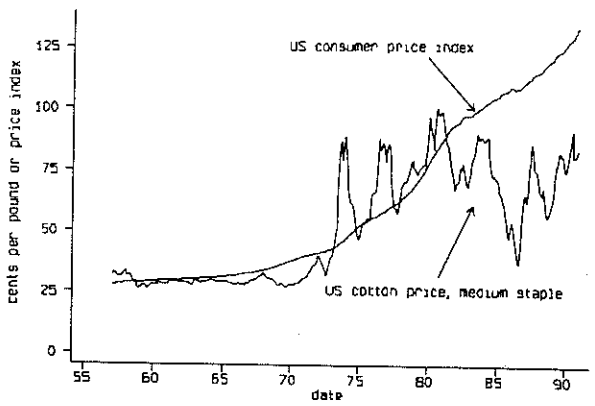

Figure 4: US Cotton Prices, monthly. (Source: *International Financial Statistics*)

has been made with the benefit of hindsight; it is a good deal easier to forecast prices once the future is safely past. In reality there is a much uncertainty, and commodity prices are very hard to forecast. There exist structural models of commodity prices that incorporate a great deal of specific and detailed information about supply and demand, but which have had a very mixed track record. While they successfully predicted the ends of the coffee and cocoa booms of the mid-1970s, they have not otherwise provided forecasts that would have aided stabilization. Non-structural time-series methods do even worse; indeed, as we shall see, the behavior of commodity prices could hardly be better designed to frustrate standard methods whose routine application leads to recommendations that are clearly absurd. Although the econometric analysis is not a success, its very failure tells us a good deal about which kinds of policies are sensible and which are not. I argue that permanent income based stabilization rules, such as international compensation or sterilization schemes, are neither desirable nor likely to be feasible.

The difficulty of forecasting commodity prices is not the only constraint on policy in Africa, and Section 2 looks at the economics and political economy of taxation and government expenditure in the context of African countries exporting primary commodities. I review arguments that African fiscal and political arrangements compromise the ability to react to external shocks. While this section is largely a review, it suggests a number of hypotheses that can be examined on the data. Some preliminary results based on pooled cross-country and time series experience are presented in Section 3. Although a number of the findings are consistent with the typically negative tone in much of the literature, a number are a good deal more positive. At least on average, over all African countries taken together, commodity booms appear to generate the sort of behavior that would be expected, and that seems appropriate; a great deal is invested, output is raised, and there is no sign of induced balance of trade problems. Fluctuations in mineral prices, including oil, are estimated to have much less effect on African economies than fluctuations in the prices of other, largely agricultural commodities. Although there are a number of more or less serious problems with the data, I have not been able to find any marked difference in stabilization success between countries that matches differences in the way com-

modity exports are taxed. While these results are far from giving African policy makers a clean bill of health, they should lead to caution in assuming that the events or analysis for one country or group of countries are automatically generalizable to the African experience as a whole.

2. Stabilization and commodity prices

2.1 Understanding and predicting prices

An appropriate response to commodity price shocks requires that some view be taken about the implications of those shocks for the future. A choice between stabilization and adjustment requires that shocks be decomposed into permanent and transitory components, something that cannot be done without a model of the process. In some cases, the reason for a price change is evident, and that reason can tell us how long the change is likely to persist. A frost that destroys a single crop has different consequences from a disease that destroys an orchard of trees. More generally, there is a great deal of information about specific commodity markets, information which can be incorporated into structural econometric models, most notably by the World Bank, who issue regular forecasts for more than 30 commodities. An alternative approach is to apply the methods of time-series analysis, and to use the history of prices to develop a model of their behavior. I start with this second approach, following through a more or less standard time-series analysis for the four commodity prices illustrated in the figures. For more thoroughgoing analyses in the same spirit, see Gersovitz and Paxson (1990) or Cuddington and Urzúa (1987, 1989).

Time-series analysis

Suppose, for example, that we wish to forecast the cocoa price series shown in Figure 1. If we use the average monthly data, combining the data from *International Financial Statistics* and the Commodity Research Bureau, there are 525 observations from January 1948 until September 1991, a sample that would seem to be large enough to obtain a precise characterization of the process. While there are a number of ways to proceed, one obvious one is to deflate by a price index, in this case the US consumer price index, and to take logs. The resulting series might then be modelled as a linear autoregressive process, with the large number of lags permitted by the long time period. Such a regression gives the following results, with absolute t-values in brackets

$$\ln p_t = \underset{(0.1)}{-0.00039} + \underset{(24.1)}{1.167}\ln p_{t-1} - \underset{(1.7)}{0.127}\ln p_{t-2} + \ldots \qquad (1)$$

Table 2

Time-series estimates from commodity prices

	cocoa	coffee	copper	cotton
constant	–0.0021	–0.0010	–0.0002	–0.0008
	(0.6)	(0.4)	(0.1)	(0.4)
$d\ln p_{t-1}$	0.2148	0.3599	0.3666	0.6350
	(5.0)	(8.8)	(8.5)	(12.9)
$d\ln p_{t-2}$	.	.	–0.1594	–0.1508
			(3.7)	(3.1)
Multiplier when following lags are included::				
1	1.14	1.56	1.47	2.22
1,2	1.32	1.59	1.27	1.92
1,2,3	1.32	1.61	1.22	2.13
1,2,12–14	1.28	1.32	1.12	1.25
1.2.12–14, 24–26	1.16	1.27	1.01	1.04
1–48	0.88	1.32	0.77	1.22
Cuddington and Urzua's multipliers:				
low-order model	0.64	0.38	1.00	0.56
high-order model if preferred	.	0.26	.	0.15
Deaton and Laroque non-parametric multiplier				
	0.24	0.11	0.22	0.13

where there are a further 46 lags, making four years in total, that are not shown, but that typically have small coefficients, the smallest being –0.06 and the largest 0.11, and standard errors that are around 0.07. The equation has an R^2 statistic of 0.975. The sum of the coefficients on the first two lags in (1) is close to unity, which suggests that the log of the cocoa price has a unit root, so that, following standard time-series practice, I regress the rate of growth on prices on lagged rates of growth. The result is as expected given (1),

$$\Delta \ln p_t = \underset{(0.5)}{-0.00207} + \underset{(3.5)}{0.1702}\,\Delta \ln p_{t-1} + \ldots \qquad (2)$$

where, once again, I have included but not shown the succeeding 47 lagged differences. This regression has an R^2 of 0.0951 (for the rate of growth of prices) and if we apply the standard Dickey–Fuller test, it is impossible to reject the hypothesis of the unit root. The additional lags

do not add significantly to the explanatory power of the regression, and if they are excluded, the coefficient on the lagged difference rises to 0.2148 and the R^2 falls to 0.0464. Equation (2), or its counterpart with higher lags excluded, is a simple, parsimonious model of the data, and although I could go on to apply more sophisticated techniques, it represents the typical result that is obtained when standard time-series analysis is applied to commodity price data.

Corresponding analysis for the prices of cotton, coffee, and copper gives the results shown in the top panel of Table 2. For all four commodities, it is impossible to reject the hypothesis that there is a unit root, and so, following standard practice, I present the regressions of first-differences on their lags. For coffee, like cocoa, a first-order specification fits the data well, and higher lags are neither individually nor jointly significant. For cotton and copper, the data prefer second-order specifications, as shown in the table.

Consider now the stabilization problem viewed in the light of these results. I illustrate using the first-order model for the (log) price change, as for cocoa and coffee, which I write as

$$\Delta \ln p_t - \mu = \beta_1 (\Delta \ln p_{t-1} - \mu) + u_t \tag{3}$$

where μ is the mean rate of change of the real price. From equation (3), expectations satisfy

$$E_t(\Delta \ln p_{t+k} - \mu) = \beta_1^k (\Delta \ln p_t - \mu) \tag{4}$$

for any date k periods ahead. The change in expectations from $t-1$ to t is therefore

$$(E_t - E_{t-1})\Delta \ln p_{t+k} = \beta_1^k (E_t - E_{t-1})\Delta \ln p_t = \beta_1^k u_t. \tag{5}$$

The change in expectations of the log price in $t+k$ is therefore

$$(E_t - E_{t-1})\ln p_{t+k} = \sum_{j=0}^{k} (E_t - E_{t-1})\Delta \ln p_{t+k} = \sum_{j=0}^{k} \beta_1^k u_t = u_t \frac{1-\beta_1^{k+1}}{1-\beta_1}. \tag{6}$$

Since u_t is the current 'news' in the price, this formula says that the ultimate effect of the news on prices far enough into the future is obtained by multiplying it by a factor $(1-\beta_1)^{-1}$. A parallel calculation for the second-order autoregressive model gives the (obvious enough) result that the multiplier should be $(1-\beta_1-\beta_2)^{-1}$. For cocoa and coffee, the long-run multipliers are 1.28 and 1.56 respectively. For copper and cotton, the corresponding long-run multipliers are 1.27 and 1.92 respectively. These numbers tell us that unanticipated changes in prices are only a signal of more

to come, and that the long-run effects of an unexpected price increase will actually be *larger* than the immediate effects, in the case of cotton, almost twice as large.

If these numbers are accepted, and if we ignore complications to do with stochastic output and possible interrelations between output and price, then an unanticipated commodity boom should not lead to saving, but to borrowing, since consumption should adjust to the newly anticipated long-term levels, which are even larger than the already inflated current price. Although some African countries seem to have followed such a strategy, elementary economics and common sense rebel against the belief that such behavior is optimal. We know that the prices of agricultural crops, like cocoa, coffee, and cotton, are affected by the weather and other natural sources of fluctuations. We also know that these sources of variation are essentially transitory. Even for tree-crops, where frosts, fires, or diseases may damage enough trees to affect harvests for several years to come, it is hard to imagine that weather-induced price changes have long-run consequences for price. That is not to say that *some* component of price innovations, such as that due to the development of synthetic substitutes, or from shocks that originate on the demand side, will not have permanent effects on price, and that even weather-induced price increases may induce new suppliers to enter the market, with permanent effects on market structure and on price. But if we accept the generally held view that most of the variance in commodity prices comes from the supply side, only a small fraction of any given price innovation can possibly be permanent, so that long-run estimates of multipliers of unity are clearly incorrect.

What has gone wrong, and why does the econometric analysis, which is standard enough, lead to the wrong answer? Part (although only a part) of the problem lies in the bias that is built into time-series methodology in favor of parsimonious models, especially when parsimony is interpreted as favoring low-order lags. The addition of higher lags to the models in Table 2 gives coefficients that are neither individually nor jointly statistically significant, but their presence affects the conclusions about the long-run multipliers. The second panel illustrates. The first three rows show the multipliers when one, two, and three lags are included, the fourth when lags one, two, twelve, thirteen, and fourteen are included (to capture effects from the previous year), the fifth with the further addition of the same lags from two years before, and the last when all lags up to 48 are included. Although the patterns are not uniform, it is clear that including more lags tends to decrease the size of the eventual multiplier. In the cases of cocoa and copper with all lags included, the multipliers are less than unity, so that at least some of the original effects of the shocks are expected to wear off. Even so, the lowest number is still 0.77 for copper, which means that three-quarters of all price innovations can be expected to persist indefinitely, something that is quite implausible given the long-run behavior of copper prices in Figure 1.

Both the graphical evidence and the fact that the multipliers decrease when more lags are included suggest that the problem may come from a failure of the econometric analysis to pay sufficient attention to low-frequency movements in the data. It might therefore be argued that yearly data would give better results. In fact, there exist annual data for these (and some other) commodities back to 1900, and these give us a longer span to work with, even though there can be legitimate doubts about whether the behavior of commodity prices during and immediately after the first world war (for example) is of much relevance for policy making in LDCs today. These data have been analyzed in a number of papers; that by Cuddington and Urzúa (1987) provides an excellent and careful time-series analysis using more sophisticated methods than the simple results above. Cuddington and Urzúa are also led to specifications with unit roots, but fit the differences using moving average rather than autoregressive models. They estimate 'low-order' models for a wide-range of commodities, and higher-order specifications for a smaller number of cases where the low-order models are not deemed to be satisfactory. The resulting multipliers are given in the third panel of Table 2; note that these are multipliers for an *annual* innovation in log price, as opposed to a *monthly* innovation in the second panel, so that the numbers are not strictly comparable.

Apart from copper, where Cuddington and Urzúa estimate a random walk, so that the long-run multiplier is unity, the multipliers are now all less than one, and when the higher-order models are preferred, as they are for coffee and cotton, the estimates are lower than for the low-order models, as was the case for the monthly data. The final panel of the Table shows estimates from Deaton and Laroque (1992) who use the same data. These are non-parametric estimates of the multiplier—see Cochrane (1988) for the basic theory—and can be loosely thought of as what would be estimated from a regression containing an infinite number of lags. These numbers are lower still, and essentially confirm the visual impression from the graphs that innovations have no long-run consequences; eventually, prices return to where they have always been. Gersovitz and Paxson (1990, Appendix A) also calculate persistence measures, in their case for annual data from 1950–87. Although the results are less dramatic than on the longer-run data, once again the persistence measures are typically lower than would be suggested by low order ARMA models.

Clearly, time-series analysis does a very poor job of providing models of commodity prices that are useful for stabilization policy. Policy advice based on standard low-order models is absurd, leading not merely to too little stabilization, but to destabilization. The analysis suggests that current fluctuations will last for ever, so that anyone who believed the results would be continuously surprised by the tendency of prices to revert to long-run levels. The failure of time-series analysis to capture long-run dynamics is not specific to commodity prices, but occurs

whenever series are persistent in the short-run, but slowly revert to either a fixed level or to a deterministic trend. For example, Cochrane (1991), commenting on Campbell and Perron's (1991) survey of unit roots in macroeconomics, writes:

> so long as you do not get too creative with breaking trends and structural shifts, any tests tell you that interest rates have unit roots, and lag selection procedures indicate a near random walk structure. That model does quite well for one-step-ahead forecasting. Yet, interest rates are almost certainly stationary in levels.

Structural models of commodity prices

Time-series analysis makes no use of a great deal of information about commodity markets that would seem to be relevant for predicting the future. There have been changes in the techniques of production for many commodities, and the development of synthetic and other substitutes has led to changes on the demand side. New countries have become producers, and new markets have been developed for consumption. In the shorter-term, the vintages of tree-crop orchards are observable, and the information can be used to project production several years into the future; for example, cocoa trees do not produce any yield until they are four years old. All this information can be incorporated into forecasts if detailed structural models are constructed. Such work is carried out by a number of market consultants and most notably by the World Bank, whose forecasts are widely noted, both by market analysts and by country governments.

The Bank has little choice but to construct such models, since it requires not only unconditional forecasts—for example for project evaluation—but also needs to be able to assess the effects on price of market developments and of deliberate policies, for example of the Bank encouraging several countries to expand their cocoa production simultaneously. These models tend to follow a common structure, with detailed modelling of supply and demand, typically by major producers and consumers, or at least by region, together with some treatment of stockholding, and price determined so as to clear markets. For example, in Akiyama and Duncan's (1982) analysis of the world coffee market, there are separate demand equations for the US, the EEC, the Middle East, Scandinavia, Southern Europe, the centrally planned economies, Japan, other industrialized countries, Brazil, and the rest of the world, while there are supply equations for Brazil (with separate equations for tree stocks and production), for Colombia, for El Salvador, for Guatemala, for Indonesia, for Ivory Coast, and for the rest of the world. The model is completed by equations for the demand for inventories by consumers, by the US, and by producers.

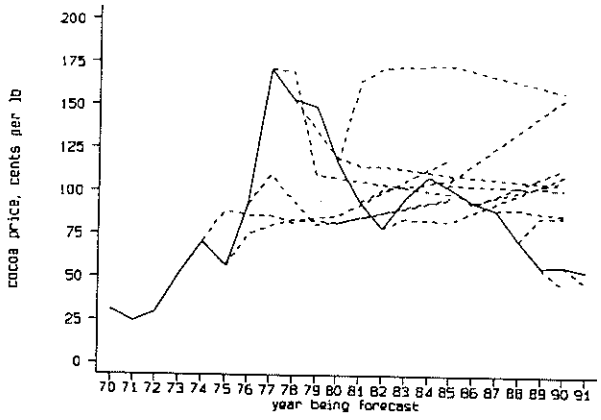

Figure 5: Actual and World Bank forecasts of cocoa prices

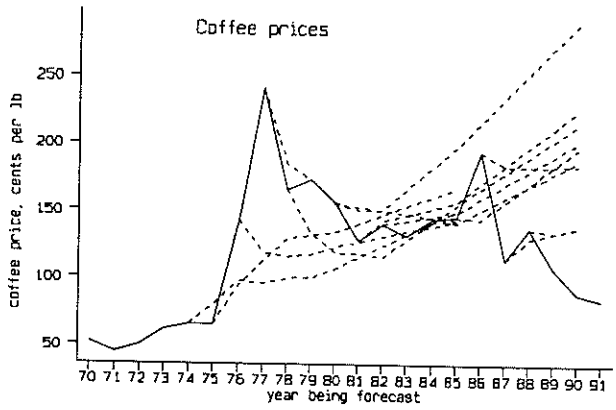

Figure 6: Actual and World Bank forecasts of coffee prices

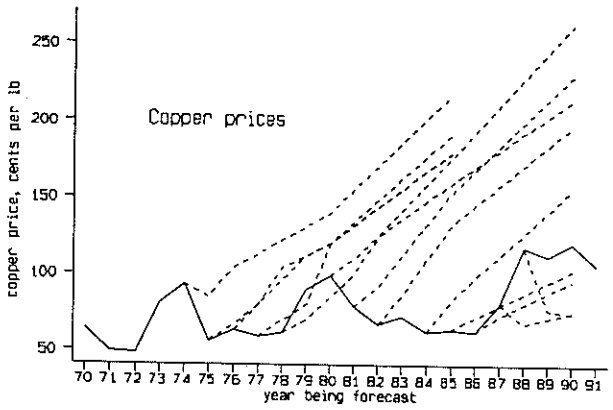

Figure 7: Actual and World Bank forecasts of copper prices

Past forecasts of price trends have been most kindly supplied to me by Ron Duncan of the International Trade Division of the World Bank, and some of these are shown for my four illustrative commodities in Figures 5 through 8. In each case, the solid line is the *annual average* actual nominal price; the units are the same as in Figures 1 through 4, but the averaging makes the graphs less variable. The dotted lines show the Bank's various nominal price forecasts, and in each case are shown as beginning from the actual price in the year in which the forecast was made. This is somewhat misleading, since the forecasts are often made early in the year (the 1980 forecast was issued in January) so that the forecasters do not have the benefit of the actual price in the year in which the forecast is made.

It is not part of my purpose here to assess either the usefulness of structural forecasts in general, nor of the World Bank's forecasts in particular. Rather I am concerned with the consequences for policy of African policy makers using the estimates for stabilization purposes, and whether these forecasts, which are made by a thoroughly professional and well-informed group, are more useful for stabilization purposes than the results from the time-series models.

It certainly makes a difference. For cocoa, the World Bank models did not predict the boom from 1976–82, even when it was under way, though once the peak was reached, the

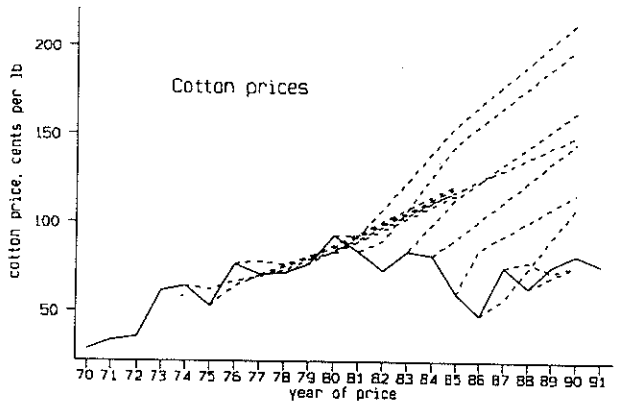

Figure 8: Actual and World Bank forecasts of cotton prices

forecasts of its demise over the next 5 to 8 years were accurate. Even before the boom, in 1974 and 1975, the ten year ahead forecasts were correct. Subsequent to the boom, in 1980 and 1981, the Bank was forecasting another resurgence in price, a resurgence that has yet to materialize. If stabilization policy, say in Ghana or Ivory Coast, had been based on these predictions, it would have been conservative during the 1976–80 boom, which is certainly more sensible than what actually happened, or what would have happened had spending been increased by more than the price increases, as would be implied by blindly following the time-series results. Subsequent experience with the forecasts would not have been so favorable; if the numbers had been treated seriously, they could have prolonged the attempts to stabilize the apparently temporary fall in prices and postponed the adjustment that was eventually necessary in any case. Even so, it is hard to imagine almost any combination of circumstances that would have allowed Ghana or Ivory Coast to borrow enough to sustain consumption at the levels of the early 1980s. When prices are declining, the time-series models will tend to overstate the consequences for the future, and thus lead to spending cuts that are too conservative and to over-adjustment downward. In the event, both Ghana and Ivory Coast were forced into adjustment programs, so that, given the reality of international capital markets, it hardly matters whether the recent downswing was seen as permanent or cyclical. Either way, consumption has to be adjusted down.

The story for coffee is similar to that for cocoa, with the boom only slowly recognized, but its demise correctly predicted. Once again however, there was a marked degree of false optimism after the boom, so that, until 1987, the Bank was forecasting prices for 1990 that were several times larger than the reality. The putative effects on stabilization policy are therefore much the same as for cocoa. Stabilization attempts would have been encouraged, and necessary adjustment postponed. While time-series forecasts tend to respond too much to current surprises, urging too much adjustment, the Bank's forecasts tended to be unresponsive to news, with previous predictions retained as long as possible, with relatively little shading in response to past failures.

The forecasts for cotton and for copper are consistently worse than those for cocoa and coffee, and it is worth noting that the Bank did not have structural models for copper prior to

1985 nor for cotton prior to 1988. Forecasts were largely driven by the Bank's predictions for inflation, exchange rates, and GDP levels, which were typically over-optimistic, and which contained none of the mean reversion that appears in at least some of the models based more explicitly on supply and demand. While cotton prices continued along a constant trend from 1970–80, the forecasts went with them, but the subsequent decline was not captured, and the predictions of a forthcoming (but never realized) boom have only slowly been shaded downwards. Until the mid-1980s, future copper prices were almost always overestimated, and by amounts that seem very large. Copper producing countries would have designed very poor policies had they acted on the basis of these predictions, quite apart from the misallocations that would have followed from the evaluation of any project whose rate of return depended on the future price of copper. Indeed, several authors have commented on the effects of the over-optimistic copper price forecasts on policy in Zambia, Powell (1991), Aron (1992).

Forecasts and stabilization policy: an evaluation

It would be a useful exercise to compile a comparison of structural and time-series forecasts for a more complete list of commodities, so that it would be possible to construct predictions of the terms of trade for individual countries. However, the illustrations given here should be enough to show that both methodologies have problems, and that neither has been a reliable guide for the choice between stabilization or adjustment. The question then arises as to whether it is possible to do better, and what guidance can be given to policy makers about what should be done in the absence of reliable forecasts. In particular, can we derive any set of automatic rules for responding to commodity price shocks?

For several writers, the permanent income theory of consumption has served as a useful model for stabilization, with consumption being held steady as prices and income fluctuate, and reserves being built up in good times and run down in bad. However, a behavioral rule that sets consumption equal to permanent income makes no allowance for precautionary motives, nor for the investment that is required for growth. Furthermore, it is clear that such a rule works best when commodity income is serially uncorrelated, and when there are no restrictions on the amounts that countries can borrow on international capital markets. Even if borrowing is limited—as it is in practice—it is still possible to accumulate a reserve fund, and although there will now be occasions when the absence of reserves forces a cut in consumption in response to a temporary income shortfall, consumption will still be a good deal smoother than income, and this can be achieved with relatively small levels of reserves. In Deaton (1991), I derive such

buffer-stock rules, and show how they operate in practice. However, positive autocorrelation in income seriously compromises the performance of such stabilization schemes. Booms and slumps last much longer, so that to achieve the same degree of stabilization, larger amounts have to be accumulated during the boom, and held for longer periods of time. Large reserves are costly, and as a result it is no longer desirable to stabilize as much, and consumption has to move more closely with income. In the limit, when income is a random walk, no stabilization is possible. It is doubtful if these results are much affected if we allow access to international capital markets; with strong positive autocorrelation, misfortune lasts for long and uncertain periods of time, and lenders are unlikely to wish to provide funds for stabilization in such circumstances.

The crucial point here has been previously argued by Gersovitz and Paxson (1990, pp. 62–3), and in the context of attempts to stabilize farmers' incomes, by Newbery (1989). Given the actual behavior of commodity prices, which are very strongly autocorrelated at high-frequencies and revert to their means only very slowly, it is quixotic to recommend any simple permanent income rule or compensation scheme as in Balassa (1988). The swings are too large, too long-lived, and too uncertain. The accumulation of reserves over booms would be very large, very expensive, and almost certainly politically infeasible. Corresponding loans are not likely to be available over slumps; the amounts of the loans that would be required are very large, repayment dates are uncertain, and may be infinite if what was thought to be a downturn turns out to be a trend. The degree of persistence in commodity prices severely limits the scope for stabilization policy so that price movements will typically require rapid fundamental adjustment.

The exceptions to this argument are those cases where it is clear *ex ante* that the price change will be short-lived. Even then, it is necessary to be careful. The Brazilian frost in 1975 that precipitated the coffee boom looks like a good example of such an event. Yet the World Bank forecasts underestimated both the effects and duration of the boom until the price had reached its peak in 1977. Temporary fluctuations are also frequently and 'authoritatively' interpreted as permanent. Gasoline shortages and price increases in the US in 1979–80 following the second oil shock were interpreted by some as a permanent consequence of the world running out of exhaustible resources. The hot summers of 1988–91 in North America have done much to persuade people of the inevitability of global warming. Popular perceptions, however plausible, are often wrong, and it is frequently difficult to determine the reasons for price changes even long after the event. There is danger in attempting to protect local prices against fluctuations in international prices, even when it *seems* clear that such fluctuations are temporary.

It should also be noted that most fluctuations in commodity prices have not been of a clearly temporary nature, and it is perhaps unfortunate that the coffee price boom of the late 1970s

should have so dominated the discussion. While it is clear that the coffee-funded booms in government expenditures in Côte d'Ivoire—see Balassa (1988)—and Kenya—see Collier, Bevan, and Gunning (1990)—were less than sensible responses to a boom that was widely understood to be of finite duration, the treatment of the subsequent slump in prices as a temporary one, and the consequent slowness in adopting adjustment policies, was a reaction that was equally widely supported, by the World Bank and others, but which turned out to be just as wrong. The recent slumps in many prices, and their failure to turn into long-forecast booms, are a better and more typical example of the persistence and unforecastability of prices.

To the extent that policy makers need forecasts of commodity prices, perhaps most importantly for project evaluation, the lesson from the long-run data, which is captured by neither by the time-series results nor by (at least some of) the World Bank predictions, is that prices tend to revert to their long-run levels, so that their real value is not likely to be higher for any prolonged period in the long-term future, and may be lower if the trend pessimists are right. Although there is still dispute about long-term trends, the trend, if present, is not large relative to variability, so that the important thing is not to be misled by booms and slumps into predicting any major change in long-run values.

If such a view is correct, why is it not captured by the structural models? I do not believe that a definitive answer can be given, nor that we have more than a very fragmentary understanding of the determinants of commodity prices in either the long or short-runs, see Deaton and Laroque (1991) for evidence on the latter. One theory that seems consistent with the evidence goes back to Lewis (1954). He noted that, in spite of substantial technical progress in the industry, the price of sugar had not risen in real terms, nor had the wages of workers in the sugar plantations. He argued that, in the presence of unlimited supplies of workers at a low wage real wage, technical improvements in sugar production are passed on to consumers in rich countries in the form of lower prices. In this model, it is not the low prices of primary commodities that keep wages low in the producing countries, but rather that it is poverty in LDCs that is responsible for the low prices of commodities. The real price of cocoa will only increase permanently when the opportunity cost of land and labor in the producing countries rises. By this account, the production of staples cannot by itself engender development, rather increases in the prices of staples must await development. In the long-run, price is equal to marginal cost.

In spite of the simplicity of Lewis's account, its features do not seem to be captured by at least some of the structural models. For example, Bateman (1990) predicts a new cocoa boom early in the next century. He points out that the prolonged low level of prices has led to an absence of replanting, and a slow decline in the size of the world's orchard. Meanwhile, demand

is expanding, so that when it eventually outstrips supply, prices will rise. But such an analysis is self-contradictory; if it were correct it would be undone by new planting four to five years prior to the anticipated price increase, the Malaysians being aggressive new producers who are likely candidates to make the arbitrage. But such responses are not included in the model, and I suspect that, as with their macroeconometric cousins, structural models of commodity prices do not give sufficient recognition to the importance of expectations.

Is it possible to distill from all this a simple policy rule for dealing with fluctuations in world commodity prices? In principle, given a description of the stochastic process driving prices, of the opportunities for capital formation and asset transactions, and of an appropriate social welfare function, there will exist an optimal policy function that embodies a set of rules for responding to any given contingency. In practice, the calculations are not feasible, and we can only guess at the nature of the solution. To the extent that the sharp upward spikes in commodity prices are driven by clearly stationary shocks, such as abnormal weather conditions or industrial disputes, it makes sense to try to smooth them out, not to adjust consumption and investment, and to accumulate the proceeds in a compensation fund, the balance of which can be used to fund consumption and investment over the long-run. It is in this case that the permanent income rule is appropriate. However, except in such cases, where the temporary nature of the shocks can be clearly and unambiguously identified, price changes should be treated as if they are permanent, and fundamental adjustments made. Although it is typically the case that prices will eventually revert to their long-run norms, the process is so long and so uncertain that attempts to ignore fluctuations by holding consumption and investment on their long-run growth paths are doomed to fail. Rather than reacting to commodity price uncertainty *ex post*, governments may do better by trying to eliminate at least some of it using futures, options, and swaps, approaches that are currently under active review by the Bank and the countries themselves.

3. The political economy of taxation and expenditure in Africa

Even had commodity prices been much easier to forecast, the responses of African governments to commodity price shocks may still have been less than ideal judged from the viewpoint of growth and stabilization. In this section, I look at the fiscal arrangements of African commodity exporters, at the forces that determine levels of taxation and government expenditures, and ask whether these arrangements are likely to affect the response of African countries to fluctuations in the prices of their exports. There is a well developed economic theory of what taxes ought to be in these countries, and there exists a substantial literature in political economy that aims to

explain why taxes are what they are. Sometimes the two views coincide, but frequently they do not, and there is a widespread belief that the internal organization of taxation and expenditure, as influenced by the political environment, has a great deal to do with difficulties in selecting appropriate stabilization policies. In this section, I review some of this literature, with a view both to identifying directions of policy reform and to identifying hypotheses to be examined in the empirical work in the next section.

The argument runs as follows. Even from a purely economic perspective, it is desirable to tax commodity exports, a prescription that is followed in most (but not all) African countries. However, tax rates are frequently hard to explain by reference to either equity or efficiency, even within administrative constraints, and can perhaps better be explained by political factors. As a result of high commodity taxes, levied by paying low and inflexible procurement prices to farmers, fluctuations in world prices lead to proportionately larger fluctuations in government revenue. In general, governments in Africa are revenue-constrained, and the large fractions of government expenditure that are financed by foreign donors are not directly controlled by the governments. Revenue from commodity booms is in some cases the only income over which governments have complete discretion, and much of it is therefore used, not for economic growth, but for constituency building and the consolidation of power. If such arguments are accepted, an important question for discussion is whether, at the same average level of taxation, arrangements that share income fluctuations more evenly between public and private sectors might not lead to superior stabilization outcomes. I deal with each of these topics in turn, looking first at the level of taxation, and then at the performance of tax systems through booms and slumps in international prices.

The level of commodity taxation

The economic theory of taxation and public expenditure pays little attention to political factors, but nevertheless provides recommendations that overlap in a number of areas with what actually happens. The optimal level of taxation on agricultural exports is not zero. Most African governments have only a limited choice of tax instruments, so that, given a revenue requirement, the question is not whether cocoa or coffee should be taxed, but at what rates. There are a standard set of rules for determining these rates, balancing equity against efficiency and taking into account the availability of alternative instruments of taxation. Newbery (1990) provides an excellent discussion in the context of pricing cocoa in Ghana, using what evidence exists on the supply responses of cocoa farmers (substantial in the long-run) and on their position in the

income distribution (worse off than urban consumers of imports, better off than much of the rural population.) In the case of tree crops, Newbery's largely static analysis has to be modified by the intertemporal issues that arise from the fact that once the orchard exists, at least some output can be obtained at very low cost. Besley (1992) shows that such circumstances can set an *upper* bound on taxes if farmers are faced by a predatory government or marketing board. If the board attempts to set too high a price, one that would induce a substantial expansion of the orchard, the farmers will calculate that the board will subsequently have an eventually irresistible incentive to reduce prices to marginal production costs, even if in so doing, there will never again be any new planting. As a result, only prices below some critical level are credible and will induce new investment.

Economic arguments also favor the use of at least some of the revenue for government investment projects. In the standard project evaluation literature, the government acts as a representative for future generations, and money in the hands of the government is committed to the highest-yielding investment projects. The taxation of agriculture in favor of industrial development, which was favored by most economists into the 1970s, and which fitted so well with the political needs of many African leaders, could be seen as the implementation of an optimal intertemporal allocation condition, equating the marginal value of funds between present and future consumption.

If there is nothing inherently wrong with export taxes, nor with taxation for investment, the details are very different from what economic theory recommended. On the taxation side, some countries have set rates at levels that seem hard to justify from an economic perspective. Newbery (1990) documents how the confiscatory rates on cocoa in Ghana gradually destroyed the industry by the early 1980s. While treecrop farmers will still harvest their crops in the face of low prices, they will not replant, and the orchard slowly diminishes. (A good deal of progress has been made in reversing this trend as a result of the structural adjustment program instituted in 1983.) The Ivory Coast, which is often taken as the example that Ghana should emulate, has consistently paid farmers the same amount for cocoa and coffee, although the latter costs almost twice as much to produce as the former in Ivory Coast, although the world price of coffee has been consistently higher, and although the Ivory Coast has some power over the world market in cocoa but not in coffee, see Benjamin and Deaton (1992). As a result, coffee in the Ivory Coast has suffered much the same fate as has cocoa in Ghana. Furthermore, the policy of keeping producer prices constant in real terms, with substantial implicit taxation, had to be abandoned in 1989 when declines in world prices turned taxes into subsidies, and producer prices were eventually cut by half.

However, it is in their recommendations for taxation and for public investment that the (once) standard economic prescriptions seem naive, particularly in their implicit assumptions that (*a*) private individuals were unlikely to save, or if they saved at all, were unlikely to make sensible investment decisions, and (*b*) governments would act as effective custodians of the future, investing wisely, and applying project evaluation guidelines to guarantee equitable and efficient growth. In practice, with tax rates poorly set, and projects selected on other grounds, great damage has been done to agriculture with little compensating benefit elsewhere in the economy.

Of course, these broad generalizations are just that, and fit some countries much better than others. Kenya, unlike Ghana or Ivory Coast, has typically not taxed the incomes of the smallholders who produce coffee, and even during the coffee price boom, the windfall was not taxed, a decision reputedly taken personally by President Kenyatta, against the advice of both the IMF and the World Bank, Killick (1984). There is surely no economic reason for tax policies to vary so much from country to country, and the explanation of the differences must rather lie in differences in political structures. Indeed, many writers have emphasized the role of ethnic divisions in Africa, and the relationship between the level of taxation and the extent to which the farmers are politically represented. Bates (1990) notes that where independence was spearheaded by farmers in search of land (Kenya) or better prices (Ivory Coast), subsequent policy has been more favorable to agricultural interests, see also Bates (1981, 1983) and Lofchie (1989). In Ghana, Nkrumah and subsequent leaders have drawn their support from urban groups, and have typically been hostile to both private sector and agricultural interests, a pattern that is repeated in many other countries. As a result, there has been no political representation of the Ashanti farmers who grow cocoa in Ghana, and who see the government as dominated by other interests. Indeed the attempt in 1954 by the National Liberation Movement to mobilize political opposition around farmer and Ashanti interests was quickly outmanoeuvred and suppressed by Nkrumah, see for example Frimpong-Ansah (1992, p. 91). In Nigeria too, ethnicity is linked to specific crops; cocoa is grown by the Yoruba in the west, groundnuts by Hausa in the north, and palm products by Ibo in the east. None of these farming interests are well represented politically, in comparison with industrial, bureaucratic, and military interests, Bienen (1988) By contrast, groundnuts in Senegal are grown by the Mourides, a politically powerful and well-organized ethnic group, who have successfully prevented high taxation of their crops, Bates (1983, p. 127).

Many African leaders adopted the standard economic prescriptions of industrialization funded from agricultural taxation, if sometimes more in rhetoric than reality, see for example Frimpong-Ansah's (1992) account of Ghana under Nkrumah. However, there are other cases and other motivations. Many (although not all) first-generation African leaders had no natural political

constituency, and the revenue from taxation could be used to build one. The investment projects that would engender economic development could also be used to make new friends, and to reward old ones. Indeed, it is a commonplace among observers that rate of return calculations play little or no role in project evaluation in Africa (or in much else of the world, see Squire 1989); economic growth is at best only one of many objectives among those who are authorizing and funding development expenditures. Nigeria is perhaps only the most egregious and well-documented example, although see also the discussion in Bevan, Collier and Gunning (1990, p. 247) of the disintegration of public expenditure management in Kenya after the coffee boom. In Nigeria, there was an uncontrolled explosion of public projects in the wake of the oil booms, Bienen (1988). In 1984, the Onosode Committee, appointed to review these and other projects, found that virtually no public sector projects were supported even by attempts to measure rates of return, and the committee—as well as the World Bank and the US Government—recommended the abandonment of a list of partially completed major public projects, including the infamous Ajaokuta steel works, which is situated far from the sea, where transport is difficult, and where there are neither sources of energy nor of iron ore. Work on many of these projects continues to date, and Ajaokuta was recently proclaimed by its project director, without apparent irony, as a model 'for the future of the black man all over the world,' New York Times (July 11, 1992). These and other projects continue, not because of their contribution to economic development, but because of the political benefits that they bring to their sponsors.

It might be thought that giving farmers good prices for their crops would also help build political support. But, as emphasized by Bates (1983), this is often less effective. It is difficult to build support across ethnic divisions, and while the benefits of high prices accrue indiscriminately to all producers, projects can be steered so as to reward friends and punish enemies. The same logic leads to a reluctance to devalue, since overvalued exchange rates both tax agricultural producers and offer the opportunity for import controls, which like projects provide many opportunities for channelling favors to urban clients. Politically powerful large farmers can be bought off with fertilizer subsidies, so that agricultural taxation falls only on the relatively poor smallholders who use little or no marketed inputs. There has been little evidence of anything other that a rhetorical commitment to equity in African pricing policies.

Taxation in booms and slumps

High taxes on agricultural exports frequently—although again not universally—take the form of marketing boards setting procurement prices which are not only lower than the world price, but

are also unresponsive to changes in world prices. Since in most African countries, there is insufficient power over world prices to induce a negative correlation between output and price, these relatively fixed prices have the effect of stabilizing farmers' incomes. Indeed, income stabilization is frequently the declared purpose of the parastatal procurement agencies. Of course, stabilization of farmers' incomes comes at the price of destabilizing government revenues. Since the issue of the level of taxation is conceptually distinct from the allocation of income fluctuations, it is possible at the same level of average taxation to imagine different arrangements for the sharing of fluctuations. The same average level of tax can be levied as a land tax, independent of the level of output or value of sales, as a specific tax, levied on the physical volume of sales, or as an *ad valorem* tax, on their value. Alternatively, governments can announce prices on a year by year basis, which would permit, for example, progressive taxation with a larger fraction withheld during booms than during slumps; in the past when Thailand was dependent on rice exports, the rice 'premium' used to be reduced when prices were low, and increased when prices were high. Just as the *level* of taxes varies across Africa, so does the extent to which farm-gate prices vary with world prices, and thus so does the extent to which revenue booms and slumps are allocated between the farmers and the government.

There are two distinct issues here, one normative and one positive. First, there is the essentially microeconomic question of the desirability or otherwise of stabilizing farmers' incomes, ignoring any problems the government might have in handling fluctuations in its own revenue. Second, there is the macroeconomic stabilization issue, that comes from comparing the actual saving and investment behavior of farmers with that of the government. There is a wide dispersion of views on these matters, and there has been controversy for at least half a century.

The stabilization of farmers' incomes was used by the British colonial administration as at least one of the arguments for establishing marketing boards. The cases for and against were well put as early as the debate between Bauer and Paish (1952) and Friedman (1954). The former argued against the use of marketing boards as instruments of taxation, proposing instead a form of moving average payment, on the grounds that 'Small producers are unlikely to have the self-restraint and foresight to set aside in good times sufficient reserves to cushion the effects of worse ones, or, even if they have, may be debarred from doing so by social customs and obligations.' (p. 766). Friedman, in reply, emphasized the forced saving aspects of the scheme, and doubted whether marketing boards were a suitable substitute for education and the development of credit markets. It is certainly correct that, if saving is ignored and it is assumed that farmers are forced to consume their incomes, then it is desirable for the government to shoulder some of the risk by stabilizing prices, and under reasonable assumptions, such

stabilization can be substantial, see Mirrlees (1988). Note, however, that as argued by Newbery (1989), the persistence of commodity price movements generates difficulties for this sort of stabilization, just as it does for macroeconomic stabilization.

That farmers misspend boom incomes is a widely held view. Frimpong-Ansah (1990, p. 71) quotes a Colonial Office memorandum of 1944, which described the consequences of farmers receiving boom incomes after World War I, as 'almost wholly evil. They received more money than they knew what to do with . . . exaggerated ideas of the value of their products, and numerous expensive tastes were acquired.' More recently, Davis (1983) recommends stabilization on macroeconomic grounds, on equity grounds, and because there will otherwise be excessive planting in response to the temporarily high prices. These views are echoed by Killick (1984) for Kenya, who writes of the 1978–80 coffee boom that 'In terms of economic management, there was an overwhelming case for preventing all the windfall gains from accruing to the farmers. These were purely windfall profits, in no sense a return on past investments, and they were large in relation to domestic demand. Alone among the major producing countries, Kenya did not tax coffee revenues.'

The contrary case is argued in terms of what happens when the government gets the revenue, and particularly its tendency to spend on ill-conceived public projects. Hirschman (1977), argues that, as early the middle of the last century, the guano boom in Peru was aborted by railway investments, and goes on to argue more generally that 'fiscal linkages' to staples are unlikely to promote worthwhile investment and growth. Bevan, Collier, and Gunning (1990) believe that the Kenyan government's ability to vet investment projects was *permanently* compromised by the scramble for projects in the wake of the boom. Even though the authorities understood perfectly well what was happening, the obvious availability of funds made it impossible to control spending departments, who refused to rank projects as a device to prevent the Ministry of Finance from exercising fiscal control. It is important to note that the Kenyan authorities received nothing directly from the coffee boom, and that the increase in government revenues was the secondary effect of the inflation of other sources of revenue, primarily imports. Nigeria is an example where the fragility of the federal structure, with 'a continuous struggle between regional autonomy and central control,' Bienen (1988), makes it difficult to prevent the rapid and uncontrolled disbursement of discretionary incomes. The transitory nature of the recent mini oil-boom associated with the Kuwaiti war was well understood by the Nigerian authorities, but immediately spent nevertheless, in spite of explicit prior announcements to the contrary by the president. In countries where foreign aid is a large fraction of government investment, it is only windfall gains over which governments have discretion. Given the political difficulties faced by

most leaders, it is not surprising that such funds are spent rapidly, and spent poorly from the perspective of long-run growth.

There are also arguments in favor of leaving stabilization to the farmers. At the micro level, as recognized in the early debates, much depends on the empirical evidence on whether smallholders can make sensible intertemporal choices. The evidence on this, although far from complete, is relatively favorable. Hill (1963), in her classic study of Ghanaian cocoa producers, claimed that the migrant farmers were classic rural capitalists, with 'a rigid view about the wastefulness of consumption expenditures.' Ingham (1973) presents some empirical evidence that is in accord with such a view. Bevan, Collier and Gunning (1989) use rather fragmentary but internally consistent macroeconomic and microeconomic evidence from Kenya to suggest that farmers fully understood the temporary nature of the boom, and saved around 60% of the proceeds. There is also more formal evidence from other countries that farmers can handle income uncertainty very well; perhaps the most convincing studies are those by Paxson (1992a, 1992b) of rice farmers in Thailand, who smooth their consumption both within and between harvest years. Bauer (1984) also argues that farmers are likely to invest well, using boom income not only to expand their orchards, but to diversify into money lending, transportation, and processing activities, many of which have high rates of return, see again Hirschman (1977) for a more detailed analysis of such linkages. Bevan, Collier and Gunning conclude their (1990) study of Kenya and Tanzania with a manifesto for policy that contrasts the 'good' behavior of farmers, with the 'bad' behavior of governments. It should be noted, however—and this is one of the main points of Bevan, Collier, and Gunning's analysis—that even 'good' behavior by farmers can be frustrated by Dutch disease effects, or an otherwise hostile macroeconomic environment, particularly if there are physical controls. If the government limits access to foreign exchange, the private sector cannot directly hold windfall balances abroad. Controls on imports will generate domestic inflation, will redistribute income from the rural to the urban sector, will undermine incentives for agricultural producers, and may abort what otherwise could have been a successful investment boom.

Many of these arguments seem worth treating seriously, as does their policy implication that governments should be encouraged, even when the level of taxation is not easily negotiated, to adjust the tax regime so as to allow the private sector a larger share in stabilizing fluctuations in commodity incomes. The effectiveness of such a policy is likely to be much enhanced if other reforms are undertaken simultaneously, particularly the dismantling of physical controls. Such steps seem desirable even if progress is made on what is perhaps the most important issue, which is finding some way of improving the quality of project evaluation. Of course, we are still at the stage of evaluating proposals based on their inherent logic, and on analogies with experience

elsewhere. The hard empirical evidence for Africa to support or contradict these positions is simply not available. In a first attempt to move in that direction, the final section offers some preliminary econometric results that attempt to assess how commodity price fluctuations have affected African countries as a whole, and whether there is evidence on a relationship between tax systems and the effectiveness of stabilization policy.

3. Pan-African empirical evidence

Data from Africa are typically incomplete and error-ridden, and there are many inconsistencies across different authorities. The results presented here use data from several different international sources, and there are cases where the numbers are contradictory or otherwise suspect. In consequence, the results should be treated with even more than the usual degree of caution.

The object of the exercise is to examine the effects of changes in commodity prices on the components of national income, consumption, investment, government expenditure, and net exports. The national income data come from the Penn World Tables, Version 5, Summers and Heston (1991), and we extract data from 1965 to 1985 for the 35 African countries listed in Table 4. The standard measure of national income recommended by Summers and Heston, and which is routinely used in the recent explosion of empirical work on economic growth, is a chain index measure of real output. It is important to note that this is an *output* measure of GDP, not an *income* measure. In particular, if there is a boom in the world price of a country's main export, there will be no *direct* effect on the GDP measure, even though the country's output will now buy a larger volume of goods and services on international markets. The Penn tables also provide data on terms of trade corrected GDP, and these data incorporate the real income effects of changes in the terms of trade. However, the results reported below use only the output data, so that any effects on national income of commodity prices represent real changes in the volume of output as a result of the price changes. For example, if producers use their windfall earnings for investment, and the investment goods are imported from abroad, investment will show an increase, net exports a compensating decrease, and GDP will remain unchanged. It is only when investment (or something else) elicits new output that we will detect an effect of commodity prices on GDP.

A measure of export prices is constructed for each of the 35 countries by weighting the international commodity price data in *International Financial Statistics* by *fixed* export weights that are specific for each country. This is preferable to using export unit values, which are affected by the composition of exports, and thus in general by what happens to GDP and its components.

Much of the cross-country empirical work on growth is plagued by endogeneity problems, and it is one of the great advantages of using international commodity prices that they are typically unaffected by the behavior of individual countries. There are a some examples where countries have some limited market power (possibly Ivory Coast and Ghana in cocoa, Madagascar in vanilla and cloves, Kenya and Tanzania in sisal, Senegal in groundnut oil, Guinea in bauxite, Zambia in copper, Gabon in manganese, and Botswana and Zaire in diamonds, Zaire in cobalt), but cases where countries have deliberately and successfully manipulated the markets have been rare. Problems will still occur when an exogenous shock, for example a miners' strike in Zambia, simultaneously affects both the country's GDP and the world price of the commodity. Even so, exogeneity is a reasonable assumption as a first approximation.

The export prices used here are constructed as follows. Fourteen commodities only are distinguished, partly on grounds of importance, but also partly because of data availability. The commodities are cocoa, coffee, cotton, copper, crude oil, groundnuts, iron ore, manganese, palm oil, phosphates, sisal, sugar, tea, and tobacco; lumber is perhaps the most important commodity excluded for lack of a suitable price series, and uranium is a serious omission for Niger. For each country, the physical volume of exports of each commodity is obtained from *African Economic Indicators*, and fixed weights w_{ci}^0 computed as follows:

$$w_{ic}^0 = (q_{ic}^0 p_i^0) / \sum_{k=1}^{14} (q_{kc}^0 p_k^0) \tag{7}$$

where 0 is the base year, 1975, c is the country, i the commodity, and q_{ci}^0 is country c's quantity of i exported in 1975, and p_i^0 is the world price in 1975. The composite export price for country c in year t, denoted P_c^t is constructed according to

$$\ln P_c^t = \sum_{k=1}^{14} w_{ck}^0 \ln p_{tk}. \tag{8}$$

Note that, although the individual commodity prices are not index numbers, but rather dollars or cents per physical measure (bags, tons, lbs, or kilos), arbitrary time-invariant changes in scales affects $\ln P_c^t$ by a fixed additive constant, which will have no effect in the regressions below. To convert to real prices, each P is deflated by the US consumer price index. There are two African countries (Lesotho and Somalia) in the Penn World Tables that export none of the fourteen commodities in 1975; these are dropped from the analysis.

Table 3 shows the results of estimating a cross-country vector autoregression including the country specific commodity prices. Since theory does not suggest any very precise form for these

effects, it seems best to adopt a relatively general model, so we regress GDP, consumption, investment, and government expenditure on three lags of each together with the current value and three lags of the real commodity price variable. The data are pooled time-series and cross-sections, and there are 18 time periods (65–85 less the three years lost to lags) for each of the 35 countries listed in Table 4 below. The intercepts in the regressions are country specific, and country specific time trends are also included; this is equivalent to detrending each country's data prior to running the regressions. Estimation is by the 'seemingly unrelated regression' (SUR) methodology, so that first-stage OLS regressions are used to estimate a variance covariance matrix of the residuals which is used in turn to calculate system-wide GLS estimates at the second stage. The distinction between OLS and SUR does not have any major impact on the results; the real issue here is not how the residuals are treated, but whether behavior is homogeneous across countries, a question to which I shall return below.

All variables appear in the regressions as logarithms. This is convenient in that the parameters can be interpreted as elasticities, but is less so when it comes to respecting the linear national accounting identities. Since the four magnitudes, consumption, investment, government, and net exports, add to the fifth, income, we can in principle choose any four for the system, with the fifth determined by the identity. In logs, the identity cannot hold exactly, and it would matter which subset were selected if the choice were not determined by the fact that net exports can be negative, and so cannot appear in a logarithmic system. In this paper, I consider only the *quantity* effects of commodity prices; price effects, especially the relative price effects associated with Dutch disease phenomena, are left for future work.

Results

The table gives the coefficients on commodity prices (the bottom panel) together with the coefficients on the system lags; figures in parentheses are absolute *t*-values. Figures printed in bold face are significantly different from zero, or close to being so and large enough to be important. The results are close enough to what might be expected so that we can perhaps resist claims that the data are so error-ridden as to be useless. On the other hand, there are a number of surprises. Start from the VAR estimates in the top of the table. GDP and its three components are all strongly autoregressive, with at least the first lag of each entering significantly into its own equation. For GDP, there is some evidence of (largely offsetting) effects in the second and third lags. The cross-effects in the VAR are confined to interactions between investment and GDP. The previous year's investment increases this year's GDP, although the effect is diminished

Table 3

VAR of income, consumption, investment, and government expenditure with commodity prices

	income		consumption		investment		government	
income								
$\ln y_{t-1}$	**0.68**	(8.7)	0.17	(1.5)	**0.68**	(2.4)	0.12	(0.9)
$\ln y_{t-2}$	**0.17**	(1.9)	0.18	(1.3)	−0.10	(0.3)	0.22	(1.4)
$\ln y_{t-3}$	**−0.21**	(2.7)	−0.06	(0.5)	−0.04	(0.1)	−0.20	(1.4)
consumption								
$\ln c_{t-1}$	0.01	(0.2)	**0.46**	(6.1)	−0.09	(0.6)	0.03	(0.4)
$\ln c_{t-2}$	−0.09	(1.8)	−0.06	(0.7)	−0.09	(0.5)	−0.09	(1.0)
$\ln c_{t-3}$	0.04	(0.9)	−0.10	(1.4)	−0.10	(0.6)	0.06	(0.7)
investment								
$\ln i_{t-1}$	**0.04**	(3.3)	0.02	(1.3)	**0.57**	(11.8)	0.03	(1.7)
$\ln i_{t-2}$	**−0.03**	(2.0)	−0.03	(1.6)	−0.07	(1.3)	−0.03	(1.2)
$\ln i_{t-3}$	0.02	(1.9)	−0.00	(0.1)	−0.08	(1.6)	0.03	(1.4)
government expenditure								
$\ln g_{t-1}$	0.02	(0.7)	−0.04	(1.0)	−0.07	(0.8)	**0.71**	(13.7)
$\ln g_{t-2}$	−0.05	(1.8)	−0.05	(1.1)	−0.03	(0.3)	−0.11	(1.8)
$\ln g_{t-3}$	0.03	(1.1)	0.02	(0.6)	−0.02	(0.2)	−0.05	(0.9)
commodity prices								
$\ln p_t$	0.01	(0.9)	0.01	(1.1)	**0.09**	(2.8)	−0.02	(1.4)
$\ln p_{t-1}$	**0.03**	(2.4)	**0.02**	(1.4)	**0.08**	(2.0)	**0.08**	(5.4)
$\ln p_{t-2}$	−0.00	(0.2)	−0.01	(0.4)	−0.04	(0.9)	−0.02	(1.5)
$\ln p_{t-3}$	0.00	(0.3)	**0.02**	(1.7)	0.01	(0.3)	0.00	(0.0)

by a negative coefficient after two years. Lagged changes in output also stimulates investment, as in a traditional multiplier-accelerator model. For a country that invests 20% of GDP, investment of $1,000 increases the next year's GDP by $200; as the effects work through the system, this falls to $100 in the second year, is $300 in year three, and continues at around $200 for several years afterwards. In this system the ultimate effect of any innovation, whether investment or commodity prices, is zero, since it is assumed by construction that the system is stationary around deterministic trends. Clearly, this is an assumption, and may well not be correct. However, these data are not informative about long-term effects, and the results should not be used to make inferences about dynamics more than a few years into the future. They certainly are not

capable of telling whether commodity booms permanently raise either GDP or its the growth rate.

Changes in international commodity prices work most strongly through investment. There are strong positive effects even contemporaneously, and these are reinforced in the subsequent period, with some offset in the third; the multiplier–accelerator links between investment and GDP transmit this into output and into further increases in investment. (Experimentation with deflation of commodity prices by an index that is more appropriate than the US CPI suggests that the somewhat implausible contemporaneous effect on investment is not robust, but that the total effect of several periods is.) There are also direct effects of commodity price changes in the previous period on both government expenditure and consumption, and although the elasticity of the former is twice as large as that of the latter, the absolute effects of the price change on consumption are almost half again as large, since on average consumption is three times larger than government expenditure. The allocation of effects between government expenditure and investment should not be treated seriously. Even in the OECD countries, there is no uniform procedure for separating government investment from government consumption, and investment (and consumption) by parastatals (of which marketing boards are only one example) will not always be allocated to the government, even in cases where it would be appropriate to do so.

The responses of output and its components to a (non-maintained) shock to commodity prices are shown in Figure 9. These are shown not in logs, but as actual changes expressed as shares of output y, and are approximated using the formula:

$$\frac{\Delta x}{y} \approx \frac{x}{y}\Delta \ln x \tag{9}$$

where x is c, i, or g, and the shares of GDP are evaluated at the sample means, and are 0.663 for consumption, 0.126 for investment, and 0.222 for government expenditure. The effects on net exports are calculated as a residual, and so will include not only the genuine effects, but errors from the loglinear approximations. The effects on consumption, investment, government expenditures, and output are relatively straightforward, and follow fairly obviously from the coefficients in the Table. The maximum effect on all five magnitudes is in the period after the price shock. Beyond the second period, investment, consumption, government expenditure, and net exports remain higher than they would otherwise have been, and the effects die away slowly, although almost all are exhausted after 5–7 years. Note particularly that the price increase generates a *fall* in net exports of half of 1% of GDP in the first year, rising to 1% of GDP in year two. In subsequent years, as the investment increases GDP, there is a *positive* effect on the trade balance. Again, it is important to recall that the direct positive effects on the balance of trade of the

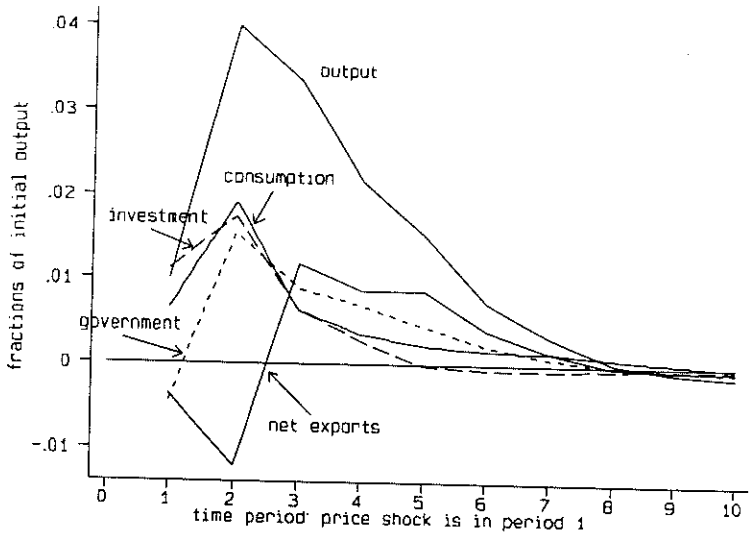

Figure 9: Impulse responses to a commodity price shock

commodity price increase are not included here, because all magnitudes are in volume terms. For these countries, exports were on average 15% of GDP, so the immediate positive effects would more than offset the immediate negative volume effects, operating presumably through additional imports.

There are a number of caveats that should be entered at this point. First, it is worth reiterating that the split between government expenditure and investment is not to be trusted. Second, it is likely that some of the measured changes in output comes from labor (and other factors) moving in and out of unrecorded activities in agriculture and elsewhere. If government expenditure employs new workers whose previous activities fell outside the national income net, then measured output will increase and decrease with government expenditure, although actual output could be moving not at all, or even perversely. Third, these results tell us very little about the *quality* of investment (or of government expenditure), although there is no evidence of the eventual declines in output that might happen if low or negative return state projects crowded-out high return private ones as a commodity price boom reallocated revenue towards government.

However, even with all the difficulties in mind, the results show no evidence of a generally unsuccessful or clearly inappropriate response to commodity price shocks, at least for the 35 countries taken together. Commodity price booms have generally favorable effects on African economies; they stimulate investment and generate additional GDP. There is no obvious evidence that booms trigger a GDP decline, nor do windfalls get immediately converted into government expenditure, at rate of one for one or even higher, nor is there any sign of trade imbalances beyond the initial effects as some of the windfall is used to pay for imports. Admittedly the evidence is relatively weak, and no doubt there are some countries where there have been horror stories. But the horror stories do not appear to generalize to all African countries.

Variations on the theme

A number of alternative sets of regressions were run to investigate hypotheses suggested by the literature reviewed in the previous section. Once again, these results should be treated with great caution, since I am even less than usually convinced that the data mean what they purport to mean, or that I have interpreted them correctly.

One possibility is that the responses to commodity booms are different from the responses to slumps. Governments may be only too willing to embark on investment programs in response to windfall gains, but find it difficult to cut back expenditures when prices fall. As a result, the expansion in the boom may favor low-quality projects, while the cuts in the slump fall on productive government services. It turns out that there is indeed some evidence of asymmetry in the results. The VAR in Table 3 was first re-estimated in first-differences, with similar responses to those already discussed, and then with price increases and price decreases entered separately, and with the coefficients allowed to differ. The results show that the significant effects are almost entirely in the boom. On an optimistic interpretation, this finding suggests that commodity price fluctuations are generally good for African economies; they stimulate growth on the upswing and do no harm on the downswing, ignoring of course the first round income effects of the changes in the terms of trade. A more pessimistic view is that much of the investment is done by government, and that what we are seeing is governments increasing spending when commodity prices rise, but being reluctant to cut it when prices fall. If so, the general criticism of African stabilization policy would be sustained. Even so, the results suggest that the consequences are benign, since the expansion in the boom raises GDP above what it would otherwise have been, and does so without deleterious long-term effects, either on GDP itself or on the balance of trade. Of course, we cannot rule out the possibility that all the GDP effects come from mismeasurement of informal activities, and that governments expand unproductive employment in good times and cannot reduce it in the slumps. Sorting out the mechanisms behind the asymmetry requires a good deal of further research and I do not explore it further in this paper.

Another issue is whether mineral prices and non-mineral prices have the same effects. Again there are reasons for suspecting not. Minerals are typically produced in enclaves, there are often very few employees—see Gersovitz and Paxson (1990) for some estimates—and in almost all cases are essentially owned by the government. It is harder to tax small-holder agriculture at close to 100%, if only because of the possibility of smuggling, something that is not an issue for minerals, except for diamonds. Mineral price booms therefore do not generate the widespread income increases among smallholders that follow price increases for agricultural crops in

Table 4

Countries in the VAR and classifications by commodity tax regime

country	high price	floater	country	high price	floater
Algeria	.	.	Mali	0	0
Benin	0	0	Mauritania	.	.
Botswana	.	.	Mauritania	.	.
Burkina Faso	0	0	Morocco	.	.
Burundi	1	1	Niger	1	0
Cameroon	1	1	Nigeria	1	0
Central African Rep.	0	1	Rwanda	1	0
Congo	0	1	Senegal	1	0
Egypt	.	.	Sierra Leone	1	1
Ethiopia	1	0	Sudan	1	.
Gabon	.	.	Tanzania	1	0
Gambia	1	0	Togo	0	0
Ghana	0	0	Tunisia	.	.
Ivory coast	1	0	Uganda	0	0
Kenya	1	0	Zaire	0	0
Liberia	1	1	Zambia	0	0
Madagascar	1	1	Zimbabwe	1	1
Malawi	1	1			

Notes: 'High price' is based on the producers' share of the world price of the most important agricultural export commodities and takes the value 1 for countries with low taxes (high prices) and zero for those with high taxes (low prices.) 'Floater' is 1 for countries where the producer price is highly correlated with the world price, and is 0 otherwise. Procurement prices in local currency are taken from World Bank (1992) and converted to US $ using the purchasing power parity exchange rates implicit in the Penn World Tables, Summers and Heston (1991). Ratios and correlations are then calculated using world prices in US $. World Bank (1992) presents direct estimates of ratios of producer price to world prices, but these appear to be based on official exchange rates and lead to many obvious misclassifications.

countries where the procurement price moves at least partially with the world price. Mineral and non-mineral price indices were formed on the same principles as above for the general export price index. In some cases, where countries export none of our minerals, the price index is set to zero; while this is arbitrary, it has no effect in the presence of country-specific intercepts. The results assign all the effects to the non-mineral prices; prices of minerals, including oil, have relatively little effect on output, and do not generate effects like those shown above. This result is important, not just because it confirms the distinction between enclave and farmer commodities, but because it does not fit easily with the interpretation that governments always spend the

windfall proceeds of export taxes. If governments willingly spend, or by political pressures are forced to spend all discretionary income, there is no reason for there to be a difference between minerals and agricultural goods. Indeed, some of the most egregious examples of misspending come from Nigeria's response to windfall oil incomes. Rather, the finding suggests that the original results depend on the private sector receiving at least some of the windfall, and hold out hope that the investment effects in Table 3 and Figure 9 come at least in part from the private sector.

Finally, there is the question of whether tax systems matter, whether the rate of tax itself has an effect on stabilization policy, and whether it matters how windfalls are shared between public and private sectors. If there are such differences, the responses of GDP and its components to commodity price fluctuations will vary from country to country, so that pooled VARs will be misspecified and possibly misleading, even for the continent as a whole. Country differences might also explain the discordance between the generally negative descriptions in the literature, and the lack of any obvious negative effects in the econometric results. Crude tests of the effects of tax systems were carried out by splitting countries into two groups according to two different criteria. In the first, the ratio of producer to world prices was used to split countries into high or low taxers; some countries cannot be assigned because of data problems. The second split was based on the correlation between producer prices and world prices, so that countries are sorted, where possible, into 'floaters' and 'non-floaters.' The results of the assignment are shown in Table 4. Perhaps surprisingly, the results of the VAR do not differ significantly across either of the two splits. Given the importance of this issue in the literature cited in Section 2, a good deal more investigation is warranted. In particular, it would be useful to look at a few individual countries where there is other evidence on the effects of commodity prices fluctuations, and then to match or contrast these results with the pan-African estimates and with the splits shown in Table 4. Such work must be left for future research.

4. Conclusions

Much of the analysis in this paper has been exploratory, and it is difficult to come to final conclusions with any confidence. Even so, there are a number of points that bear restating. First, it should always be remembered that commodity prices are not only highly variable, but that they are extremely hard to predict more than a year or two ahead. Cases where booms or slumps are obviously temporary are far from typical; the long-prolonged and unforeseen slumps of the late 1980s and 1990s provide much better examples of the problems that have to be faced by policy makers in African countries. Standard econometric time-series analysis does not deliver pre-

dictions that are helpful for policy, nor do the more elaborate structural forecasts prepared by the World Bank, at least over the period examined here. Moreover, the fact that commodity price shocks typically have effects that persist for many years means that simple stabilization or compensation rules are unlikely to work. Compensation funds will run dry or become unsustainably flush with funds, and lending facilities will be stretched beyond any reasonable limits. Once again, it is deeply misleading to think about commodity price shocks as short term phenomena associated with poor harvests. Countries should only try to ride out fluctuations in the prices of commodity exports when it is transparently and uncontroversially clear that the fluctuation is temporary. When this is not the case, attempts to postpone adjustment will either lead to disaster (when prices fall) or to wasted investment opportunities (when prices rise.)

The political economy literature suggests many reasons why political institutions in Africa may prevent the outcomes that would be recommended by economic analysis using the traditional criteria of equity and efficiency. That literature has also documented an impressive number of case studies, as well as a number of attractive theoretical generalizations based on those countries that have been studied in depth, particularly Ghana, Nigeria, Kenya, and Tanzania. The previous section examined the empirical evidence using pooled national income data from 35 African countries from 1960–85. Although all the usual problems with African data should be kept in mind, I confess to having been surprised by the fact that these experiments failed to uncover obvious evidence that commodity price booms hurt those who sell as well as those who buy. Positive shocks to export prices appear to generate a good deal of economic growth, and they do it by stimulating what appears to be productive investment. Although there is indeed evidence of an asymmetric response, with investment and (ultimately) GDP expanding more in response to price increases than they decline in response to price falls, and although this asymmetry is consistent with the common observation that governments spend in response to booms but cannot contract during slumps, the expansionary phase still has the positive effects listed above. Taking Africa as a whole, I have not found evidence that commodity price booms lead to unwise and unsustainable expenditure booms which eventually lead to falls in GDP, balance of payments problems, and an accumulation of debt. This is not to say that such a view is not correct in some countries, although I found no differences in results when the sample was split according to the taxation of commodity exports. Even so, it would be extremely useful to have a more detailed analysis of the experience of individual countries in relation to that of the continent as a whole.

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