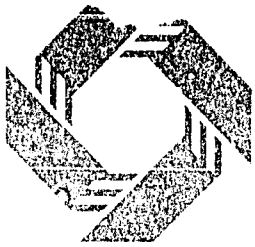

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Commodity Prices and Macroeconomic Management in Africa

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This paper examines the empirical consequences of commodity price booms in a cross-section of African countries and challenges the conventional wisdom that commodity price booms are so mismanaged as to have been generally harmful. Although there is much heterogeneity in the individual country experience, African countries grow faster when the prices of their exports are increasing rather than when prices are falling and perhaps one fifth of the decline in the rate of economic growth in Africa in 1980-85 as compared with 1970-75 can be attributed to the behavior of commodity prices. Although it is true that the countries that experienced commodity price booms in the late 1970s increased their long-term international debt then and in the early 1980s, so did countries that experienced no booms, or that faced declining world prices for their exports, so that there is no systematic evidence of an association between commodity price booms and the accumulation of debt. There is more evidence of a link between commodity prices and inflation, though the effect is modest once domestic price deflators have been purged of the automatic effects associated with the increase in world prices of exports.

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EXECUTIVE SUMMARY

It is now widely believed that commodity price booms are bad for African countries, and that macroeconomic mismanagement is so severe as to turn potential blessings into curses. It is argued that although governments initially try to save windfalls, they finally invest far in excess of their saving, so that the final legacy of the windfall is debt, that such investments are usually of poor quality and have low returns, and that governments raise their current expenditures in a way that is difficult to reverse when the boom turns to slump, and thus destabilize the economy when sharp and often harmful cuts have finally to be made. In Deaton (1993), some of these contentions were tested by an econometric analysis of the dynamic effects of commodity price changes on GDP and its components, and few deleterious effects were found. Instead, commodity price shocks have both immediate and lagged direct effects on investment, with indirect effects on gross domestic product through a mechanism that bears a close resemblance to the textbook multiplier–accelerator. Although there is a simultaneous expansion in government expenditure and in net imports—the last presumably the counterpart of the increase in real investment—the estimates show neither a sustained expansion of government expenditure nor the presence of sharp reversals some years after the shock. There is also no evidence of a long-term deterioration in net exports; a positive commodity price shock results in an *increase* in net exports from the second year on. These results can be (and were) challenged on a number of grounds: that they paid no attention to the country experience where the conventional story had been established, that they took no account of the ultimate effects of commodity price booms on debt and on inflation, and that they likely suffered from the usual ambiguities of interpretation associated with the weak data base for the continent as a whole. The current paper addresses these issues.

Section 1 re-establishes the original results using improved measures of commodity prices, and with the correction of a number of errors in the original data series. The 14-commodity indices are extended to 20-commodities, so that we now have good price indices for a number of countries whose commodity exports were not included in the original study. Section 2 looks at the individual country evidence, and explores the links between commodity prices and real GDP, using both purchasing-power-parity and 'official' national accounts data. There is a great deal of heterogeneity from country to country; some show an obvious link between out-

put and commodity prices, some show none, and some show links in some periods that are not repeated in later episodes. Individual country regressions are hampered by lack of degrees of freedom, but the positive association between commodity price growth and the growth rate of GDP in the pooled data is replicated for more than three-quarters of the countries. Over all the countries together, there is a clear association between commodity price and output growth, so that perhaps one fifth of the decline in the rate of economic growth in Africa in 1980–85 as compared with 1970 –75 can be attributed to the behavior of commodity prices.

Section 3 investigates the relationship between commodity prices, the accumulation of debt, and inflation. The econometric results show no effect of commodity price booms on long-term international debt, and the reason is transparent from inspection of the data. Although it is true that the countries that experienced commodity price booms in the late 1970s increased their long-term international debt then and in the early 1980s, so did countries that experienced no booms, or whose export prices fell, so that there is no systematic evidence of an association between commodity price booms and the accumulation of debt. There is more evidence of a link between commodity prices and inflation, though the effect is modest once domestic price deflators have been purged of the automatic effects associated with the increase in world prices of exports. Standard deflators, that divide nominal national income by a real output measure include the inflated commodity prices in the former but not in the latter, and generate 'domestic inflation' as a matter of mechanical accounting.

Section 4 investigates the robustness of the econometric results to alternative specifications, estimation strategies, and data sources. The major area of concern is the substitution of 'official' for purchasing power parity national accounts, where the dynamic effects of commodity price changes on the structure of national output are estimated quite differently. However, the differences between the two sets of results are largely differences of timing, and both sets of national accounts show the same positive effects of commodity price increases on output and growth in the medium to long-runs.

0. Introduction: the story so far

There is general perception in the policy community, supported by the academic literature, that macroeconomic policy in many developing countries has generally failed to deal satisfactorily with the problems posed by the volatility of the prices of primary commodity exports. Although African countries are not alone in their dependence on exports of primary commodities, the problem is particularly acute in Africa. It has been argued that the policy responses to price shocks have been bad enough to convert what should have been windfall gains into net losses, Gelb (1981). Nor is there a lack of possible explanations for this state of affairs. Commodity prices are not only extremely difficult to predict, but there is no well-documented scientific understanding of the underlying processes, whether or not there are cycles, whether booms must soon be reversed, whether slumps can last for ever, or whether there is a link between short-term fluctuations and long-run trends. There are also good political reasons why policy makers in Africa are either unable or unwilling to take the measures that would help realize the benefits of commodity price booms and minimize the costs of slumps. Deaton (1993) reviews the political and economic arguments in some detail.

One of the most thoroughly examined commodity price 'events' in Africa is the Kenyan coffee boom of 1976–79, which has been explored in a series of studies by Bevan, Collier, and Gunning (1989, 1990, 1991). The methods applied to Kenya have recently been used by a team of researchers led by Bevan, Collier, and Gunning to look at a series of other commodity price shocks—Bolivia in 1985 (tin and natural gas), Botswana (diamonds), Cameroon (oil discoveries), Colombia (coffee), Costa Rica (coffee), Côte d'Ivoire (coffee and cocoa), Egypt (oil), Ghana (cocoa), Indonesia (oil), Malawi in 1977–79 (tea and tobacco), Mexico (oil), Niger in 1975–81 (uranium), Nigeria (oil), Senegal in 1974–77 (groundnuts and phosphate), Venezuela in 1982 and 1986 (oil), and Zambia (copper). In their overview paper, Bevan, Collier, and Gunning (1991) conclude that although there are considerable differences from one country to another, certain aspects of the Kenyan boom generalize. They argue (*i*) that although governments initially try to save windfalls, they finally invest far in excess of their saving, so that the final legacy of the windfall is debt, (*ii*) that such investments are usually of poor quality and have low returns, (*iii*) that governments raise their current expenditures in a way that is difficult to reverse

when the boom turns to slump, and thus destabilize the economy when sharp and often harmful cuts have finally to be made, (*iv*) that governments do not make appropriate use of international capital markets, and (*v*) that these conclusions do not depend much on whether the windfall income from the boom accrues in the first instance to the government or to the private sector. The last point is a result of (*a*) automatic increases in tax revenue as private incomes increase, and (*b*) discretionary increases in tax rates by the government in order to capture a larger share of the boom, for example new taxes on 'windfall profits.'

This summary, although clearly not supposed to hold in every case, provides a convenient, detailed, and well-researched statement of what has become the conventional wisdom, not only in academic circles, but also in US AID, in the World Bank, and among country economists. Deaton (1993), which is the predecessor of this paper, examines this conventional wisdom using econometric rather than case study techniques. A commodity price export series was constructed for 35 African countries, and pooled data from the Penn World Table were used to examine the effects of changes in commodity prices on the components of GDP. In an admittedly limited range of experiments, the results did not confirm at least the worst features of the conventional story. According to the econometric estimates, commodity price shocks have both immediate and lagged direct effects on investment, with indirect effects on gross domestic product through a mechanism that bears a close resemblance to the textbook multiplier–accelerator. Although there is a simultaneous expansion in government expenditure and in net imports—the last presumably the counterpart of the increase in real investment—the estimates show neither a sustained expansion of government expenditure nor the presence of sharp reversals some years after the shock. There is also no evidence of a long-term deterioration in net exports; a positive commodity price shock results in an *increase* in net exports from the second year on. While these results are far from showing that African policy makers respond optimally to commodity price shocks, and while they do not address important elements in the conventional story—such as the low quality of windfall-generated investment—they provide no obvious support for the view that positive commodity price shocks have negative effects on output and growth.

In this paper, we take the argument a stage further, and examine some of the potential sources of discrepancy between the case-study and econometric evidence.

We look at the individual country experiences, and make an attempt to see whether the differences can be attributed to the choice of countries for the case studies on the one hand, and to the blurring of the econometric evidence by an averaging over heterogeneous experiences on the other. We also look at the evidence linking debt and inflation to commodity price booms. That debt is the ultimate legacy of commodity price booms is part of the conventional story, and there are widespread—if rarely documented—beliefs that the African debt 'crises' of the 1980s had their ultimate roots in the commodity price booms of the late 1970s. That domestic prices—or more precisely the prices of non-tradables—should rise in response to a commodity price boom is a prediction both of Dutch disease models—when the price change is seen as permanent—or of 'construction boom' models when it is seen as temporary and where the state restricts access to international asset markets. More loosely, there is the perception that the ultimate consequence of a commodity price boom is to 'leave the country mired in debt and inflation,' Devarajan (1991). Finally, we take up the general question of the robustness of the results with respect to different assumptions and different data.

As do Bevan, Collier, and Gunning, we find that there is a good deal of heterogeneity across different African countries, but unlike them, we find no strong evidence for the general applicability of the conventional wisdom. The heterogeneity is not surprising given the huge differences in political and economic institutions across Africa, not to mention the differences in the commodities themselves, in their conditions of production, marketing, and taxation. As a result, it is naive to expect the econometric analysis of many countries together to reveal more than the broadest generalities. Nevertheless, we believe that if the conventional wisdom is to be useful as a generality—as opposed to a description of what happened in a few countries—it should be consistent with the econometric evidence.

If the case-study and econometric results are ultimately different, which should we believe? Each methodology has its strengths and weaknesses. The case studies, and particularly those of the Kenyan coffee boom, contain a wealth of detailed local information that can never be brought into the econometric methods. Given the detail, it is possible to study one country at a time, and to look for both similarities and differences between them. This is much more difficult for the econometric time-series methods, because individual country series are relatively short, and where pooling across countries is required for statistical precision. However, there

are compensating difficulties with the case studies, some of which are general to the method and some of which are specific to the methodology used by Bevan, Collier, and Gunning for the Kenyan case, and applied by their collaborators to the other countries. All of the studies are concerned with specific price episodes, and while not excluding other periods, give the greatest attention to the events surrounding the selected period. Such selections are not always obvious nor uncontroversial, and face exactly the same difficulties as have plagued the dating of business cycles in macroeconomics, where such methods have been almost entirely abandoned in favor of time-series methods that do not require prior identification of booms and slumps. For example, in Aron's (1991) insightful study of Zambia, there was a copper price 'boom' from 1964 to 1974, followed by a series of negative shocks thereafter. But the copper price fell almost continuously from 1970, and it is not clear why the decline should not be treated as a single decline, rather than split in two parts, the end of a boom, followed by the beginning of a slump. Similar timing issues arise for other booms in other countries.

One of the key underlying issues is the treatment of expectations, and here it is very hard to see any real alternative to time-series analysis. Bevan *et al* draw a distinction between 'inclusive' and 'exclusive' expectations, the latter describing those cases where price events are not only unexpected, but are sufficiently so to contradict the previous expectation *mechanisms*. Structural breaks in stochastic processes are potentially important phenomena, and are not well-handled by time-series methods. However, the distinction between 'inclusive' and 'exclusive' expectations is perhaps even harder to manage in practice than are structural breaks in econometrics. The stochastic processes that describe commodity prices are very poorly understood in any case, and even official forecasts—such as those of the World Bank— have often been weak, so that it is clearly impossible to tell whether a discrepancy between an expectation and outcome is the result of routine forecast error, of structural change, or simply of poor (or politically biased) forecasting. We would argue for a neutral approach to such matters, confining our attention to the observable impacts of prices, and not trying to make unsupportable distinctions about expectations.

The heart of the problem here is the isolation of the effects of commodity prices from what would otherwise have happened. Bevan *et al* construct explicit counterfactuals, predicting the state of the economy without the commodity price shock.

Although they can bring to bear a variety of data sources and information to this task, this is surely an area in which the econometric analysis has an overwhelming advantage. Like the econometric analysis, the counterfactuals in the case-studies use past data and past relationships, but they are nearly always based on simple extrapolation of ratios from the years immediately prior to the event. It is hard to think of cases where this would not be done better by the automatic controls in a vector-autoregression.

Our own view is that the appropriate general methodology is to use case studies as a vehicle for generating hypotheses, and that without the material from country studies—both by economists and political scientists, as well as from development practitioners in the field—we would have little knowledge of the causes and consequences of policy making in Africa. However, the role of the econometric evidence, which in the African context is at its best when data can be pooled from many countries, is to test the validity of the generalizations. If the country study results do indeed reveal general laws, they should be apparent in the formal analysis. If they are not—and they do not seem to be for the conventional wisdom about commodity prices—then the country studies remain country studies, and cannot be seen as more than that.

The plan of the rest of the paper is as follows. Section 1 sets the stage. We describe the commodity price index and present the base results that update (and improve) those in Deaton (1993). These serve as our baseline for the various robustness experiments. Section 2 is concerned with individual country experience. We present graphical evidence on commodity prices and their relation to GDP, using both types of GDP data, the purchasing-power parity data from the Penn World Table, and the official exchange rate converted data from *International Financial Statistics* or the *World Development Report*. Section 3 reports results on the effects of commodity prices on debt and on domestic price inflation. Finally Section 4 presents a summary of results of various other experiments designed to explore the robustness of our results.

1. The data and baseline results

The simple time series model presented in Deaton (1993) consists of a four component vector autoregression extended (VARX) to include the effects of commodity

prices. There are four equations in the system, for real gross domestic product, for consumption, for investment, and for government expenditure, all expressed in logarithms; net exports are left implicit in the system. In each equation, the current value is regressed on three lags of itself, and three lags of each of the other three variables in the system, together with the *current* value and three lags of a measure of the price of commodity exports. The base data come from the Penn World Table, Summers and Heston (1991), and the regressions use pooled data from the 35 African countries listed in Table 2. It is important to note that the Penn data are *output* measures, and so do not include the increase in real *income* that results from a commodity price boom that makes exports more valuable in terms of world purchasing power. These effects are real enough, but they are not included in the results; what we are looking for here are the effects of commodity price changes on output.

Country specific effects and trends are accommodated by including country specific dummies and time trends. An alternative method would be to run the regressions in first-differences with country specific intercepts, the results of which will be explored in Section 4. The commodity price measure varies from country to country and is constructed using information on African exports of the 20 commodities listed in Table 1; this is an improvement over Deaton (1993) which used only 14 commodities. For each of the countries, we calculate the total value of exports on the 20 commodities in 1975, and calculated weights by dividing the value of exports in 1975 on each commodity by this total. These weights are then held *fixed* over time and are applied to the world prices of the same commodities—taken from International Financial Statistics—to form a geometric weighted index of prices. The commodities for each country and their weights in 1975 exports are given in Table 2; because the nature and composition of each country's exports differed in 1975, the commodity price indices move differently for each country, even though the underlying world prices of the 20 commodities are the same. We make no attempt to allow for the fact that different countries may receive different prices for their products, for example by quota sales though commodity price agreements, or by selling forward through agents. The weights are held fixed over time because we are trying to construct an *exogenous* variable, which cannot therefore include any supply responses to world prices. As a result, we lose some important windfall events, for example the discovery of oil in Cameroon in 1975 with produc-

tion coming on line in 1978—one of the episodes included in the Bevan *et al* comparative study—but the loss is inevitable if we are to exclude other, clearly endogenous quantity changes. (It is also not obvious that output windfalls must have similar effects to price windfalls.) Even with fixed weights, exogeneity is threatened to the extent that countries have market power in individual commodities.

Note also that the 20 commodities are far from comprehensive. The case of diamonds in Botswana is perhaps the most glaring omission; Table 2 shows Botswana's 1975 exports as 82.6 percent nickel and 17.5 percent copper. However, there are many other examples, some of which are listed in the notes to Table 2. Like diamonds, these omissions are forced on us by the inability to obtain useful prices. The resulting price indices will typically be correlated with the true (complete) price indices for each country, but the omissions will make the proxy less than perfect, and will therefore tend to bias towards zero the estimated effects of commodity prices. Before inclusion in the VARX, the commodity price index is deflated by the World Bank's index of imports of manufactured goods by developing countries. This is another improvement over Deaton (1993) who used the United States consumer price index.

The baseline results are presented in Table 3, and for all coefficients save those on commodity prices, are very close to those in the previous paper. Although the elimination of various errors in constructing the commodity price indexes has the effect of making the estimated coefficients on the commodity prices *smaller*, the patterns are unchanged. A commodity price boom has a positive effect on investment in the same year, and further direct positive effects on investment, government expenditure, and GDP in the second year. These effects are then amplified by positive feedbacks (multiplier-accelerator effects) between investment and income. The impulse response functions are essentially those in Figure 9 of Deaton (1993); the effects on output, consumption, investment, and government expenditure—in that order of magnitude—peak one year after the shock, and die away thereafter, with little visible effect after five years. The effects on real net exports are negative in the year of the shock and in the next year, as indeed they must be since the immediate increase in investment has to come from imports, but are positive and diminishing thereafter.

2. The experience of individual countries

It is not useful to try to replicate the extended vector autoregression for each country. With only 21 annual observations per country, the full VARX with all lags as in Table 3 would leave us with only 2 degrees of freedom for each regression. As a result, we must either simplify the VAR, or continue to rely on some degree of pooling, or use some different technique. We begin with the last. Figures 1 through 4 show the GDP and commodity price data for the 36 countries, nine in each Figure. The solid lines in each of the graphs are two alternative estimates of real GDP, one the Summers-Heston purchasing power parity figure from the Penn World Tables, and one the official GDP figure converted at official exchange rates, as reported in *International Financial Statistics* or the World Bank's *African Economic Indicators*. The latter source provides a somewhat longer time series, from 1961 to 1986, rather than 1965 to 1985 as covered by the Summers-Heston data. Superimposed on the same graphs is the commodity price index described in Section 1. All series are in logarithms and are scaled to be zero in 1980.

These figures raise a number of points for discussion. First, the Summers-Heston and IFS data are sometimes very different indeed, and more so than would appear to be justifiable by purchasing power parity corrections alone. Egypt (Figure 1), Gabon and Lesotho (Figure 2), Rwanda (Figure 3), Tanzania, Uganda, Zambia, and Zimbabwe (Figure 4) are only the worst examples, and the compression of scales in these diagrams makes the situation look a good deal better than it might. As always, international comparisons of national accounts data are hazardous, and nowhere more so than in Africa. Even so, the broad pictures of economic growth and decline over two decades are not markedly different for the two series, although the year to year details can be very different.

Second, we have shown the commodity price series directly as computed, without any weighting for the importance of exports in each economy. The clearest examples are provided by the countries whose exports are almost entirely oil, Algeria, Congo, Gabon, Nigeria, and Tunisia, for whom the commodity price index is visibly the same in the Figures. However, exports of the 20 commodities do not account for the same share of GDP in all these countries, so that (for example) their share in Tunisia at 7.1 percent of GDP is less than a half of the corresponding share in Algeria, which is 18.7 percent. It might be argued that the effect of com-

modity prices changes on GDP is likely to depend, not on the price index directly, but on the price index weighted according to the importance of those exports in the economy. While we broadly agree with this argument, and will examine the consequences of reweighting the prices in Section 4 below, it should be noted that there is no rule that says that price must operate exactly in this way. Some of the effects described in the conventional story depend as much on the absolute size of government revenue as on its share of GDP, so that the weighting issue is ultimately an empirical one. For the country by country analysis that is the topic of this section, the weighting will simply rescale regression coefficients without affecting fit or significance, and from the point of view of the figures, the behavior of the series is more easily seen than when they are weighted by export shares in GDP, which for several countries removes any visible variation in the price.

The diagrams confirm the diversity of the individual country experience. There is certainly no obvious general law whereby gross domestic product is determined by swings in the price of commodity exports. For about half of the countries, Burkina Faso, Burundi, Cameroon, the Central African Republic, Congo, Egypt, Ethiopia, Gambia, Liberia, Mali, Mauritania, Mauritius, Morocco, Rwanda, and Senegal, there is no obvious link between commodity prices and GDP, either in the short or long-runs. For others, Gabon, Ghana, Ivory Coast, Niger, Nigeria, Sudan, Tanzania, Togo, Zaire, Zambia, and Zimbabwe, there appears to be a connection in both the short and the long-runs, although the strength of the relationship varies a good deal from country to country. There are several other cases, Burundi, Cameroon, and Kenya in the coffee boom, Algeria, Egypt, Gabon, and Nigeria after the first-oil shock, Lesotho in the mid-1970s wool boom, Mauritius in the mid-1970s sugar boom, where there are *episodes* during which price changes were closely connected with changes in GDP, but where the relationship did not hold in other price booms during the period. Finally, it is quite frequently the case that there is a longer-term relationship, with higher commodity price growth in the 1960s and 1970s associated with much stronger economic performance than was the case in the late 1970s and 1980s, when growth rates were slower or even negative in years when commodity prices were often declining.

This graphical evidence shows why there is scope for several different interpretations of the experience. Continent wide relationships, if present, are certainly not strong enough to dominate events, so that we can hardly escape from an econo-

metric analysis that allows some sort of control for other variables. And while case studies of specific episodes can cast a good deal of light on the political and economic processes that operated during those periods, it is clearly dangerous to extrapolate the findings, unless they can be shown to apply to all such episodes and to other countries.

One econometric approach to the individual country data is to estimate simplified versions of the extended vector autoregression and we have investigated a number of ways of doing so. One is to regress for each country the logarithm of GDP on its lag, on a time trend, and on one or two lags of the logarithmic commodity price index. Alternatively, we can experiment with a difference on differences approach, in which the growth rate of GDP is regressed on its own lag, and on one or two lags of the rate of growth of commodity prices. Given that we have only 21 observations per country, some of which are lost to lagged variables, it is not surprising that many of these regressions fail to yield coefficients that are statistically significantly different from zero. For example, in the levels regression using the Summers–Heston data and a single once-lagged commodity price index, the *t*-values are absolutely greater than 1.5 in 17 out of 36 cases; for three of these, Congo, Nigeria, and Uganda, the coefficients are *negative* (the estimated elasticities of GDP to the commodity price index are –0.085, –0.142 and –0.309 respectively). The positive values associated with the large *t*-values are 0.227 (Botswana), 0.088 (Burundi), 0.068 (Cameroon), 0.215 (Egypt), 0.231 (Gambia), 0.108 (Ghana), 0.077 (Ivory Coast), 0.114 (Kenya), 0.161 (Malawi), 0.047 (Mauritius), 0.049 (Morocco), 0.064 (Niger), 0.255 (Sierra Leone), 0.241 (Zambia). Ignoring *t*-values, 29 of the 36 coefficients are positive, the exceptions, in addition to Congo, Nigeria, and Uganda are Algeria, Burkina Faso, Gabon, and Sudan. The differenced regressions—including the lagged rate of growth of GDP and the lagged rate of growth of commodity prices—differ in detail but are similar in general. There are 24 out of 36 positive coefficients, and seven *t*-values greater than 1.5. One of these, for Burkina Faso, is negative (–0.128), while the others are for Burundi (0.134), Ghana (0.140), Kenya (0.130), Liberia (1.5), Tunisia (2.1), and Zambia (1.5).

These results show the inevitable consequences of trying to make bricks with too little straw; the lack of sufficient observations prevents precise estimation, and prevents the results from being robust across different specifications and data sets. While they also confirm the diversity of the country experience, the broad picture

shows why the pan-African VARX yields a positive association between GDP and commodity prices, and provides no reason to doubt that conclusion.

One hypothesis suggested by the Figures is that economic growth and commodity prices are linked over longer spans, with GDP and commodity prices linked over quinquennia or decades, rather than over shorter periods. It is impossible to test this contention country by country, since there are only two decades or four quinquennia for each. Nevertheless, we can test whether such an association holds over all the countries by pooling the data. The results for different specifications and data sources are shown in Table 4. All the coefficients shown in the table come from regressions of the average annual rate of growth of real GDP over a five year period on the average annual rate of growth of the commodity price index over a five year period. In the top half of the Table, we use the Summers-Heston GDP data, and in the bottom half the data from *International Financial Statistics*. Within each half, there are four rows depending on the lag between GDP growth and commodity price growth. Hence, the first row of the top panel shows a regression in which there are four observations from each country, the growth rates from 1965 to 1970, from 1970 to 1975, from 1975 to 1980, and from 1980 to 1985, and where the GDP and commodity price growth is contemporaneous. In the second row, there are three observations per country, the dependent variables being the GDP growth rates from 1970–75, 1975–80, and 1980–85, and the independent variable the commodity price growth rates for 1969–74, 1974–79, and 1979–84. The corresponding lags in the third and fourth rows are two and three years, again with three observations from each country. Regressions are run with and without country-specific intercepts, and both sets of results are shown in the Table. We have also rerun the regressions with 'year' (in this case quinquennial) dummies, without significant differences in the results.

For both types of GDP data, the estimated effects are strongest and most precisely estimated when the lag between the five-year growth rates is one or two years. The inclusion of country dummies tends to reduce somewhat the precision of the estimates, and also the estimates themselves, but the effects are small. The association is closer for the IFS data than for the Summers–Heston data, although we must beware of the possibility that the IFS data are at least partially income-based, and so include some of the real national income that accrues from the commodity price changes themselves, something that is—at least in principle—expli-

citly excluded in the Summers–Heston output measures.

The right hand side of the Table returns to the issue of weighting commodity price changes according to the importance of commodity price exports in GDP. The regressions are run in exactly the same way as on the left-hand side of the table, but prior to differencing, the logarithm of the commodity price index is multiplied by the 1975 share in GDP of exports of the 20 commodities. By the application of such weights, commodity price shocks are converted into GDP shocks, or at least their money equivalent. The average over all countries of the export weights is close to ten percent, so that the estimates on the right-hand side of the Table are a good deal larger than those on the left. But once again, the GDP figures from the IFS give the tightest relationship, although now both data sources suggest a one-year lag. As before, the inclusion of country dummies has a small effect in reducing both the size and precision of the estimates, but the qualitative conclusions remain the same. An increase in commodity prices that is worth one percent of GDP per annum is estimated—over a five year period—to increase the growth rate of GDP by half of one percent in *addition* to the direct effects on net income.

These findings do not support the contention that macroeconomic management is so bad in general that increases in commodity prices ultimately decrease either national product nor national income. However, they do confirm the perception that the recent relatively poor economic performance of African countries has had something to do with the recent poor performance of the prices of African exports. From 1970–75, the 'impact' weighted commodity prices grew at 0.51 percent per annum over the 36 countries as a whole, while real GDP per capita grew at 2.4 percent a year according to Summers–Heston and 1.6 percent a year according to the IFS data. A decade later, from 1980–85, impact weighted commodity prices *declined* by 0.25 a year, while GDP declined at 0.3 percent a year (Summers–Heston) or 0.5 percent a year (IFS). According to the results in Table 4, about a fifth of this reduction in economic growth rates can be attributed to the reduction in the rate of growth of commodity prices. Commodity prices may not be all that are important for growth in Africa, but they are certainly a part of the story.

3. Inflation and debt

Even if commodity price booms are good for output per head, does the experience

leave countries 'mired in debt and inflation?' This sections looks at the evidence.

Table 5 shows the relationship between commodity prices and long-term debt, the latter taken from the (1991–92 diskette version) of the World Bank's *World Debt Tables*. The definition of long-term debt (defined by the Bank as obligations with maturities greater than one year) is the sum of 'debt outstanding' in the categories, IBRD, IDA, other multilateral, bilateral, suppliers, commercial banks, bonds, buyers credit, and use of IMF credit. Private non-guaranteed debt is excluded from these figures, an omission that, while possibly large for some of the African countries (Côte d'Ivoire, Kenya, and the oil-producers) is necessary to guarantee consistency and quality over all the countries and time periods; indeed even the official debt figures are only available from 1970, thus shortening the number of observations in these regressions. Each figure in the Table is the regression coefficient of the rate of growth of long-term debt over a three year period on the rate of growth in commodity prices over a three year period, and the table presents results for various lags between zero and three; the results for further lags are similar, and are not shown. As usual, estimates are presented for impact weighted commodity prices and for unweighted prices, and, as in Table 4, by whether or not country specific intercepts are included. However the relationship is estimated, none of the parameters is significantly different from zero. Indeed, to the extent that any pattern is apparent, it is one of negative coefficients, which corresponds to the 'common sense' finding, that commodity price booms make countries better off, and help them reduce their debt. There is no evidence in these estimates, nor in those employing longer lags, that commodity price booms typically leave a legacy of debt.

Since the change in debt is the current account deficit, one way of checking these conclusions is to examine the effect of commodity prices on the current account balance. *African Economic Indicctors* provides data on exports and imports in current US dollars, which we deflate by the nominal GDP in US dollars from the same source; while this is not exactly what we want, it gives some indication of the burden of debt accumulated from the trade balance. If this measure is regressed on its own lags and on the GDP-weighted logarithmic commodity price indices, we find a large, positive, and statistically significant contemporaneous effect, followed by a negative coefficient of similar magnitude after one period. It is impossible to reject the hypothesis that the sum of the coefficients is zero, so that this alternative way of looking at the issue provides no evidence against the previous results, that

commodity prices have no long-term effect on debt.

Once again, we emphasize that the results do not disprove that, in individual cases, commodity price booms were mismanaged to the point of increasing long-term debt. What they do show is that there is no such general result for African countries taken as a whole. Indeed, an examination of country by country plots of graphs of commodity prices and debt shows that while indeed there were large increases of debt for the oil and cocoa/coffee exporters through the late 1970s and early 1980s following the booms in their commodity prices, there were also major increases in debt for countries that experienced no such booms, including the large number of countries with downward trends in the prices of their exports. While this cannot be taken as evidence that countries with commodity price booms handled their debt well, they apparently did no worse than other countries. Case studies that reveal an association between debt and commodity prices in the countries with price booms are incomplete unless set against studies of countries without booms, who also increased their debt.

We investigate the role of commodity prices on the general price level using a VARX approach, in which the price level and the money supply are the two dependent variables, supplemented by the effects of commodity prices. Table 6 presents the results for the case where commodity prices are weighted by the average share of commodity exports in GDP and presents two specifications; in the top of the table, prices, money, and commodity prices are used in (log) levels, while in the bottom, all variables are used in log differences. We experimented with two different definitions of domestic prices. In the first, shown on the right hand side of the table, we use the GDP deflator from the *African Economic and Financial Indicators* data base. While this is perhaps the obvious measure of prices, it has the disadvantage of containing the automatic effects of changes in world commodity prices. If as we suspect, the nominal values of GDP count exports of commodities at current world prices converted to local currency, and if constant price GDP is an output measure, the ratio of the two will by definition increase with increases in the world price of exports. In an attempt to find a price index that is purged of this effect, we also constructed a measure of prices from the implicit deflator of *consumption* in the Summers-Heston data. The ratio of current to real consumption from the P[illegible] World Table, which is a purchasing power parity index that is expressed as a fraction of the US $ exchange rate, is multiplied first by the exchange rate, to convert

it to local currency, and then by the ratio of current to constant price GDP in US dollars, to pick up the amount by which prices have increased since the base year. In the table, where it appears on the left-hand side, it is referred to as the Summers-Heston consumption deflator. In all cases, the VARX includes country specific intercepts and time trends.

The major differences between the top and bottom of the table are, as is to be expected, on the 'own' first lags, with the differencing eliminating much of the autocorrelation in the levels. The differences between the two price measures is that commodity prices (or the growth of commodity prices) has a large and significant instantaneous effect on the GDP deflator, but very little on the Summers-Heston consumption deflator. We take this as an indication that the construction of the latter has successfully removed the accounting effect of commodity prices in the price indices. Apart from this, the main influence of commodity price changes on inflation comes, not directly, but through current and lagged effects on money, which is significantly positive in all four price regressions, in levels, in differences, and using both deflators. The impulse response functions for the price level and for inflation are shown in Figures 5 and 6. The former shows that in a country where 25 percent of GDP comes from commodity exports, a doubling of world prices would raise the GDP deflator by 2.5 percent in the first year, but the consumption deflator by only 0.5 percent in the first year and a little over one percent in the subsequent four years. In Figure 6, the same price increase is shown in terms of the additional inflation introduced into the system. Although it can be argued that an appropriate monetary policy could have eliminated these inflationary effects, they are hardly large enough to generate a great deal of concern over the inflationary effects of commodity price increases.

The effects in the Figures are qualitatively what would be predicted by either Dutch disease or construction boom theory. The increase in domestic incomes raises the relative price of non-tradables, so that unless there is a compensating monetary contraction, there will be an increase in domestic prices. We also ran some limited experiments to check whether the price increases were larger for the investment deflator than for the consumption deflator. Construction boom theory predicts that, in the presence of controls on imports and investment abroad, the additional saving generated by windfall incomes from commodity booms is diverted into domestic investment, stimulating both output and the relative prices of investment goods.

However, VARX regressions including the investment deflator showed effects that were very similar to those for the consumption deflator that are shown in the Figures. We could find no evidence that commodity price increases raised the price of investment relative to consumption.

4. Robustness of the results

The results of this paper have so far been more consistent with the guardedly positive interpretation in Deaton (1993) than with the pessimism of the conventional wisdom. While we certainly have no basis for the assertion that macroeconomic policy-making in Africa is well-done, let alone optimal, the evidence is not consistent with the view that the benefits of commodity price booms are non-existent or negative, at least for African countries as a whole. Even so, our results are not reached without making assumptions about specifications and data that might affect the results, quite apart from the pervasive general doubts about the quality of data that hamper all such investigations in the African context. In this section, we consider a number of alternative specifications and data choices to try to get some sense of the robustness of the results.

The basic VARX regressions reported in Section 1 use national accounting data from the Penn Wold Tables Mark 5. The 20 commodity price index for commodity exports is deflated by an index of import prices for developing countries. The basic format assumes that the variables are trend stationary in logarithms and country specific intercepts and time-trends are included in all regressions. The equations are estimated by feasible generalized least-squares (FGLS) or seemingly unrelated regressions (SUR) under the assumption that error variances are constant over time but differ across countries. For the basic case in Table 3, the results do not differ by much if the equations are estimated by ordinary least squares (OLS) rather than FGLS. Such differences as exist are largely in the timing , with the OLS regressions showing significant contemporaneous effects of the commodity price index on output, consumption, and investment. The weighted regressions move this impact into the first lag of commodity prices except for investment where the contemporaneous impact remains significant although the first lag remains present.

The FGLS estimation effectively weights each country by a weight that is proportional to the precision of the OLS estimates, with countries with small

equation standard errors given greater weight than those where the regression predicts poorly. This interpretation raises questions about alternative weighting schemes. One possibility is to weight countries by population, so that the results can be thought of as representative of African people, rather than as representative of a typical African country, where Nigeria or the Sudan count no more than Gabon or Lesotho. Weighting the regressions by populations in 1975 generates results that are close to the OLS estimates, with most of the effects on GDP contemporaneous with changes in commodity prices.

Another specification issue is the inclusion of the country specific trends. Many of the countries display only limited deviations from stationarity over the sample period, and causal inspection of the data in Figures 1 through 4 suggests that the removal of the trends might be eliminating some of the long-run effects of commodity prices on output or output growth. However, when the basic (FGLS) regressions are re-estimated without the country specific trends the results are similar to those in Table 3 although the effect on investment is considerably muted.

The choice of deflator for the commodity price index is less than obvious. For terms of trade issues, which has been of much concern in the commodity price literature, it makes sense to deflate the prices of LDC commodity exports by the prices of their imports, but the general index used here is not country specific, and even if it were, might not be the appropriate index for short-run macroeconomic or debt-related issues. One obvious alternative is the US consumer price index, which differs from the import price index in a number of respects, but the largest difference over the period is accounted for by the different weighting of petroleum products. Since there are five countries in our data that are primarily oil exporters, the difference in weighting is potentially important, but in fact the alternative deflation makes little difference to the basic results, although the impact on government expenditure is somewhat reduced when commodity prices are deflated by the US consumer price index.

The country by country regressions of output and its lags on commodity price indexes indicate that there are some major differences across countries in the lag patterns and some of the oil producing countries show negative effects of prices on output. For the oil exporters, the index number problems for the net export component of real output are likely to be considerably more difficult than for other countries because of the large size of the export sector and the wild fluctuations in

oil prices over the period under analysis. Such large variations might also reveal weaknesses in the linearity of the specification. When the five oil-producing countries are excluded, the impact on government expenditure is much reduced, although the other equations remain much the same, a result that suggests that the oil economies may account for a good deal of the increases in government consumption associated with commodity booms.

Perhaps the most important data-related issue concerns the national income accounts. The Summers-Heston data have several virtues, not least consistency and a treatment of net exports that should eliminate any direct accounting effect of commodity price changes on real output. If there are problems with the purchasing power parity corrections that have proportional or even trend effects, they will be eliminated by the country specific trends and intercepts in our logarithmic specifications. Nonetheless, we have already seen—not least in Figures 1 through 4—that there are cases where the standard national accounts data give different results, and it seems wise to reexamine the basic results using these data. The VARX reported in Table 3 was reestimated using the output data from the World Bank's *African Economic and Financial Statistics*, a data source that allows a somewhat longer time-span (1961–86) than does the Penn World Table. The results are quite different. In the feasible generalized least squares regressions, the impact on output is attenuated, while the contemporaneous impact on consumption is *negative* but is then reversed at one lag. The impact on investment is still positive and large, though no single lag is significant at the five percent level, while the impact on government consumption is similar to that on private consumption and is also highly significant. These results are not affected by restricting the sample period to be the same as that in the basic Summers-Heston regressions. However, if the commodity price variable is restricted so that it enters only with a one year lag the results are similar to the results when the same restriction is placed on the Summers-Heston data. The effects are positive and highly significant in all equations, and compared with Table 3, the net coefficient is smaller for output but larger for investment. The private and government consumption coefficients are similar across the two data sets. The comparison between the two sets of accounts is therefore much more destructive for the detailed dynamics of the effects of commodity prices, than it is for the broad conclusions over the medium term, a conclusion that is reinforced by the close correspondence of the two sets of results in Table 4.

Another specification issue is the assumption of trend-stationarity. The obvious alternative is a specification in first-differences, and the VARX was estimated in this form including only country-specific intercepts. Although the estimates of long-run persistence are quite different by construction, the estimated elasticities are again quite similar. The impact on investment becomes quite large, with a one percent permanent increase in the commodity price leading to a cumulative 0.35 percent increase in investment, accounting only the direct effects. Once again, there are positive effects in all equations. When the alternative national accounts data are used in place of Summers-Heston, the results are similar in differences to the corresponding results in levels, and are again quite different from the Summers-Heston data in either levels or differences. But once again, the difference between the two data sets disappears when the price index is restricted to enter only at the first lag.

We have also investigated the re-estimation of the VARX in Table 3 using 'impact weighting,' the rescaling of the commodity price index by the share of the 20 commodity exports in GDP in 1975. Impact weighting leaves significant effects of commodity prices in all the components of GDP, although the effects are largely contemporaneous, and the impacts are rather smaller than in the base regression when corrected for the average size of the weights. Restricting commodity prices to enter with only a one year lag still yields significant estimates although with a smaller effect on consumption. For the alternative national accounts data, the weighting makes no appreciable difference to the results.

5. Conclusions

This paper has examined the empirical consequences of commodity price booms in a cross-section of African countries. Starting from the analysis in Deaton (1993), we have improved the way in which we measure commodity prices, including more commodities in the index, and thus increasing the number of countries that we can study. The results confirm the earlier evidence, not that African policy makers necessarily handle commodity price fluctuations well, but that the effects of price increases have been generally benevolent, as might at first be supposed. Increases in prices are associated most strongly with increased investment, and subsequently with increased consumption and output; as is to be expected, there are short-run negative effects on the real balance of trade, but there is no evidence of a medium

or long-run deterioration associated with a commodity price boom. We have looked in some detail at the individual country evidence, which is quite heterogeneous, although there is clear evidence overall that African countries grow faster when the prices of their exports are increasing than is the case when prices are falling. Our estimates suggest that perhaps one fifth of the decline in the rate of economic growth in Africa in 1980–85 as compared with 1970–75 can be attributed to the behavior of commodity prices. We have also examined whether commodity price booms lead to debt and inflation. It is true that the countries that experienced commodity price booms in the late 1970s accumulated a great deal of long-term external debt then and in the 1980s. But so did many other African countries who experienced no such booms or whose commodity prices were actually declining, and we find no clear association between debt and commodity price booms. There is more evidence that commodity price increases generate inflation, but the effect is a modest one, particularly once we have eliminated the mechanical accounting effects of commodity prices on the price measures. Since these results are contrary to what has become the conventional wisdom, and since all empirical results based on African data must be treated with caution, we have conducted a range of robustness tests, with different data and with different methodologies. Although the results are different in detail, with the timing of the effects quite sensitive to the use of 'official' versus 'purchasing power parity' national accounting data, the broad picture is the same; increases in the world prices of commodity exports are beneficial to African economies, and decreases are harmful.

6. References

American Metal Market, 1978, *Metal Statistics 1978*, New York. Fairchild Publications.

Aron, Janine, 1992, 'Mismanaged mineral trade shocks: the Zambian copper boom and crash 1964–80,' Centre for the Study of African Economies. Oxford, processed. (Oct.)

Bevan, David, Paul Collier, and Jan Willem Gunning, 1989, *Peasants and governments: an economic analysis*, Oxford. Clarendon Press.

—— —— and ——1990, *Controlled open economies: a neoclassical approach to*

structuralism, Oxford. Clarendon Press.

—— —— and ——1991, 'Temporary trade shocks in developing countries: consequences and policy responses,' Centre for the Study of African Economies. Oxford, processed. (Jun.)

Deaton, Angus S., 1993, 'Commodity prices, stabilization, and growth in Africa,' Institute for Policy Reform, Washington, D.C. and Princeton University Research Program in Development Studies, processed. (Apr.)

Devarajan, Shantayanan, 1991, 'Cameroon's oil boom of 1978–85,' World Bank and Harvard University, processed. (Oct.)

Gelb, Alan, 1988, *Oil Windfalls: Blessing or Curse*, Oxford University Press for the World Bank.

OECD, annual, *Uranium: resources, production, and demand*, Paris.

Jenkins, Gilbert, ed., 1989, *Oil economists' handbook*, New York. Elsevier Applied Science. (5th ed.)

Radetski, Marian, 1981, *Uranium: a strategic source of energy*, New York. St. Martin's Press.

Summers, Robert, and Alan Heston, 1991, 'The Penn World Table (Mark 5): an expanded set of international comparisons, 1950–1988,' *Quarterly Journal of Economics*, **106**, 327–68.

United Nations, 1987, *UNCTAD Commodity handbook 1986*, New York. United Nations.

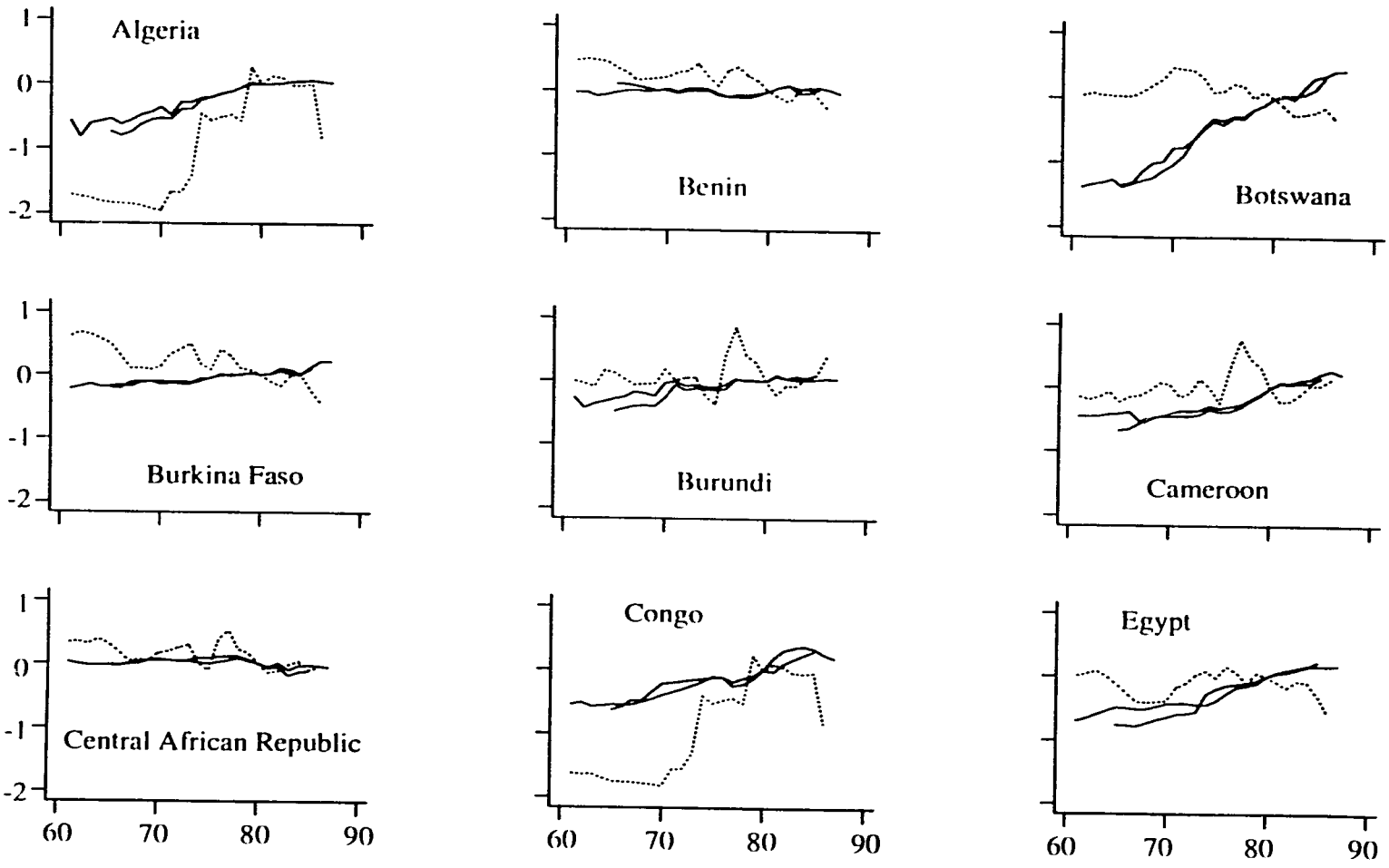

Figure 1: Indices of GDP (solid lines) and commodity prices (broken lines)

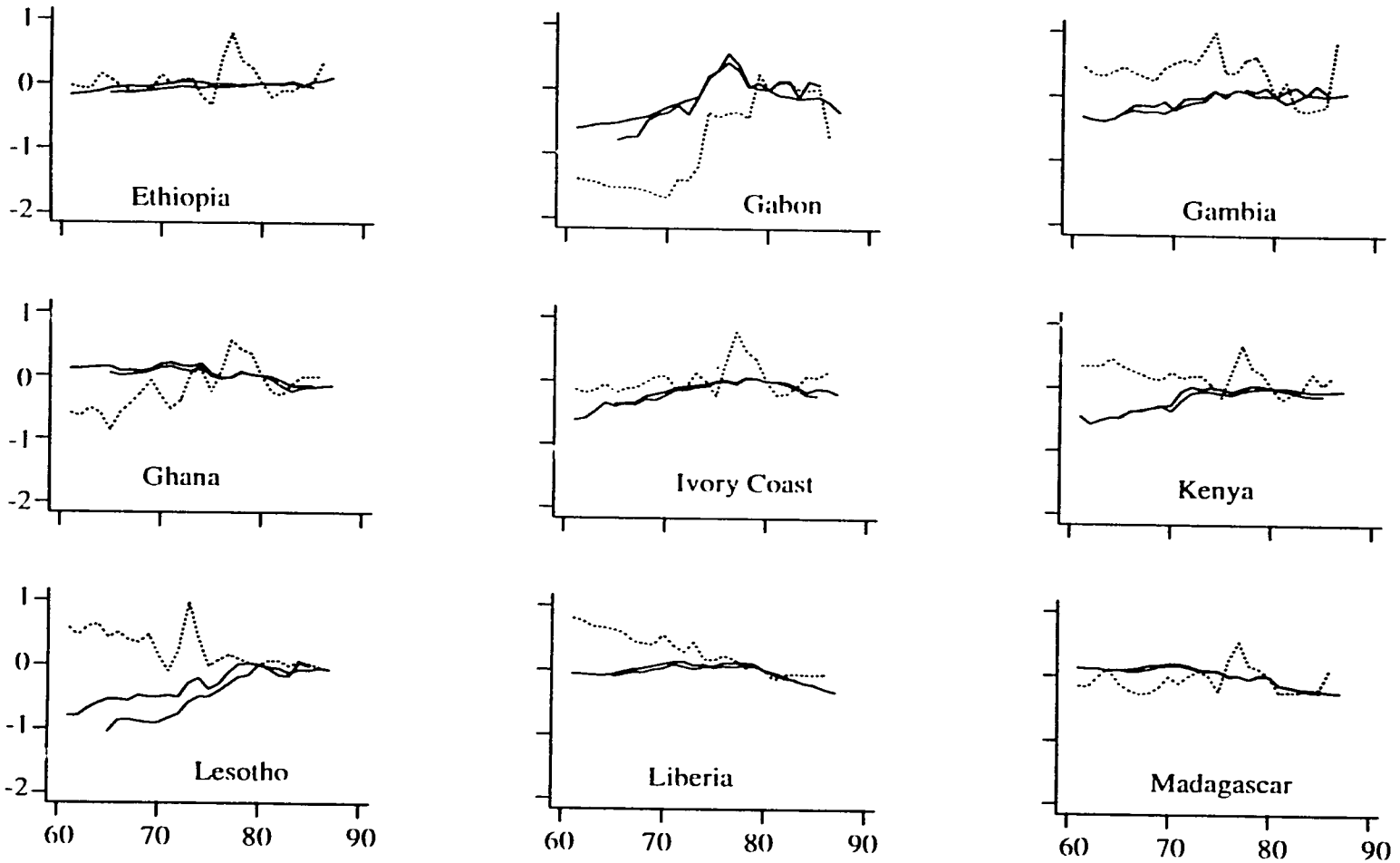

Figure 2: Indices of GDP (solid lines) and commodity prices (broken lines)

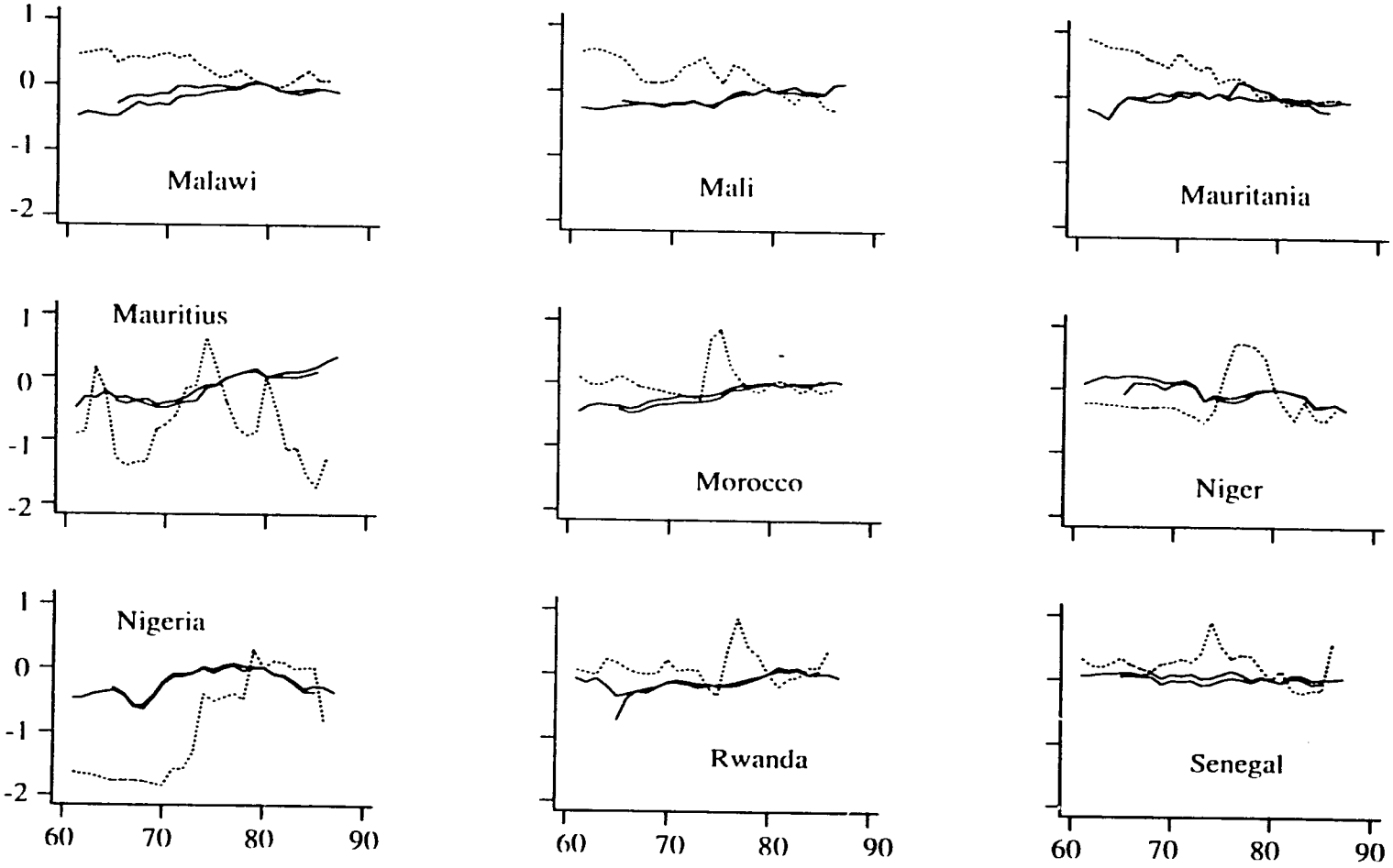

Figure 3: Indices of GDP (solid lines) and commodity prices (broken lines)

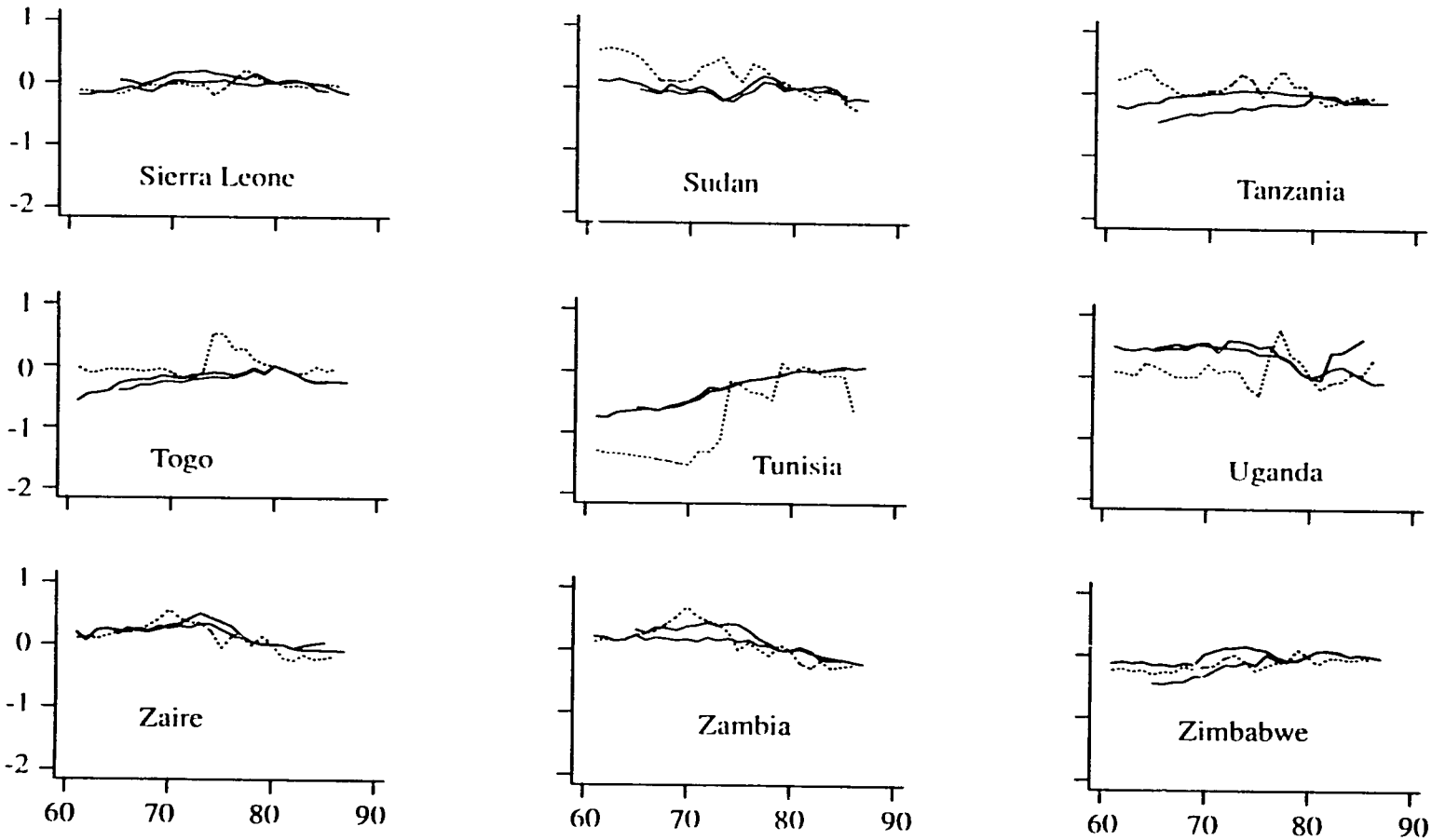

Figure 4: Indices of GDP (solid lines) and commodity prices (broken lines)

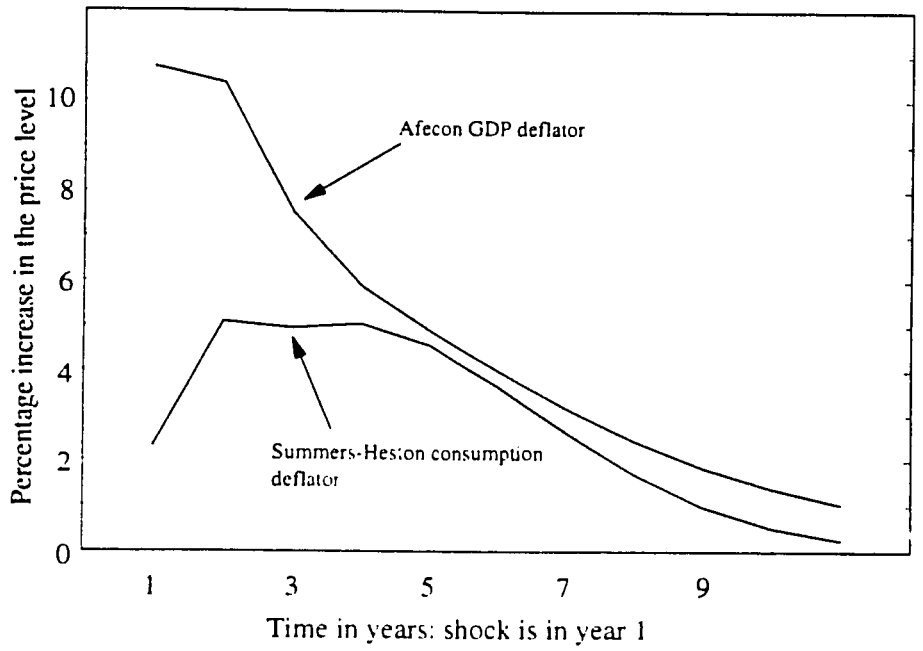

Figure 5: Impulse responses of prices in response to commodity prices

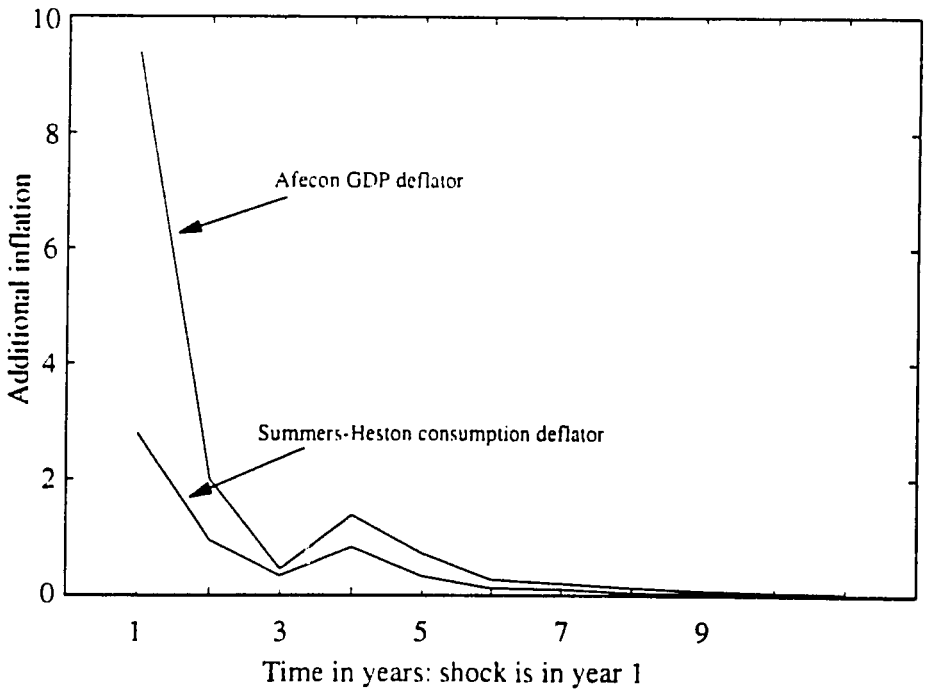

Figure 6: Impulse reponse function of inflation to commodity price growth

Table 1: Commodities included in the index

bauxite	gold	oil-palm products	sugar
cocoa	groundnuts	nickel	tea
coffee	iron	phosphates	tobacco
copper	manganese	rubber	uranium
cotton	oil	sisal	wool

Table 2: African countries and the distribution of their exports in 1975 across 20 primary commodities (percentages)

Algeria	coffee 0.0, copper 0.0, iron 0.5, oil 98.9, phosphates 0.6, tobacco 0.0
Benin	cocoa 9.4, coffee 2.6, cotton 62.5, groundnuts 3.9, oilpalm 12.7, tobacco 8.9
Botswana	copper 17.5, nickel 82.6
Burkina Faso	cotton 100.0, groundnuts 0.0
Burundi	coffee 93.7, cotton 3.0, tea 3.3
Cameroon	cocoa 40.9, coffee 44.6, cotton 4.4, groundnuts 0.0, oilpalm 3.6, rubber 4.2, sugar 0.1, tea 0.2, tobacco 2.0,
C.A.R	cocoa 0.4, coffee 38.6, cotton 56.0, groundnuts 0.3, tobacco 4.7
Congo	cocoa 2.2, coffee 0.7, copper 0.8, groundnuts 0.0, oil 92.1, oilpalm 0.2, sugar 3.0, tobacco 1.1
Egypt	cotton 70.0, oil 20.8, phosphates 3.9, sugar 5.3
Ethiopia	coffee 88.8, cotton 7.1, groundnuts 5.4, sugar 3.6
Gabon	coffee 0.0, manganese 13.8, oil 86.2, oilpalm 0.0, sugar 0.0
Gambia	groundnuts 97.7, oilpalm 2.3
Ghana	bauxite 5.4, cocoa 80.2, coffee 0.7, gold 13.6, oilpalm 0.0, tobacco 0.0
Ivory Coast	cocoa 38.2, coffee 48.5, cotton 2.4, groundnuts 0.0, oilpalm 9.6, rubber 1.4
Kenya	coffee 45.8, cotton 2.6, oilpalm 0.0, sisal 12.9, sugar 0.1, tea 38.5
Lesotho	wool 100.0
Liberia	cocoa 1.5, coffee 1.8, iron 79.9, oilpalm 0.2, rubber 16.7
Madagascar	cocoa 1.4, coffee 71.2, groundnuts 1.6, sisal 10.5, sugar 14.1
Malawi	coffee 0.2, cotton 2.4, groundnuts 0.3, sugar 11.0, tea 27.4, tobacco 58.7
Mali	cotton 87.8, groundnuts 11.0, tea 0.5, tobacco 0.8
Mauritania	copper 4.6, iron 95.4
Mauritius	sugar 98.7, tea 1.3
Morocco	copper 0.4, cotton 0.1, iron 0.5, manganese 0.9, phosphates 98.2
Niger	cotton 0.1, groundnuts 5.8, uranium 94.1
Nigeria	cocoa 4.1, coffee 0.0, groundnuts 0.0, oil 94.0, oilpalm 1.4, rubber 0.4
Rwanda	coffee 87.3, tea 12.7
Senegal	cotton 2.2, groundnuts 66.0, phosphates 31.7, sugar 0.0
Sierra Leone	bauxite 56.5, cocoa 7.9, coffee 8.2, iron 16.3, oilpalm 11.3
Sudan	cotton 92.1, groundnuts 7.9
Tanzania	cocoa 0.4, coffee 31.8, cotton 23.8, groundnuts 0.0, oilplam 0.0, sisal 25.7, sugar 3.4, tea 6.3, tobacco 8.6
Togo	cocoa 21.0, coffee 9.0, cotton 1.6, groundnuts 0.2, oilpalm 2.5, phosphates 65.6
Tunisia	oil 74.8, phosphates 22.4, sugar 2.0, tobacco 0.0
Uganda	cocoa 0.1, coffee 78.3, copper 3.2, cotton 10.6, tea 7.1, tobacco 0.9
Zaire	cocoa 1.0, coffee 10.3, copper 79.6, cotton 0.2, gold 2.2, groundnuts 0.0, manganese 1.0, oilpalm 2.8, rubber 2.1, tea 0.9
Zambia	copper 98.5, tobacco 1.5
Zimbabwe	coffee 1.3, cotton 12.0, gold 34.5, nickel 15.9, tea 1.8, tobacco 34.5

Table 2 Notes: The figures show the 1975 distributions by commodity for each country of total exports of the 20 commodities, so that, apart from rounding errors, the numbers add to 100. Several important commodities are excluded for data reasons: diamonds (Botswana, Sierra Leone), lumber (Cameroon, Ghana), gum arabic (Sudan), chrome (Sierra Leone), vanilla and cloves (Madagascar), beef (Botswana) and cobalt (Zaire). An entry of 0.0 indicates that the commodity is included for that country, but the fraction is less than a tenth of one percent.

Sources: Shares are computed from combining 1975 prices with physical quantities. The quantities for all except bauxite, gold, nickel, rubber, uranium, and wool are taken from the World Bank's African Economic and Financial data diskettes. The prices for all but oil and uranium come from *International Financial Statistics*. Prices selected are those closest to a world price included in *IFS*, with the African option selected when possible, *e.g.* Ugandan coffee prices in New York, Ghanian cocoa in London, East African sisal, Nigerian groundnuts in London, Sudanese cotton, and Moroccan phosphate. Quantities of oil are reported in metric tonnes while standard price series are reported in $ per barrel. The per barrel price was converted to a metric tonne basis using the density of Nigerian crude taken from Jenkins (1989) which also supplied the oil price series (Arabian light crude, since there is no African series reported.) The physical quantities for 1975 for bauxite, nickel, rubber and wool come from the 1986 UNCTAD commodities handbook, United Nations (1987). Quantity figures for gold are taken from American Metal Market (1978), and for uranium from OECD (19??). The uranium price series comes from American Metal Market and from Radetski (1981) and are spot prices on the NUEXCO exchange for U_3O_8.

Table 3: VARX for commodity prices and components of GDP

	income	consumption	investment	government
$\ln y_{t-1}$	0.84 (11.5)	0.20 (1.9)	0.92 (3.2)	0.23 (1.7)
$\ln y_{t-2}$	0.11 (1.2)	0.15 (1.2)	0.02 (0.1)	0.18 (1.1)
$\ln y_{t-3}$	–0.28 (3.7)	–0.13 (1.2)	–0.08 (0.3)	–0.17 (1.2)
$\ln c_{t-1}$	–0.03 (0.8)	0.52 (7.5)	–0.23 (1.3)	–0.02 (0.2)
$\ln c_{t-2}$	–0.07 (1.4)	–0.06 (0.7)	–0.18 (0.9)	–0.08 (0.8)
$\ln c_{t-3}$	0.05 (1.0)	–0.10 (1.4)	–0.05 (0.3)	0.04 (0.4)
$\ln i_{t-1}$	0.03 (2.8)	0.02 (1.3)	0.61 (12.8)	0.03 (1.6)
$\ln i_{t-2}$	–0.03 (2.2)	–0.03 (1.7)	–0.08 (1.5)	–0.04 (1.5)
$\ln i_{t-3}$	0.02 (1.5)	0.00 (0.1)	–0.13 (2.8)	0.03 (1.2)
$\ln g_{t-1}$	0.01 (0.3)	–0.02 (0.6)	–0.12 (1.3)	0.72 (14.2)
$\ln g_{t-2}$	–0.06 (2.2)	–0.07 (1.7)	–0.07 (0.6)	–0.11 (1.9)
$\ln g_{t-3}$	0.02 (1.0)	0.04 (1.3)	–0.01 (0.1)	–0.12 (2.3)
$\ln p_t$	0.00 (0.5)	0.01 (0.8)	0.10 (2.8)	–0.02 (1.3)
$\ln p_{t-1}$	0.03 (2.8)	0.03 (2.0)	0.09 (2.0)	0.08 (4.4)
$\ln p_{t-2}$	0.00 (0.0)	–0.00 (0.2)	–0.02 (0.9)	–0.02 (0.9)
$\ln p_{t-3}$	0.01 (1.1)	0.03 (2.0)	0.06 (1.6)	–0.01 (0.8)

Notes: Estimated coefficients from SUR estimation of a four equation system of log GDP, log consumption, log investment, and log government expenditure. The SUR variance covariance matrix is estimated from first-stage OLS residuals. Different countries are allowed to have the same error variances but are constrained to have the same correlation matrix of the cross-equation innovations.

Table 4: Effects of commodity prices on GDP using five-year non-overlapping growth rates

	no weighting		*'impact' weighting*	
	no dummies	*country dummies*	*no dummies*	*country dummies*
Summers–Leston data				
no lag	0.086 (2.2)	0.056 (1.4)	0.548 (2.5)	0.329 (1.4)
one year lag	0.090 (2.5)	0.070 (2.0)	0.514 (2.6)	0.340 (1.6)
two year lag	0.096 (2.4)	0.074 (1.8)	0.343 (1.3)	–0.160 (0.5)
three year lag	0.066 (2.0)	0.041 (1.2)	–0.064 (0.3)	–0.606 (2.4)
IFS data				
no lag	0.028 (0.9)	0.026 (0.8)	0.512 (2.7)	0.407 (2.1)
one year lag	0.100 (2.8)	0.084 (2.3)	0.536 (3.2)	0.474 (2.8)
two year lag	0.123 (3.8)	0.118 (3.7)	0.326 (1.4)	0.057 (0.2)
three year lag	0.085 (2.3)	0.074 (1.9)	0.054 (0.3)	–0.287 (1.4)

Notes: In the 'impact weighted' regressions, the logarithmic commodity price indexes are weighted by the share of the commodity exports in GDP in 1975.

Table 5: Effects of commodity prices on long-term debt using three-year non-overlapping growth rates

	no weighting		*'impact' weighting*	
	no dummies	*country dummies*	*no dummies*	*country dummies*
no lag	–0.075 (0.8)	–0.085 (0.8)	0.337 (0.6)	0.669 (0.9)
one year lag	–0.039 (0.5)	–0.041 (0.5)	–0.270 (0.5)	–0.303 (0.5)
two year lag	–0.084 (1.2)	–0.090 (1.2)	–0.487 (1.0)	– 0.570 (1.0)
three year lag	–0.113 (1.2)	–0.132 (1.3)	–0.950 (1.7)	– 1.344 (1.9)

Table 6: Effects of commodity prices on prices: VARX of logarithms of money and prices

	Summers-Heston consumption deflator		*AEF GDP deflator*	
	prices	*money*	*prices*	*money*
Specification in levels				
prices				
one year lag	0.675 (14.8)	0.066 (1.8)	0.866 (18.8)	0.170 (3.7)
two year lag	–0.037 (0.7)	0.012 (0.3)	–0.212 (3.6)	–0.059 (1.0)
three year lag	0.027 (0.6)	–0.014 (0.4)	0.065 (1.5)	–0.009 (0.2)
money				
one year lag	0.237 (5.6)	1.091 (24.6)	0.182 (4.9)	1.009 (21.6)
two year lag	–0.154 (2.6)	–0.319 (5.0)	–0.106 (2.1)	–0.309 (4.8)
three year lag	0.077 (1.8)	–0.090 (2.0)	0.066 (1.8)	–0.025 (0.5)
commodity prices				
no lag	0.023 (0.4)	0.149 (2.9)	0.108 (9.2)	0.059 (4.1)
one year lag	0.034 (0.4)	0.159 (2.6)	–0.067 (4.2)	0.021 (1.1)
two year lag	–0.056 (0.6)	0.039 (0.7)	0.004 (0.2)	0.011 (0.5)
three year lag	–0.053 (0.7)	–0.089 (1.7)	0.020 (1.4)	0.048 (3.2)
Specification in log differences				
inflation				
one year lag	–0.013 (0.3)	0.053 (1.4)	0.156 (3.3)	0.151 (3.1)
two year lag	–0.010 (0.2)	0.025 (0.7)	–0.042 (0.9)	0.033 (0.7)
three year lag	0.060 (1.4)	–0.026 (0.7)	0.078 (1.7)	–0.006 (0.1)
money growth				
one year lag	0.247 (6.1)	0.380 (8.4)	0.138 (3.7)	0.339 (7.2)
two year lag	–0.011 (0.2)	–0.053 (1.1)	0.038 (1.0)	–0.073 (1.5)
three year lag	0.141 (3.4)	0.030 (0.7)	0.098 (2.6)	0.010 (0.2)
commodity price growth				
no lag	0.028 (2.2)	0.040 (2.9)	0.094 (7.5)	0.039 (2.8)
one year lag	–0.012 (0.9)	0.059 (4.2)	–0.006 (0.5)	0.047 (3.2)
two year lag	0.001 (0.1)	0.033 (2.3)	–0.007 (0.6)	0.033 (2.2)
three year lag	–0.023 (1.8)	0.046 (3.2)	0.015 (1.2)	0.052 (3.5)

Note: Impact weighted by the average share of exports of the 20 commodities in GDP. Excludes Liberia and Lesotho, where no money supply data are available, 1975 for Kenya and Tanzania, and Botswana before 1976 and Zimbabwe before 1975. The AEF GDP deflator is taken from the World Bank's African Economic and Financial diskettes. The construction of the Summers-Heston consumption deflator is explained in the text.