Non-oil commodity prices: Cyclical weakness or secular decline?

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Commodity Prices: Cyclical Weakness or Secular Decline?

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Abstract

Primary commodities still account for the bulk of exports in many developing countries. However, real commodity prices have been declining almost continuously since the early 1980s and there is evidence of renewed weakness. The appropriate policy response to a terms of trade shock depends importantly on whether the shock is perceived to be temporary or permanent. Our results indicate that the recent weakness in commodity prices is mostly of a secular nature, stressing the need for commodity exporting countries to concentrate on export diversification and other structural policies. There is, however, scope for stabilization funds and the use of hedging strategies since the evidence also suggests commodity prices have become more volatile.

JEL Classification Numbers:
C22, E3, and E61

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I. Introduction

Primary commodities still account for the bulk of exports in many developing countries. In effect, the reliance on primary commodities as the main source of export earnings has not diminished for many countries, particularly in Africa, where manufactures often account for less than 15 percent of merchandise exports (see Table 1). However, real commodity prices have been declining almost continuously since the early 1980s and there is evidence of renewed weakness. 1/ Since their short-lived recovery in 1984, real commodity prices have fallen by about 45 percent, translating into a sharp deterioration in the terms of trade for most commodity exporters. Not surprisingly, the performance of real export earnings for many developing countries during the 1980s and 1990s has been closely linked to the countries' success in diversifying their export base. 2/ As Table 2 highlights for a selected group of countries, the Asian experience is characterized by a marked shift toward the export of manufactures and strong increases in real export earnings; at the other extreme, the African reality can be generally described as one where continued reliance on primary commodity exports has resulted in a marked and persistent deterioration in real export earnings.

As Chart 1 illustrates, during 1992 (the latest year for which an annual average is available) the price of commodities relative to that of manufactures reached its lowest level in over 90 years. 3/ Thus, a casual perusal of the evolution of real commodity prices would seem to lend some support to the Prebisch-Singer hypothesis, which posits that the long term trend of the price of primary commodities relative to the price of manufactures is negative. 4/ Empirical evidence of the Prebisch-Singer hypothesis is, thus far, not conclusive and this issue has been addressed in a number of papers, including Sapsford (1985), Cuddington and Urzua (1989),

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1/ Unless otherwise noted, real commodity prices refer to the IMF all non-fuel commodity price index deflated by the IMF index of manufacturing export unit values (MEUV) of industrial countries. Both indices are in U.S. dollars. This is the traditional deflator used in analysis of international commodity prices; however, like other price indices of manufactured goods, the MEUV may fail to capture quality improvements in manufactured goods (particularly, consumer durables and capital goods).

2/ It is important to note, however, that export diversification is not the only factor explaining the marked regional differences in export performance. As will be subsequently discussed, the volume of exports of agricultural commodities surged in Asia during the 1970s and 1980s while it declined for Africa during the same period.

3/ The sustained decline predates our sample period of 1900-1992. Using a different commodity index that begins in 1854, Boughton (1991) documents the decline of real commodity prices during the second half of the 19th century. The source of the data plotted in Chart 1 is Grilli and Yang (1988) for the period 1900-1986 and updated by the authors for 1987-1992.

4/ See Prebisch (1950) and Singer (1950).

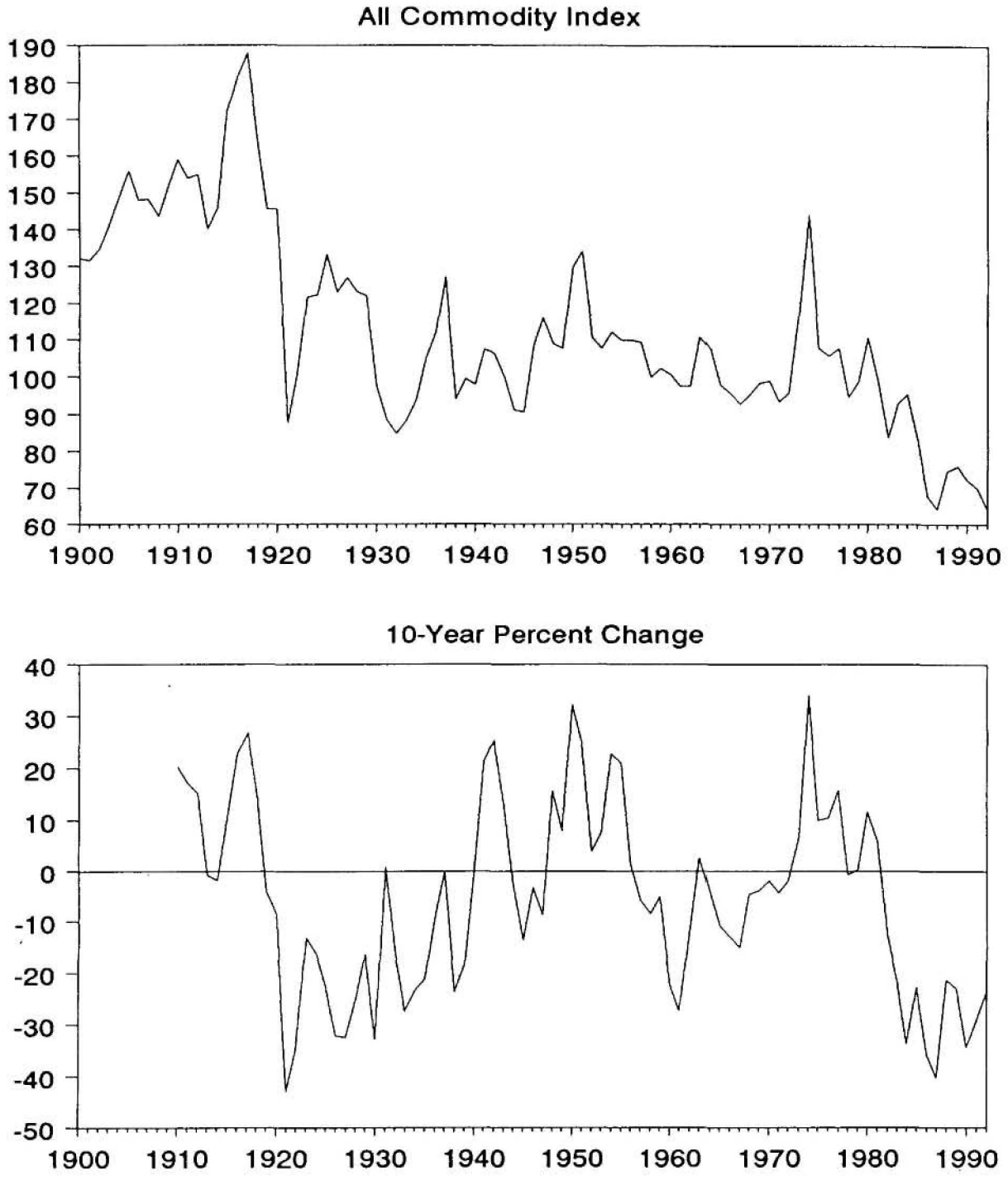
Table 1. The Structure of Merchandise Exports: Selected Developing Countries 1965 and 1990

(As a percent of merchandise exports)

Country	1965			1990		
	Fuels, minerals, and metals	Other primary commodities	Manu-factures	Fuels, minerals, and metals	Other primary commodities	Manu-factures
Africa						
Burundi	0	94	6	0	98	2
Cote d'Ivoire	2	93	5	10	80	10
Kenya	13	77	10	19	70	11
Mauritania	94	5	1	81	13	6
Senegal	9	88	3	22	56	22
Tanzania	1	86	13	5	84	11
Asia						
Malaysia	34	60	6	19	37	44
Pakistan	2	62	36	1	29	70
Philippines	11	84	5	12	26	62
Sri Lanka	0	99	1	6	47	47
Thailand	11	86	3	2	34	64
Latin America						
Argentina	1	93	6	6	59	35
Bolivia	93	4	4	69	27	14
Brazil	9	83	8	16	31	53
Colombia	18	75	7	32	42	26
Mexico	22	62	16	43	13	54
Uruguay	0	95	5	0	60	40

Source: World Development Report, 1992, World Bank.

Chart 1. Real Commodity Prices: Long-Term Developments, 1900 - 1992



Sources: Grilli and Yang and International Monetary Fund.
Note: Commodity prices are deflated by the export unit values of manufactured goods.

Table 2. Real Export Earnings 1970-92 1/

(Average annual percent change)

Country	1970 - 1979	1980 - 1992
Africa		
Burundi	3.7	-3.7
Cote D'Ivoire	6.1	-8.2
Kenya	-3.0	-5.4
Mauritania	-6.6	13.2
Senegal	-0.9	3.6
Tanzania	-2.7	-5.6
Asia		
Malaysia	8.9	8.1
Pakistan	2.6	6.1
Philippines	3.8	3.5
Sri Lanka	1.2	5.9
Thailand	9.9	10.7
Latin America		
Argentina	2.5	2.2
Bolivia	9.1	-0.7
Brazil	7.4	4.6
Colombia	7.4	8.5
Mexico	11.3	5.6
Uruguay	0.5	4.3

Source: World Economic Outlook, various issues, International Monetary Fund.

1/ Real export earnings are defined as the value of exports deflated by import unit values.

and Ardeni and Wright (1992). Of more practical concern to the policymaker, the presence of a negative trend or a series of downward shifts in prices (see Powell (1991)) implies that efforts to stabilize the incomes of commodity producers for an extended period of time must take into account the fact that real commodity prices have not shown signs of fluctuating around a constant mean.

The aim of the paper is to provide the general stylized facts about the behavior of commodity prices that may be useful in formulating the policy response to commodity price shocks. For instance, as noted by Cuddington and Urzua (1989), and Deaton (1992), the usefulness of a stabilization fund will depend crucially on whether the shocks to commodity prices are primarily of a temporary or a permanent nature. Further, even if temporary shocks play a dominant role, the ability to stabilize will depend on the persistence of shocks and the duration of cycles. Similarly, as Ghosh and Ostry (1993) argue, the benefits that can be obtained from stabilization funds, or more generally, from precautionary savings will be greater in a more volatile and uncertain environment. This is because, the more uncertain is a country's export revenue stream, the greater the value to that country of accumulating assets as a means of insuring itself against future shocks. Hedging strategies, as well, acquire greater importance as volatility and uncertainty increase.

This paper examines these issues using quarterly data for the 1957:I-1993:II period for some of the major commodity groupings: an all non-oil commodity basket, beverages, food, and metals. A number of empirical regularities emerge from the analysis. First, alternative methods of decomposing time series into their secular (trend) and cyclical (temporary) components yield a common result--the recent weakness in real commodity prices is primarily of a secular persistent nature, and not the product of a large temporary deviation from trend. The former observation would suggest that a rebound in real commodity prices to their pre-1980s level, while always possible, does not appear probable. Second, the relative importance of permanent shocks varies considerably across commodity groupings: while permanent shocks account for only 30 percent of the variance of metals prices, they account for about 85 percent of the variance of beverage prices. Third, the characteristics of the cycle also vary markedly across commodities. Shocks are the least persistent for metals and the most persistent for beverages. The previous two observations suggest that the scope for stabilization policies appears to be very commodity-specific. Lastly, the volatility in commodity prices has risen steadily and considerably since the early 1970s, particularly for the once relatively-stable food grouping.

The paper proceeds as follows. Section II reviews recent price developments, presents a quantitative measure of the relative importance of permanent (versus temporary) shocks in explaining the variation in real commodity prices, and examines how the volatility of commodity prices has evolved over time. The analysis in Section III aims to disentangle to what

extent the recent weakness in commodity prices reflects cyclical forces (related to, say, recession in several of the industrial countries), and to what degree the weakness is secular and due to more persistent causes (technological change, for instance). The characteristics of the cycle are also examined in this section. Section IV briefly summarizes the major factors that lie behind the observed weakness in commodity prices. Policy implications for countries adjusting to terms of trade shocks are taken up in the final section.

II. Stylized Facts

This section briefly reviews recent price developments. The time series properties of commodity prices are analyzed and a quantitative measure of the relative importance of permanent shocks in explaining the variation in real commodity prices is presented. Lastly, we use a variety of tests to determine if the nature of the shocks to commodity prices has changed over the course of the sample and examine how the volatility of commodity prices has evolved over time.

1. How important is the permanent component of price shocks?

As noted earlier, the design and feasibility of stabilization and hedging strategies depend importantly on the nature of the shock. At the risk of oversimplifying, it can be said that income stabilization policies and hedging are useful in dealing only with temporary and, preferably, short-lived shocks. Permanent shocks require adjustment and, possibly, the implementation of structural policies. To determine how important a role, if any, permanent shocks play in explaining the variability in commodity prices, we proceed in two steps. First, we establish the time series properties of the various commodity indices via the standard Augmented Dickey-Fuller (ADF) and the Phillips-Perron unit root tests under two alternative hypotheses: the first of these assumes no structural breaks occurred within the sample; the second allows for a one-time break in both the mean and the trend at a pre-specified point in time (see Perron (1988)). 1/ If the series is stationary, all shocks are temporary and the null hypothesis of a unit root is rejected. If the null hypothesis is not rejected, then the series has a permanent component of unknown size. Second, to determine the size of the permanent component we employ Cochrane's (1988) methodology, which provides a measure of the persistence of shocks to a variable by examining the variance of its long differences.

The form of the ADF test employed, given by equation (1), allows for both the presence of a constant (nonzero mean) and a constant deterministic

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1/ As will be shown later, commodity prices exhibit heteroskedastic behavior in the sample considered. Hence, the Phillips-Perron test, which can handle more general forms of heteroskedasticity, is the more appropriate unit root test.

drift. To ensure that the regression residuals are serially uncorrelated, past differences of the variable (denoted by Δ) are also included. As suggested by Campbell and Perron (1991), we begin by including a generous number of lags; if the past differences do not enter significantly, these are dropped sequentially. 1/ Similarly, the Phillips-Perron test allows for constant and drift terms.

$$\Delta y_t = \mu + \beta t + \alpha y_{t-1} + \sum_{i=1}^{k} \delta \Delta y_{t-i} + e_t \qquad (1)$$

The results of the unit root tests, which are summarized in Table 3, uniformly indicate that, when no breaks are assumed, for the log of the price series examined the null hypothesis of a unit root could not be rejected at standard confidence levels. 2/ Perron (1989), however, has suggested that it is important to model large "shocks" which may result in a one-time break in either the level, the slope (or both of these) of macroeconomic time series when testing for unit roots. Standard unit root tests, Perron (1988) shows, have little power to distinguish between nonstationarity and stationarity around a broken trend. The 1973 oil price shock, for instance, may have had persistent effects on real commodity prices.

To examine this possibility, the deterministic component was modelled to incorporate a single structural break, at which time both the level and slope of the deterministic component changed (the exact specification used is shown in the bottom panel of Table 3). As in Perron (1988) the sample behavior of the data was allowed to indicate where the "potential" break, denoted in the Table by T_B, occurred. These breaks are timed closely with the oil shock for the all-commodities, food, and metals baskets. For beverages the 1977 coffee supply shock appears as the best candidate of a behavioral change. The actual prices and the deterministic broken trends are plotted in Chart A.1. As Table 3 shows, the results of the Perron unit root tests indicate that the metal index is stationary around the broken trend while for the food and beverages indices the unit root hypothesis cannot be rejected. For the all-commodity index the results are ambiguous, but the more powerful Phillips-Perron tests indicate nonstationarity. However, the power of the Perron tests has recently come into question (see Zivot and Andrews (1992)) and their analysis shows these results should be interpreted with care. Given that: (a) there are ambiguities about the exact time series properties of some of the commodity price indices (all-commodities and metals), (b) the more general concerns about the power of the Perron test, (c) the lack of consensus in the literature about the

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1/ In the case of most commodity price indices studied here, the choice of lag length is not trivial, as it can change the results. For a detailed discussion of this issue see Cuddington and Wei (1992).

2/ The unit root hypothesis could be rejected for metals at the 10 percent confidence level.

Table 3. The Unit Root Tests 1957:I-1993:II

Alternative hypothesis: no structural breaks

Regression: $\Delta y_t = \mu + \beta t + \alpha y_{t-1} + \sum_{i=1}^{k} \delta \Delta y_{t-i} + e_t$

Series	k	t-statistic on α (A.D.F. statistic)	Phillips-Perron statistic
All commodities	5	-2.1353	-2.6112
Beverages	5	-2.5308	-1.4472
Food	3	-1.8665	-2.4743
Metals	1	-3.3555	-3.2849

Critical values	1%	5%	10%
150 observations 1/	-3.73	-3.46	-3.16

Alternative hypothesis: one-time structural break occurring at T_B

Alternative Hypothesis: $y_t = \mu_1 + \beta_1 t + (\mu_2 - \mu_1) DU_t \; (\beta_2 - \beta_1) DT_t + e_t$

Regression: $\Delta \hat{y}_t = \alpha \hat{y}_{t-1} + \sum_{i=1}^{k} \delta \Delta \hat{y}_{t-i} + e_t$

Series	T_B	t-statistic α (A.D.F.)	Phillips-Perron	λ	Critical values 2/ 1%	5%	10%
All commodities	73:I	-6.449	-4.306	0.4	-4.81	-4.22	-3.95
Beverages	76:I	-3.353	-3.955	0.5	-4.90	-4.24	-3.96
Food	73:I	-4.082	-3.949	0.4	-4.81	-4.22	-3.95
Metals	74:III	-4.558	-3.659	0.5	-4.90	-4.24	-3.96

1/ The critical values are taken from Guilkey and Schmidt (1989). The number of observations in the sample period is 146.

2/ These are taken from Perron (1989). Chart A.1 plots the fitted broken trends to the data.

existence and timing of breaks, we proceed under the hypothesis that the series in question have a unit root component. 1/2/

However, as the unit root tests are silent as to the size and relative importance of the permanent component, we proceed to shed light on this issue by employing the methodology proposed by Cochrane (1988). Specifically, if the variable y has the following representation,

$$y_t = \delta y_{t-1} + \epsilon_t, \quad where \ \ \epsilon_t \sim N(0,\sigma^2_\epsilon). \tag{2}$$

then if δ=1 and the disturbance term, ϵ, is white noise, then y follows a random walk and the variance of its k-differences grows linearly with the difference

$$var(y_t - y_{t-k}) = k\sigma^2_\epsilon. \tag{3}$$

If δ<1, so y is a stationary process, the variance of its k-differences is given by

$$var(y_t - y_{t-k}) = \sigma^2_\epsilon(1-\delta^{2k})/(1-\delta^2) \tag{4}$$

Therefore, the ratio $(1/k)var(y_t-y_{t-k})/var(y_t-y_{t-1})$ is equal to one if y is a random walk. If y is stationary all shocks eventually die out, so the variance ratio converges to zero. If y is a more general I(1) process, which has both permanent and temporary (stationary) components, the ratio will converge to the ratio of the variance of the permanent shock to the total variance of y. Thus, the closer that ratio is to unity, the larger the size of the unit root component and the lower is the relative importance of temporary shocks. In the limiting case, where the ratio converges to unity, there would be no scope for stabilization policies since all shocks are permanent. The presence of an important temporary component, however, does **not** guarantee that price (and/or income) stabilization policies will be feasible, since persistence in the temporary component may be so high so as to make stabilization extremely costly. Hence, as regard stabilization policies, "temporariness" is a **necessary** but **not sufficient** condition. The nature of and persistence in the temporary component will be examined in the following section.

Table 4 summarizes the main results. The values of k range between one and twenty years. For each of the four commodity indices, permanent shocks

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1/ See for instance, Cuddington and Urzua (1989), Powell (1991), and Ardeni and Wright (1992).

2/ As will be subsequently discussed, the main stylized facts that emerge as well as the policy implications, will not change considerably if the Perron test results are taken at face value and the all-commodity and metals indices are treated as stationary around a broken trend. For the food and beverage indices this is not an issue, as all the test results uniformly indicate the existence of a unit root.

Table 4. $1/k$ Times the Variance of k-Differences 1/
1957-92

σ_k^2/σ_1^2 for various k (Years)					
2	4	8	10	12	20
		All commodities			
1.032	0.465	0.524	0.448		
(0.007)	(0.013)	(0.022)	(0.026)		
		Beverages			
1.176	1.220	0.904	0.998	1.260	0.846
(0.007)	(0.013)	(0.025)	(0.029)	(0.033)	(0.039)
		Food			
1.188	0.816	0.682	0.613	0.731	
(0.007)	(0.013)	(0.021)	(0.024)	(0.027)	
		Metals			
1.099	0.481	0.333	0.287		
(0.007)	(0.013)	(0.022)	(0.026)		

1/ Annual data was used. All commodity price indices are deflated by the export unit values of manufactures. Standard errors are in parentheses. The standard errors were tabulated from Monte Carlo simulations (600 replications) for n=35 and k=10, 12, and 20 under the null hypothesis of a random walk.

play a role in explaining the variance of commodity prices. However, its relative importance varies considerably across commodity groupings and just as much within groupings (see Cuddington (1992)). Permanent shocks are least important for metals (29 percent of the variance of yearly changes) and most important (85 percent) for beverages. The all commodity index, reflecting the differing characteristics of its components, falls in the middle of the range, with permanent shocks accounting for about 45 percent of the variance of yearly changes. 1/ For the two price indices with the largest unit root component, beverages and food, the ratio took the longest number of years to converge, possibly indicating that even the temporary component of these series exhibits a high degree of persistence. The policy implications of these findings are discussed in the final section.

It is worth noting that, as this methodology is based entirely on the univariate behavior of the variable, it does not discriminate among types or sources of temporary shocks. For example, it does not distinguish between a temporary shock due to a recession in the industrial countries and a temporary shock arising from a bumper crop. Such a distinction would require a full structural model of real commodity prices (see, for example, Borensztein and Reinhart (1994)).

2. The rising volatility of commodity prices

In addition to assessing whether a commodity price is driven primarily by permanent or transitory shocks, it is important to consider other aspects of the nature of the shocks when designing policy. For instance, even if the price is stationary around a deterministic trend (so all shocks are temporary), there are relatively few gains from setting up a stabilization fund and/or hedging if the variance of prices is small and large shocks are rare. The benefits that can be obtained from stabilization funds, or more generally, from precautionary savings will increase in a more volatile and uncertain environment, as greater uncertainty in a country's export revenue stream increases the value to that country of accumulating assets as a means of insuring itself against future shocks (Ghosh and Ostry (1993)). Similarly, hedging strategies acquire greater importance as volatility increases and the probability of large destabilizing shocks is high. To examine these issues, we focus on the sample moments of the price series of interest.

To examine the issue of rising volatility, we first test for the presence of heteroskedastic disturbances and then proceed to review the descriptive statistics of commodity prices over different sample periods. The tests for heteroskedasticity on the log-differences of real commodity prices (the results for the all-commodity index are reported in Table 5)

1/ This result is in line with the findings of Cuddington and Urzua (1989), who using annual data for an all-commodity index for the period 1900-1983, find that about 39 percent of the shocks to real commodity prices are permanent.

Table 5. The Changing Variance of Commodity Prices: Tests for Heteroskedasticity 1959:I-1993:II 1/

ARCH test	$\chi^2(1) = 7.683$ (0.005)
Breusch-Pagan test	$\chi^2(3) = 6.377$ (0.095)
White's test	$\chi^2(5) = 11.034$ (0.051)

1/ Due to the nonstationarity of the data, the tests were performed on the log-differences of the real all-commodity price index.

uniformly reject the null hypothesis that the shocks to commodity prices are identically distributed during the sample period considered. 1/

These results are consistent with the picture that emerges from Table 6, which presents the evolution of the basic descriptive statistics of the real commodity indices over three subsamples. Several features are worth noting. First, the average price (as well as the mode, which is not reported) is markedly lower during the most recent sample, consistent with the presence of a negative trend. 2/ Second, there is a sustained and sharp increase in the variance of commodity prices. 3/ This is evident in all the indices but most pronounced in the all commodities and food groupings. 4/ The coefficient of variation rises sharply as prices become more volatile around a falling mean; for food the increase in the coefficient of variation is sixfold. Chart 2, which plots the coefficients of variation (based on a moving 15-year sample) for the 1972:I-1993:II period, also highlights the marked rise in volatility. Not surprisingly, the sharpest increases in volatility appear to have taken place during the early 1970's following the breakdown of the Bretton Woods exchange system and on the heels of the first oil shock. However, volatility has continued to increase during the 1980s and 1990s. Lastly, the evidence on the probability of large shocks is mixed; the distributions of commodity prices (true for all indices considered) were characterized by excess kurtosis (fat tails) during the 1970s, as large shocks became more commonplace. 5/ However, the more recent sample is characterized by relatively infrequent realizations of large shocks.

1/ It is interesting to note, that the same tests performed on the entire 1900-1992 period do not indicate heteroskedastic disturbances. Volatility was high in the pre-World War II period, diminishes drastically during the 1950s and 1960s, and rises again in the early 1970s. Hence, shocks to commodity prices were relatively small, only in a small subsample within a period of 90 years. Not surprisingly, the test for heteroskedasticity do not find that shocks to commodity prices were smaller at the beginning of the sample than at the end of the sample.

2/ As shown in Table 5, the distribution is skewed to the left for the all commodity, beverages and metals baskets.

3/ This feature has also been discussed in Deaton (1992) and Deaton and Laroque (1992).

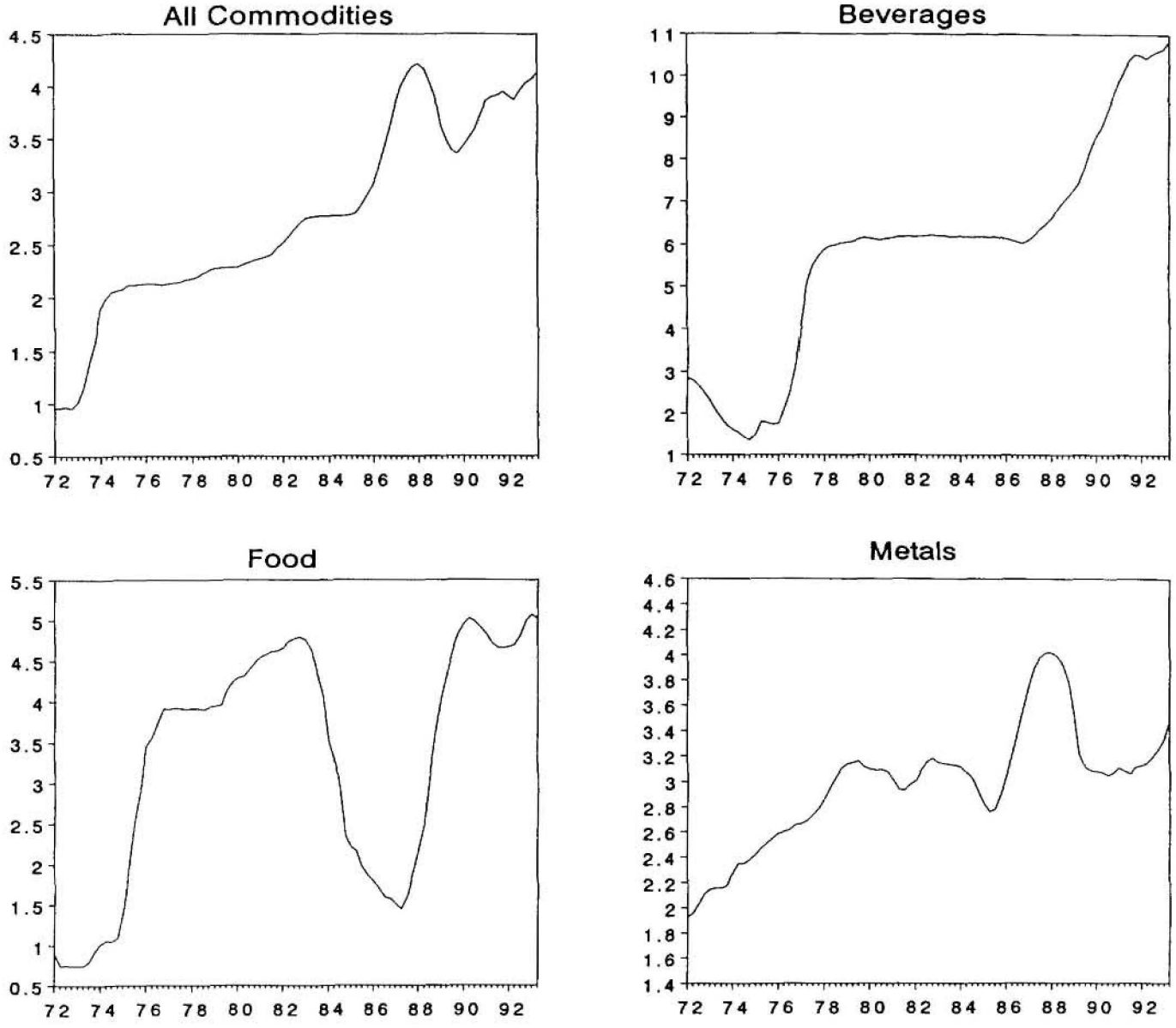
4/ For a rational expectations model that is capable of generating predictions that match some of the observed characteristics of commodity price behavior described here (high volatility, skewness, and excess kurtosis), see Deaton and Laroque (1992).

5/ This issue is not trivial, as excess kurtosis increases the value of precautionary saving. For example, for a level of consumption sufficiently close to subsistence a large adverse shock in the absence of precautionary saving could have devastating effects.

Chart 2. The Rising Volatility in Real Commodity Prices

Coefficients of Variation

1972:I - 1993:II



Sources: International Financial Statistics, IMF and the authors.

Note: The coeffcient of variation is based on fifteen-year moving averages and fifteen year standard deviations which are backward looking, hence the observation for 1972:1, for instance, is based on data from 1957:II - 1972:I.

Table 6. Descriptive Statistics
1957:I - 1993:II 1/

Sample period	1957:I - 1969:IV	1970:I - 1979:IV	1980:I - 1993:II
Number of observations	52	40	54
	All commodities		
Mean	4.714	4.705	4.386
Variance	0.001	0.017	0.031
Coefficient of variation	0.789	2.806	4.036
Skewness	1.275	1.291	-0.061
	(0.000)	(0.001)	(0.859)
Kurtosis	1.939	1.019	-1.386
	(0.008)	(0.229)	(0.052)
	Beverages		
Mean	4.573	4.668	4.203
Variance	0.018	0.112	0.199
Coefficient of variation	2.974	7.178	10.611
Skewness	1.152	0.979	-0.411
	(0.001)	(0.015)	(0.230)
Kurtosis	0.083	0.396	-1.254
	(0.909)	(0.640)	(0.078)
	Food		
Mean	4.766	4.789	4.341
Variance	0.002	0.042	0.053
Coefficient of variation	0.839	4.280	5.300
Skewness	0.428	1.129	0.138
	(0.221)	(0.005)	(0.687)
Kurtosis	-0.096	0.338	-1.526
	(0.901)	(0.690)	(0.032)
	Metals		
Mean	4.819	4.677	4.412
Variance	0.008	0.016	0.024
Coefficient of variation	1.868	2.737	3.490
Skewness	0.619	1.299	-0.250
	(0.039)	(0.001)	(0.467)
Kurtosis	-0.280	1.638	-0.802
	(0.700)	(0.053)	(0.260)

1/ The variables are the logs of the commodity index deflated by the price of manufactures. The statistics are sample moments; note that due to potential nonstationarity, the population moments may not be not well defined. The numbers in parentheses are probability values under the null hypothesis of normality.

III. Temporary Weakness or Secular Decline?

The aim of this section is to provide an idea to what extent the recent weakness in commodity prices is associated with reversible cyclical forces, or in what measure it is part of a longer-term secular decline. We employ three alternative methodologies to address this issue, the main reason for such an eclectic approach is to determine whether the results are sensitive to the choice of technique. 1/ The persistence and other features of the cycle are also examined.

1. Trend-cycle decompositions

If a unit root is present, then admissible ways of disentangling trend from cycle is either by the methodology proposed by Beveridge and Nelson (1981) or by the structural time series approach associated with Harvey (1985), as both of these approaches allow for the presence of a stochastic trend component. We apply, in turn, both of these approaches.

First, employing the Beveridge-Nelson (B-N) technique (Beveridge and Nelson (1981)) as modified by Miller (1988), we decompose the real commodity price into its "permanent" (or steady-state) component and "temporary" (or cyclical component), denoted by z and c, respectively. As discussed above, the identifying criteria for this technique is that the former captures the nonstationary component of the variable, while the latter captures its stationary element. Hence,

$$y_t = z_t + c_t \tag{5}$$

The evolution of the permanent component is given by

$$\Delta z_t = \mu + \frac{(1-\theta_1-\theta_2-\ldots-\theta_q)}{(1-\phi_1-\phi_2-\ldots-\phi_p)}\epsilon_t \tag{6}$$

where θ and ϕ are the parameters describing the ARMA process. Using the estimates of θ, ϕ, and ϵ the path of the permanent component is constructed. The cyclical component is calculated residually, as the difference between the estimated permanent component, z, and the actual values of y. 2/

Using the Box-Ljung Q statistic as a guideline, the ARMA processes were selected so as to whiten the error. In general the longer ARMA processes provided the best fit. 3/ At the quarterly frequency, an ARMA(20,4) process was fitted to the all-commodity and beverages groupings, while food

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1/ Two of these approaches are discussed in the text, while the third is explained in the appendix.

2/ For additional details see Beveridge and Nelson (1981) and Miller (1988).

3/ For a discussion of the problems associated with fitting low ARMA processes to macroeconomic data see Cochrane (1988).

and metals were characterized by ARMA(16,4) processes. Table A.1 in the Appendix reports the full estimation results for the annual frequency and the main diagnostics of the quarterly estimation. Chart 3 plots the actual series along with the estimated permanent component. For example, large deviations from trend were evident in the all-commodity, food, and metals indices during 1973, at the time of the first oil shock. For beverages, the largest deviations from trend during the sample take place during 1977 and is associated with a supply shock. 1/ As Chart 3 illustrates, with the exception of the metals basket, for which the actual price is below trend since late 1990, actual prices for all other indices are close to their permanent trend component. Chart 3 also illustrates that the evolution of the permanent component changes considerably during the course of the sample. While during the 1960's and up to the first oil shock all prices were relatively stable, the trend becomes markedly negative since the mid-1970's (for beverages somewhat later).

An alternative approach to decomposing a time series into its stochastic trend and cycle is associated with Harvey (1985). This structural time series approach relies on the Kalman filter. The stochastic trend or permanent component, z_t, can be modeled as:

$$\begin{aligned} z_t &= z_{t-1} + \beta_{t-1} + \eta_t \\ \beta_t &= \beta_{t-1} + \epsilon_t \end{aligned} \tag{7}$$

where η_t and ϵ_t are uncorrelated white-noise disturbances.

The cycle is given by

$$\begin{bmatrix} c_t \\ c_t^* \end{bmatrix} = \rho \begin{bmatrix} \cos\lambda & \sin\lambda \\ -\sin\lambda & \cos\lambda \end{bmatrix} \begin{bmatrix} c_{t-1} \\ c_{t-1}^* \end{bmatrix} + \begin{bmatrix} \omega_t \\ \omega_t^* \end{bmatrix}, \tag{8}$$

$$0 \leq \lambda \leq \pi, \quad 0 \leq \rho \leq 1,$$

where, as before, c_t is the cyclical component, ω_t and ω_t^* are uncorrelated white noise disturbances and c_t^* appears by construction (see Harrison and Akram (1983)). The parameters λ and ρ describe the frequency of the cycle and the damping factor on the amplitude of the cycle, respectively. For further details, see Harvey (1989).

The Maximum Likelihood (ML) estimates of the structural time series model present a similar scenario to the Beveridge-Nelson decomposition.

1/ Since coffee has a large weight in the beverage index, this price spike is associated with a severe frost in Brazil which did considerable damage to the trees.

Chart 4 plots the permanent component produced by this technique alongside the actual price series; as before, the bulk of the recent price weakness is associated with the secular component and there is no evidence of an abnormally large cycle. The most substantive differences between the results from the two methods are that: (a) the Kalman-filter approach produces smoother trend components for the beverages and food groupings, and, hence, a somewhat more volatile cycle and, (b) metals prices during 1993 are closer to trend using the structural time series approach than using the B-N decomposition. However, even giving the results of the Perron tests a higher weight and treating the all-commodity and metals indices as stationary about a broken trend, the main implications about trends and cycles remain. As Chart A1 in the Appendix highlights, the recent weakness does not appear to be of a primarily cyclical nature.

2. Characteristics of the cycle

Chart 5 plots the cycles generated by the two methods; as noted earlier, the similarities are strong. In effect, the pairwise correlations between the cycles generated by the two approaches are quite high: 0.95 for the all-commodity index, 0.87 for beverages, 0.90 for food, and 0.87 for metals. 1/ It is also evident from these charts the cycles are correlated across commodity groupings. Cycles in the all-commodity index are highly correlated (correlations above 0.80) with cycles in food and metals. Beverages exhibit the most idiosyncratic behavior, as cycles appear to be primarily driven by supply shocks.

As formerly noted, the temporary shocks that drive the cycle can exhibit differing degrees of persistence. Stabilization funds are better suited to smoothing out short-lived shocks; the more persistent the shock--the greater the costs of maintaining an "artificially" high internal price (assuming the shock had tended to depress prices). To examine this issue, we first fit an AR process to the cycle component. The Schwarz criterion was employed to select the appropriate specification (see Lütkepohl (1985) for a discussion of the advantages of this criteria over existing alternatives). Secondly, the estimated model was used to generate impulse responses that allow us to visualize the time it takes for the effects of the shock to disappear (or become arbitrarily small). Table 7 presents the estimated model while Chart 6 plots the impulse responses. While the full effects of the shock may take longer to disappear, for practical purposes we will focus on the time it takes for these effects to become smaller than some arbitrary cutoff, say plus/minus 0.02 of a unitary shock, after which the impact of the shock are minimal. Based on these considerations, it appears shocks to the metals index are the least persistent (reaching the

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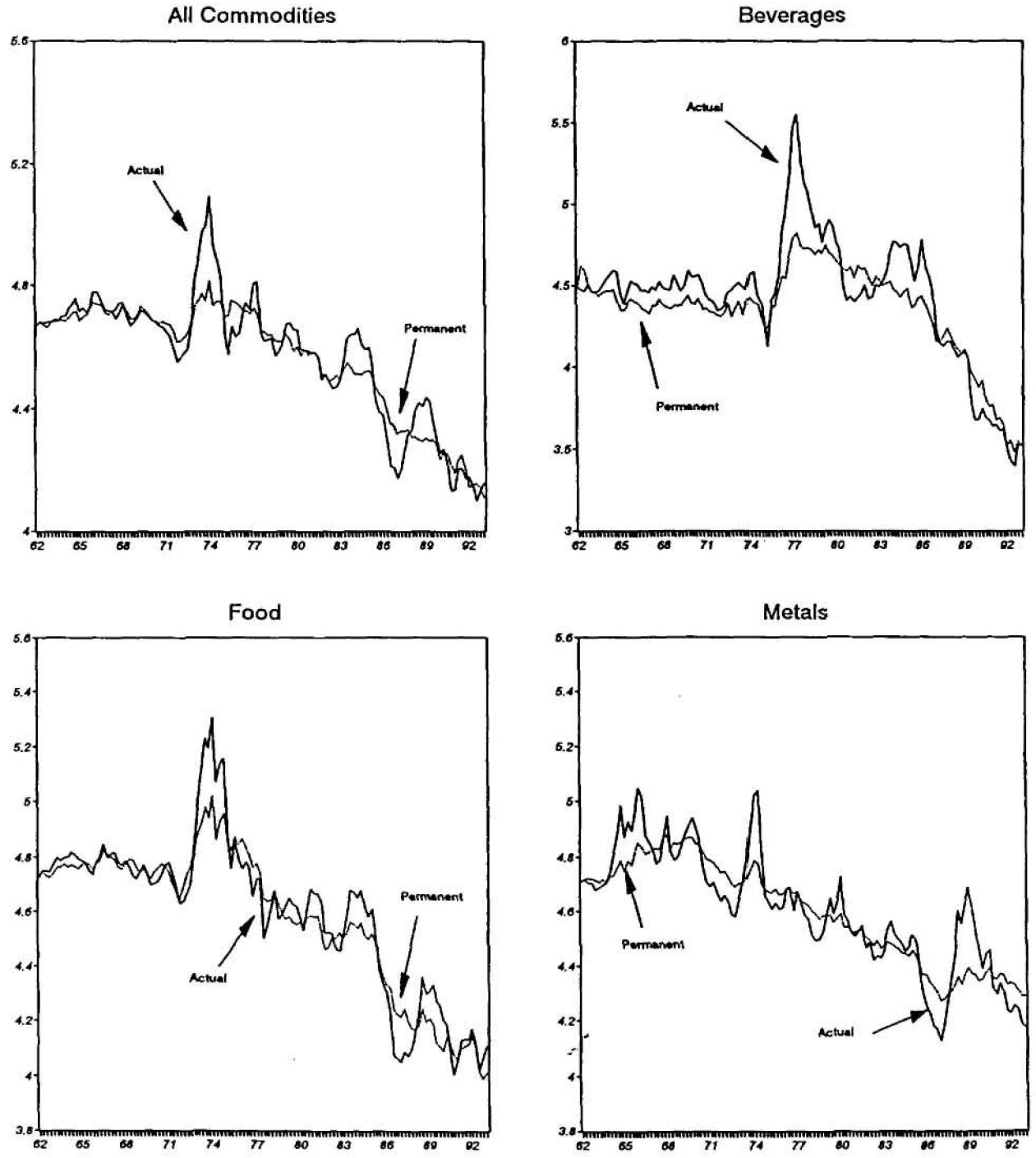
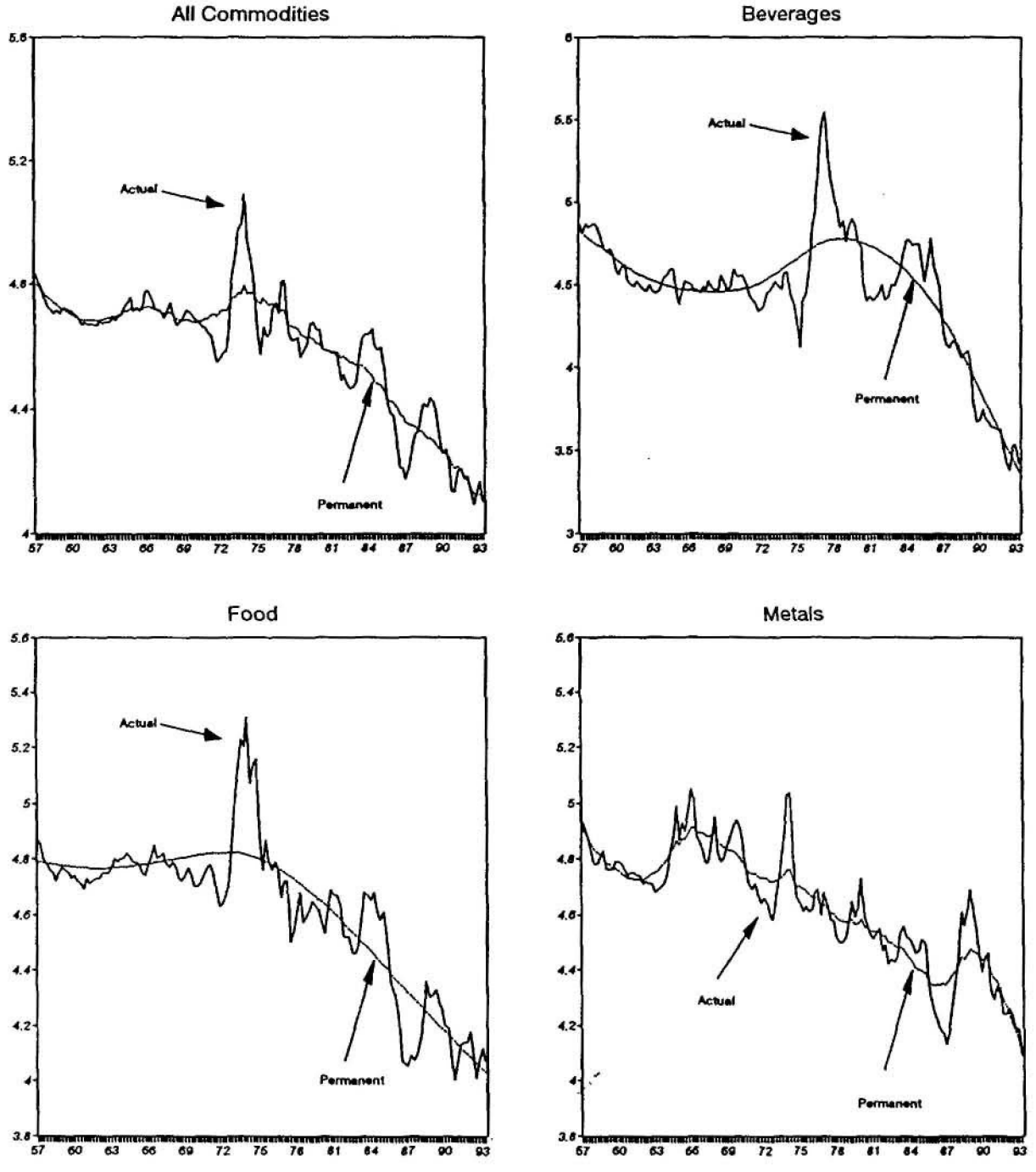
1/ These correlations are not spurious, since, by construction, the cycles are stationary series.

Chart 3. Real Commodity Prices: Trends & Cycles
Beveridge-Nelson Decomposition
1962:I - 1993:II



Sources: International Financial Statistics, IMF and the authors.

Chart 4. Real Commodity Prices: Trends & Cycles
Structural Time Series Decomposition
1957:I - 1993:II

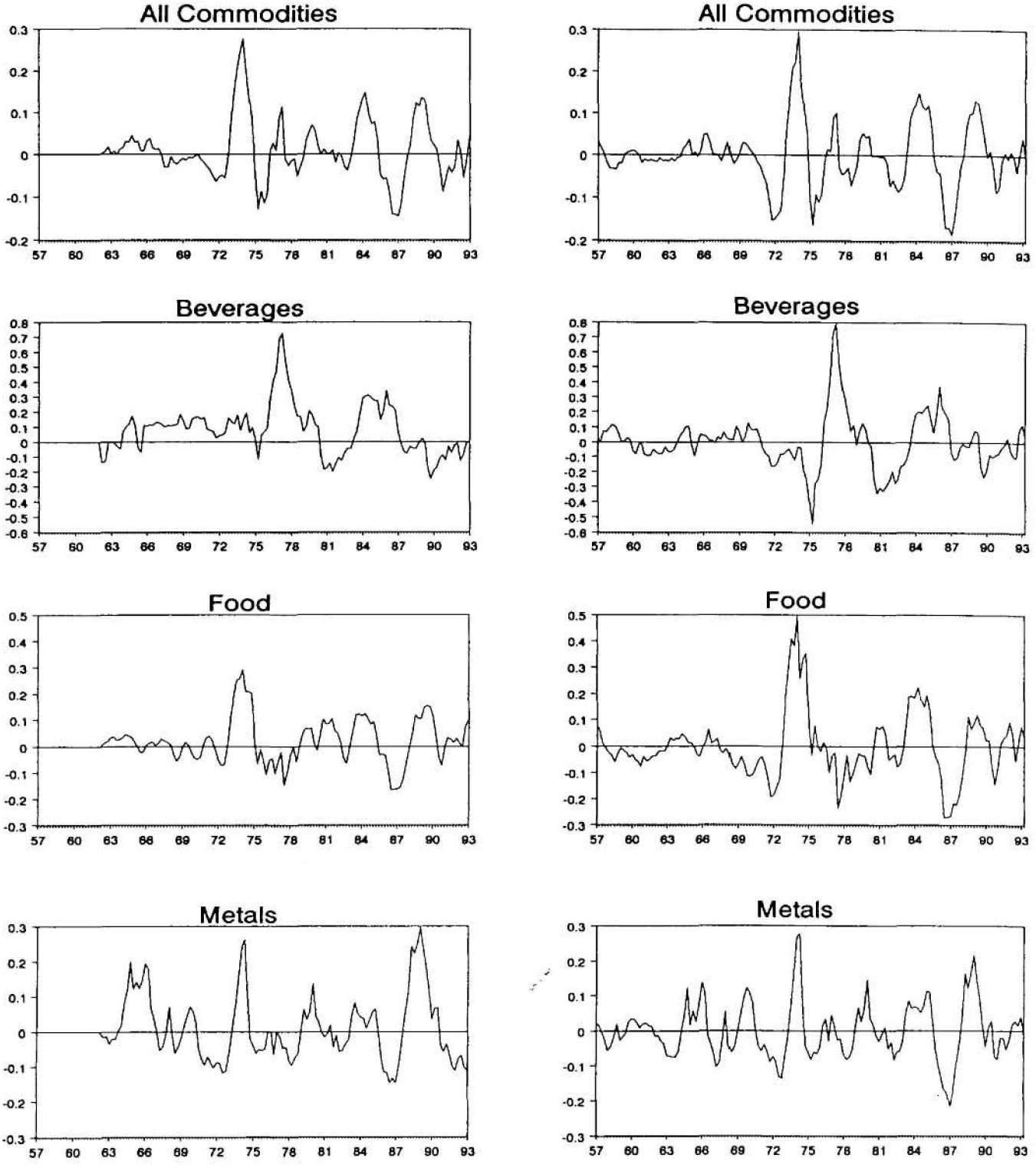


Sources: International Financial Statistics, IMF and the authors.

Chart 5. Real Commodity Price Cycles

Beveridge-Nelson Cycle (left panel) versus Kalman filter Cycle (right panel)

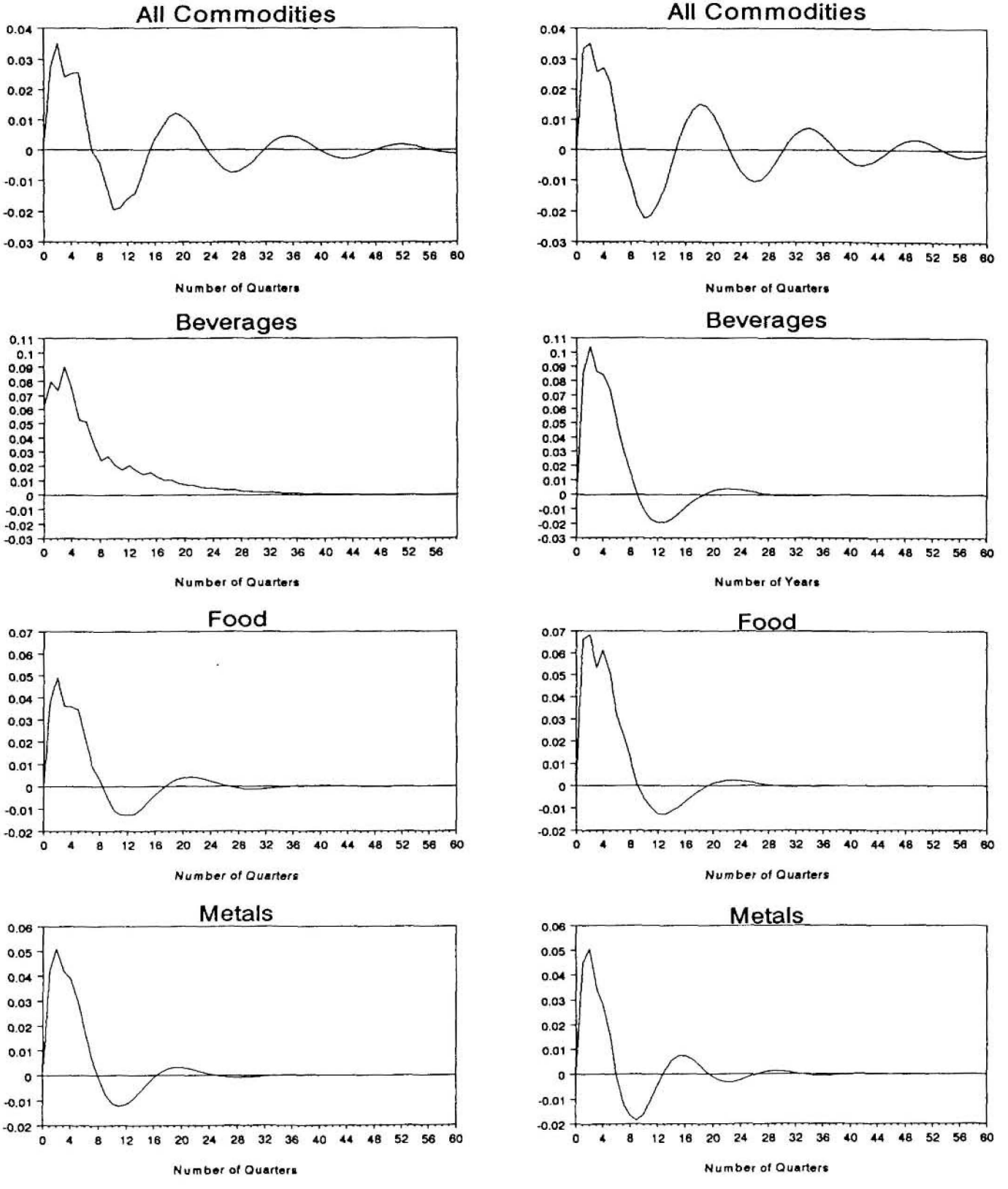
1957:I - 1993:II



Sources: International Financial Statistics, IMF and the authors.

Chart 6. Impulse Responses: Persistence in the Cycle

Beveridge-Nelson Cycle (left panel) versus Kalman filter Cycle (right panel)



Notes: These impulse responses are based on the estimated AR processes reported on Table 4.

Table 7. Persistence and Dynamics of the Commodity Price Cycle 1/

The dependent variable is the cyclical component of:	All Commodities	Beverages	Food	Metals
	Beveridge-Nelson cycle: 1966:I-1993:II			
AR(p)	AR(4)	AR(5)	AR(4)	AR(4)
AR(1)	1.296	1.278	1.279	1.206
	(0.078)	(0.091)	(0.088)	(0.094)
AR(2)	-0.795	-0.457	-0.696	-0.462
	(0.128)	(0.135)	(0.142)	(0.147)
AR(3)	0.818	0.525	0.621	0.279
	(0.131)	(0.132)	(0.143)	(0.147)
AR(4)	-0.623	-0.786	-0.429	-0.260
	(0.080)	(0.136)	(0.900)	(0.093)
AR(5)	*****	0.359	*****	*****
		(0.922)		
R^2	0.883	0.879	0.829	0.817
	Structural Time Series cycle: 1960:I-1993:II			
AR(p)	AR(3)	AR(1)	AR(3)	AR(2)
AR(1)	0.609	0.727	0.492	0.639
	(0.191)	(0.181)	(0.194)	(0.184)
AR(2)	-0.586	*****	0.322	-0.337
	(0.193)		(0.219)	(0.179)
AR(3)	0.353	*****	-0.444	*****
	(0.190)		(0.194)	
R^2	0.321	0.389	0.354	0.617

1/ Standard errors are in parentheses. There are no problems associated with nonstationarity, as the cyclical component is, by construction, a stationary, zero-mean variable. The optimum lag length for the AR processes was selected according to the Schwarz Information Criteria. Impulse responses are plotted in Chart 6.

cutoff in six to seven quarters) and most persistent for beverages (12 to 13 quarters). 1/

3. General observations on the time-series properties of commodity prices

A series of recent papers, including Cuddington and Urzua (1989), Powell (1991), Ardeni and Wright (1992), Deaton and Laroque (1992), and Schmitt-Grohé (1993), analyze the behavior of real commodity prices. These papers, which give careful consideration to modelling the time series properties of commodity prices (usually for long-run annual data), often present contradictory results. 2/ There is relatively little consensus on whether real commodity prices are stationary or not or when, if any, structural breaks have taken place.

Similar ambiguities arise from the analysis of the quarterly post-war data used in this study. There is, however, one robust finding in the empirical work--real commodity prices exhibit a high degree of persistence and the high autocorrelation in the data is well documented. So while ambiguities about the **exact** time series properties of real commodity prices remain, a number of practical implications still emerge from an analysis of their time series behavior. **First**, whether the trend component is modelled by a simple broken deterministic linear trend (Char A.1 in Appendix) or by a more complicated stochastic process using alternative methodologies (this section), the recent decline in commodity prices appears to be **primarily** of a secular nature (Charts 3, 4, and A1 all illustrate this point). Contrary to the findings of Boughton (1991), there is no evidence in any of the decompositions that the recent price weakness is part of an anomalous cycle. This would suggest that the prospects for a **sharp** recovery in real commodity prices to pre-1980s levels appear somewhat dim. **Second**, irrespective of the technique used, it is evident that the downward trend has steepened in recent years, implying that the design of stabilization efforts should incorporate this feature of commodity price behavior. **Third**, while for some of the indices (all-commodities and metals) the results on stationarity are not clearcut, from a practical policy standpoint this distinction may not be relevant. As noted earlier, the success of stabilization funds requires shocks to be temporary. However, if a shock is temporary, but its effects persist for many years, price stabilization may be equally infeasible.

IV. Factors Affecting Commodity Prices: A Summary

The previous sections have focused exclusively on the univariate properties of real commodity prices. There has been no attempt to link the behavior of commodity prices to other economic time series, as in

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1/ Note that the scales in the panels of Chart 6 are not uniform across commodities, with beverages having the widest scale (reflecting the higher variance of its cycle) and the all commodities having the narrowest.

2/ See Chart 1.

Dornbusch (1985), Chu and Morrison (1986) and, more recently, Borensztein and Reinhart (1994) through a structural model. This section does not aim at providing a structural framework; its purpose is to briefly identify and list the factors which are likely to explain the behavior of commodity prices, including factors that are often ignored in the empirical literature (usually because these are less amenable to quantification and may differ substantially between commodities and/or between countries or country groupings). 1/ While some developments are likely to simultaneously have an impact on **both** the trend and the cycle of real commodity prices, in this section an attempt is made to identify which factors are likely to be linked primarily to the trend (specifically, the persistent weakness since the late 1970s) and which ones are predominantly associated with the cycle.

1. Secular developments

a. Economic growth and the demand for commodities

Analyses of commodity market developments have usually focused on the macroeconomic conditions in industrial countries as the principal factor affecting commodity prices. Given the role of many commodities as inputs for production by manufacturing industries, their demand is closely related to the level of industrial economic activity, the major part which takes place in industrial countries. Therefore the trend decline in real commodity prices is, at least, partially related to the marked and secular slowdown in the growth of output in the industrial countries in the early 1970s, with 1973 constituting the end of the strong postwar expansion phase for most countries. 2/

In addition to the slowdown in growth, a declining intensity of resource use, particularly in industrial countries, has contributed to reduced rates of growth in the demand for commodities. Table 8 presents data for the G-7 countries on the growth of real GDP and consumption for several major metals over two subperiods; the data document a widespread and persistent slowdown across countries and across commodities. In addition, Table 8 reports changes in an intensity of use measure, (i.e., metal consumption per unit of real GDP) which is designed to give an indication of longer-term trends in technological innovation or in structural factors governing resource use. While there are differences between countries and particular metals, the general picture that emerges is consistent with a downward shift in the intensity of metal use between the periods. 3/

1/ For example, health concerns are often cited as having affected demand for tobacco, sugar, and fats in the major industrialized countries.

2/ For a discussion of the factors behind the slowdown in growth, see, for example, Adams, Fenton, and Larsen (1987).

3/ Tilton (1990) has shown that this pattern holds more broadly for member countries of the OECD.

Table 8. Intensity of Metals Use in Major Industrialized Countries

(Average percentage changes)

	1962-1973			1974-1991		
	Consumption	Real GDP	IU 1/	Consumption	Real GDP	I 1/
			Aluminum			
United States	9.3	3.5	4.1	-0.1	2.2	-2.4
Japan	20.3	9.5	13.0	3.2	3.9	-0.8
France	7.4	4.9	3.1	3.1	2.4	0.6
Germany	9.6	4.2	6.3	3.1	2.1	0.9
Italy	10.5	5.3	7.7	4.6	2.8	1.6
United Kingdom	5.2	3.1	1.7	-0.5	1.7	-2.2
Canada	8.6	5.3	1.4	3.1	3.0	-0.0
			Copper			
United States	4.7	3.5	-0.6	0.5	2.2	-1.9
Japan	11.2	9.5	4.2	2.3	3.9	-1.6
France	4.6	4.9	-0.2	1.2	2.4	-1.2
Germany	2.7	4.2	0.2	2.0	2.1	-0.2
Italy	3.4	5.3	0.3	2.8	2.8	-0.1
United Kingdom	0.4	3.1	-5.1	-3.5	1.7	-5.2
Canada	6.1	5.3	-2.5	-0.4	3.0	-3.5
			Lead			
United States	3.5	3.5	-0.7	-0.3	2.2	-2.5
Japan	6.9	9.5	-1.5	3.3	3.9	-0.7
France	3.1	4.9	0.8	1.0	2.4	-1.4
Germany	3.5	4.2	-0.7	1.2	2.1	-0.9
Italy	9.0	5.3	6.9	1.1	2.8	-1.8
United Kingdom	0.3	3.1	-4.2	-0.1	1.7	-1.8
Canada	3.8	5.3	-1.7	2.7	3.0	-0.5
			Zinc			
United States	7.1	3.5	2.0	-2.4	2.2	-4.7
Japan	11.4	9.5	2.3	0.7	3.9	-3.2
France	4.0	4.9	1.1	0.6	2.4	-1.8
Germany	3.3	4.2	-0.3	1.6	2.1	-0.5
Italy	7.9	5.3	3.0	2.1	2.8	-0.8
United Kingdom	1.5	3.1	-2.0	-2.3	1.7	-4.0
Canada	7.6	5.3	0.2	0.1	3.0	-2.9
			Tin			
United States	1.3	3.5	-3.5	-2.1	2.2	-4.3
Japan	8.6	9.5	1.6	-0.2	3.9	-4.0
France	1.7	4.9	-2.3	-1.9	2.4	-4.2
Germany	-0.2	4.2	-0.2	1.4	2.1	-0.8
Italy	4.2	5.3	-1.3	-1.2	2.8	-4.0
United Kingdom	-1.4	3.1	-4.6	-2.7	1.7	-4.4
Canada	4.2	5.3	-2.0	-3.1	3.0	-6.0
			Nickel			
United States	5.0	3.5	-1.0	-1.2	2.2	-3.4
Japan	17.3	9.5	9.2	3.9	3.9	-0.0
France	6.8	4.9	0.2	2.2	2.4	-0.3
Germany	8.8	4.2	4.2	2.1	2.1	-0.1
Italy	10.3	5.3	7.8	2.8	2.8	-0.1
United Kingdom	2.3	3.1	-4.3	0.6	1.7	-1.2
Canada	8.3	5.3	0.6	4.4	3.0	1.2

1/ I = Intensity of use, i.e., consumption over real GDP.

Various explanations have been put forward for the trends observed in the intensity of metals use in the industrialized countries. Some of these explanations stress the changing composition of output: the shift from manufacturing to services; the declining share in GDP of gross domestic investment, including structures, which is more metal intensive than other components of expenditure; and, more recently, declines in the defense-related industries. Other explanations focus on the role of resource-saving technologies and the process of materials substitution.

Much less information is available on intensity of metals use outside the industrialized countries. For the former CMEA countries, Dobozi (1990) shows that the period of growing metals consumption and rising intensity of use also came to an end in the mid-1970s as output growth in the former CMEA countries also slowed. However, rather than falling as in the industrial countries, intensity of metals use stagnated or showed little change before declining sharply in the 1980s. As regard developing countries, the rapid pace of industrialization in the Asian region and in parts of Latin America in the 1960s through to the early 1980s has been linked with rising intensity of resource use, and appears to be related to the relatively high levels of gross domestic investment being maintained during this period. The subsequent picture, however, is mixed as external financing difficulties lowered investment and growth rates in many developing countries, particularly in Africa and Latin America.

b. The surge in supply

As shown in Borensztein and Reinhart (1994), supply conditions have played a key role in explaining the weakness in commodity prices, particularly since the mid-1980s. In part, the reasons for the supply response in the 1980s can be found in the debt crisis and the need to adopt adjustment policies that, among other things, aimed at increasing export earnings through an expansion in export volumes. For instance, during 1984-88 the commodity supply index increases at an a 13 percent annual rate, almost three times as fast as the 5 percent annual growth rate of the previous ten years. 1/

However, there are "structural" persistent trends in technology, information diffusion, and factor productivity that have allowed for sharp and sustained increases in the supply of numerous commodities during the past decade. While there are marked differences between commodities and quantification is difficult, there are a number of important examples of where these type of technology-driven shift factors can be shown to be important.

The diffusion of information about prices, techniques, and marketing opportunities can bring about significant increases in overall commodity supplies through new entrants into international markets. The emergence

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1/ See Borensztein and Reinhart (1993).

during the 1980s of first Malaysia and then Indonesia as major cocoa producers is one of the prime examples of this phenomenon. Whereas producers other than these two countries on aggregate increased production by about 15 percent between 1980-81 and 1991-92, Malaysia and Indonesia increased their combined raw cocoa output by 500 percent. During the 1970s, the larger plantations in Malaysia became aware that the rise in real cocoa prices would make production profitable; decisions were made to move into cocoa and the rate of plantings accelerated accordingly. Later, the smaller estates and smallholders followed suit. 1/ Rising production levels and export earnings in Malaysia did not go unnoticed by the authorities and agricultural companies in Indonesia; in addition, many Indonesians received firsthand experience of cocoa growing by working on Malaysian cocoa plantations. As a result, plantings there grew rapidly through the mid- and late 1980s, and Indonesia rose from being a small producer of specialty "fine" cocoa to producing 167,000 tons of mostly bulk cocoa in 1991-92. While declines in cocoa prices since the mid-1980s have had an effect on other (higher cost) producers, cocoa production remains profitable in Indonesia due to high productivity.

Minerals and metals also provide examples where the accumulation of knowledge and technological progress have led to significant shifts in long-run supply curves. However, the most remarkable examples of information diffusion and technologically-driven productivity growth are found in agriculture. Despite demand growth, particularly due to high rates of population growth in developing countries, the rise in production has been such that real food prices have, with the exception of a brief episode in the mid-1970s, declined significantly in the post-war period. 2/ While land under cultivation has increased in many parts of the developing world, a sustained increase in yields over time has played a major role in the agricultural supply-demand equation. Cereals provide the premier example, but other crops have also registered significant increases in yields. Advances in agroscience that have led to the development of higher-yield and more disease-resistant varieties, the increased use of fertilizers and pesticides, and the spread of irrigation are the principal factors cited for the increases in agricultural yields (see Chart 7). The improvement in yields was a more or less continuous process in the agricultural sectors of the industrial countries, but in the developing sharp increases came more recently. High-yielding wheat and rice varieties were introduced in a number of developing countries and the rate at which high-yielding varieties were adopted in many cases was rapid.

The improvements in technology are likely to be "irreversible" in nature and are not limited to a few commodities. These developments have had widespread effects and have led to improving yields for many types of

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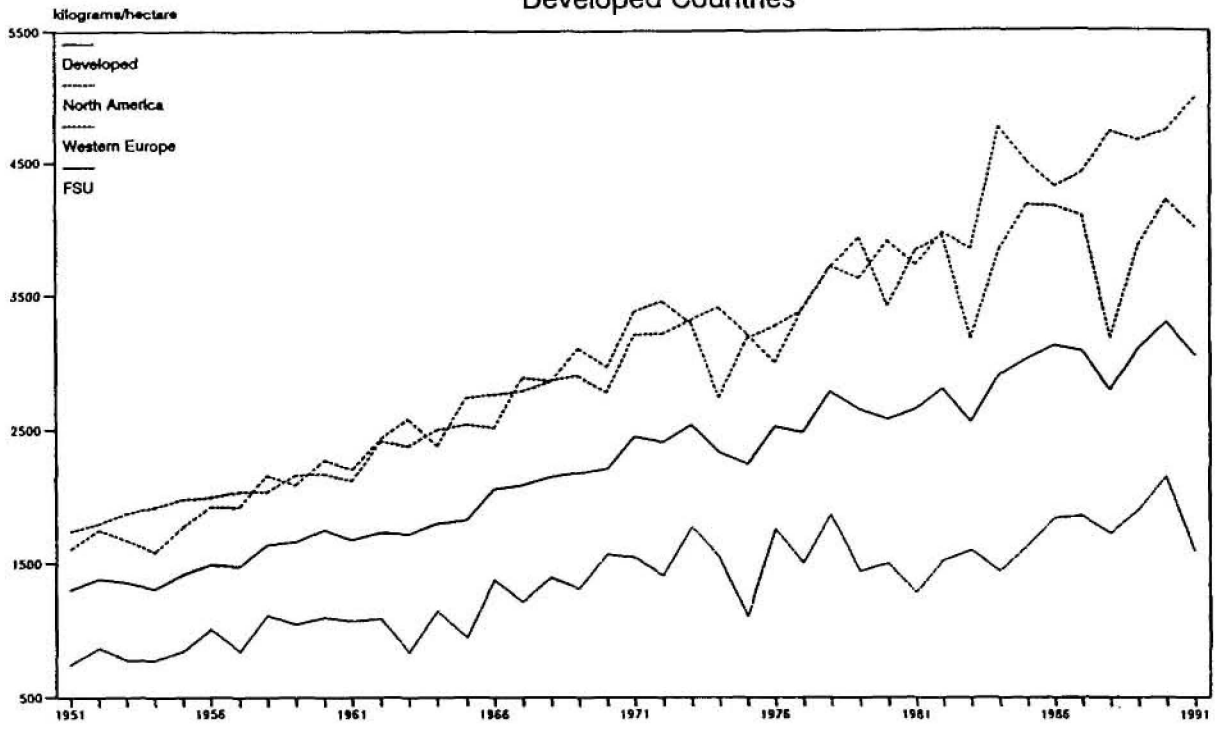
1/ There is a 5-year lag between planting and commercial production.

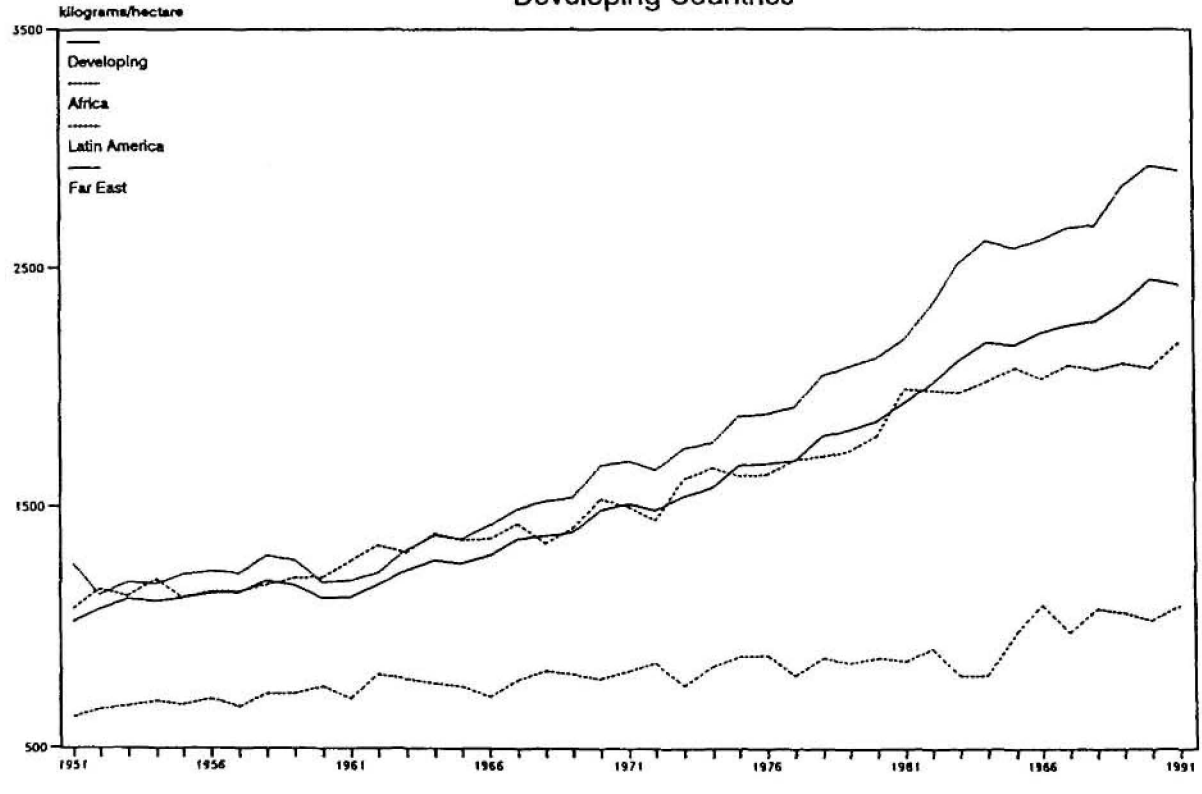
2/ The price of services such as transportation, packaging, processing, and retailing have generally been rising over time tending to offset the impact of lower "raw" food prices on retail food prices.

Chart 7. Cereal Yields by Region

Developed Countries



Developing Countries



Source: FAO Yearbook

crops, including the beverages (cocoa, coffee, tea), oilseeds, vegetables, and agricultural raw materials such as cotton. It seems likely, particularly in light of recent major advances in biotechnology, that in the future as in the past innovation and information diffusion will continue to play a significant role in increasing agricultural yields still further, possibly extending the observed secular decline in food prices.

There is also little doubt that the agricultural policies of industrial countries have been an important factor in the rapid expansion in world commodity supplies during the 1980s and has contributed to the weakness in prices for many agricultural products. 1/ National (or transnational in the case of the EC) agricultural policies in the industrial countries typically act to stimulate output and discourage consumption, thereby reducing import needs or increasing supplies available for export. Such government intervention has been a common feature in industrial countries in the post-WWII period; however, a marked deterioration in the agricultural trade environment took place in the 1980s and agricultural trade disputes became increasingly acrimonious, particularly between the United States and the EC. The case of wheat provides an instructive example. Price support under the EC's Common Agricultural Policy has been so "effective" that wheat supplies surplus to Community requirements have grown over time and have had to be sold on world markets, made possible by the provision of export subsidies. Between 1980-81 and 1991-92, wheat exports from the EC rose by 55 percent to nearly 22 million tons (an increase in market share from 14 percent to 20 percent). In order to counter EC penetration in its traditional markets, the United States introduced the Export Enhancement Program (EEP) in 1985. While trade in wheat has been the most notable source of contention, other grains and commodities (e.g., meat, sugar, oilseeds) have been also affected by similar price support schemes.

c. International Commodity Agreements (ICAs)

Part of the blame for weakening commodity prices during the 1980's and 1990s is often attributed to the international community's failure to abide by and support commodity agreements designed to help stabilize prices and ensure a "fair" return to commodity producers. 2/ Several such agreements were in effect during the 1970s and early 1980s. In June 1984 the agreement covering sugar collapsed. Thereafter, other agreements followed suit or became economically moribund; tin (October 1985), cocoa (February 1988), coffee (July 1989), and natural rubber (April 1993). The immediate impact on price of a breakdown in a commodity agreement may have a large "temporary" component, as prices spike downward, for instance, beverage

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1/ Most partial and general equilibrium models suggest that real prices for most agricultural products would rise if reforms were implemented by the industrial countries. See Goldin and Knudsen (1990).

2/ See, for example, Maizels (1990).

prices fall below trend from mid-1987 to mid-1989 (Charts 3-5). 1/ However, the effects of the breakdown are likely to have an important "permanent" component, as the behavior of exporters adjusts to the more competitive regime. In effect, the evidence suggests that, in addition to the debt crisis and the technological innovations discussed above, the breakdown of ICAs has been a contributing factor behind the sharp expansion in certain commodity supplies in recent years.

2. Cyclical factors

a. Weak economic performance in recent years in the industrial countries

One of the reasons cited as contributing to the recent weakness in real commodity prices is the lackluster economic performance of the industrial countries (World Economic Outlook (1993)). As noted in the empirical literature (Dornbusch (1985), Morrison and Chu (1986), among others), industrial production in the industrial countries is a key determinant of commodity prices, with estimated elasticities generally clustered in the 1.0-2.0 range. While the current environment is not characterized as a deep recession, industrial production in the industrial countries has been flat since 1989. 2/ However, as noted throughout the paper, the bulk of the weakness in commodity prices appears to be secular in nature. A sizable negative cycle component in commodity prices, such as a those characterizing the 1975 and 1982 recessions in the United States and other industrial countries (see Chart 5), is not currently present. Further, Borensztein and Reinhart (1994) show that only a small fraction of the variability in real commodity prices in the 1989-92 period is attributable to output developments in industrial countries. Their analysis indicate that developments in the FSU (discussed below) can account for a more important share of the recent variability in commodity prices.

b. Falling demand and supply shocks from the Former Soviet Union

The recent output collapse in the FSU (it is assumed, for purposes of this discussion that the bulk of the decline is "temporary", although evidently quite persistent) has depressed demand for a number of imported commodities such as cocoa, corn, and tea. Further, demand within the FSU for metals is reported to have fallen sharply, particularly as the production of armaments declined. Hence, the response by commodity producers in the FSU in light of this demand shift and the dislocation accompanying the reform process has led to supply shocks in international commodity markets. This has been particularly evident in the metals markets where, for example, zinc exports from the FSU have risen by nearly

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1/ Unless the breakdown of the ICA was fully anticipated, in which case, prices would have already reacted.

2/ The index used is published in International Financial Statistics, IMF.

700 percent during 1989-92. Exports of metals to western markets offered a ready means of raising large amounts of much-needed foreign exchange. But while shortages of foreign exchange led to official sanctioning of increased metal exports to western markets, the failure to fully liberalize domestic metals prices in the Russia and other republics also created huge arbitrage opportunities. 1/

Coupled with adverse cyclical conditions in the West, the surge in the exports of metals from the FSU contributed significantly to the weakening of commodity prices, particularly metals prices, on international markets. While shocks from the FSU have been important contributory factors in recent price weakness, the question of the persistence of the shocks is subject to a good deal of uncertainty.

V. Policy Issues

The previous sections of the paper examined how non-oil commodity prices have evolved over time and discussed the possible reasons for the observed behavior. Both the rising volatility in real commodity prices and the downward trend experienced over recent years present serious problems for many member countries of the Fund, as these have a direct impact on the variability and the level of export earnings, and consequently, on incomes (and hence, private savings and investment), and government budgetary positions. The response to volatility in commodity prices, however, gives rise to issues that are quite different from those emanating from secular declines in prices. It is therefore crucial to correctly interpret market developments in each case in order to elaborate the appropriate policy response or, in fact, consider whether a policy response is warranted at all. This section first reviews some of the standard reasons why government may wish to intervene. The remainder of the section briefly discusses alternative forms of intervention.

1. Reasons for government intervention

A traditional argument for government assuming much of the commodity price risk is based on microeconomic considerations relating to the welfare and behavior of private agents. 2/ If the government does not attempt to stabilize commodity prices and supply is price inelastic in the short run, then private agents will bear all the commodity price risk and will face variable and unpredictable income streams over time. 3/ If the government

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1/ Effective early in 1993, domestic prices for metals were liberalized and other steps were also taken to reduce the scope for illegal trading.

2/ This section draws on Deaton (1992).

3/ Limited or nonexistent access to domestic and international capital markets may make consumption smoothing difficult (or impossible) for a portion of the population. Hence, consumption would be subject to the vagaries of income.

intervenes to stabilize the prices private agents receive, it is argued, the welfare of risk-averse individuals will increase, as they will enjoy smoother income and consumption streams.

Empirical evidence on savings behavior in developing countries that might shed light on this issue is suggestive but rather limited. However, it has been found that rice farmers in Thailand, for example, smooth their consumption quite successfully both within and between harvest years. 1/ An analysis of the coffee boom in Kenya of 1976-79 found that as much as 60 percent of boom income went into private savings; farmers were aware that the boom was due to frost damage in Brazil and that their income gains were largely of a windfall nature. 2/ This is not to say that there were no ill effects in Kenya from the boom (including those emanating from government behavior), but only that on the microeconomic level the ability of private agents in developing countries to absorb some level of commodity price risk and smooth consumption may be substantially greater than many policymakers have assumed or allowed. On the macroeconomic level, the policy implication is that governments may be well advised to reassess their intervention strategies and the responsibility they assume for managing consumption (or more generally absorption) risk at the country level.

A second argument for government intervention rests on the "hysteresis effects" of large temporary destabilizing shocks. A sufficiently large price decline, if passed on entirely to the producer, may prove to have persistent (or permanent) effects on supply. For example, in the case of coffee, new tree plantings may not take place and care of the existing trees may lapse, leaving productive capacity reduced for an extended period of time and, potentially, resulting in loss of market share.

A third reason for intervention is that in some cases, especially for countries with a heavy dependence on minerals, the principal concern is with the fluctuations in government revenues. Often, a fund is established to act as a buffer for government expenditures and financing.

2. Short-term government intervention strategies

For the reasons discussed above, as well as for a variety of other considerations, most governments have chosen to assume a role in attempting to deal with the effects of fluctuations in international commodity prices on the domestic economy. The nature of the intervention has been varied, but the most often-used strategies are outlined below.

a. International commodity agreements

As international commodity prices are volatile and generate disruptive effects on the economies of primary product exporters, there is obvious

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1/ *See Paxson (1992).*

2/ See Bevan, Collier, and Gunning (1987) and (1989).

appeal to national authorities in attempting to achieve greater stability in international commodity prices through cooperative commodity agreements of some kind. There may also be similar interest in importing countries, but it is likely to be less acute as their import structures generally tend to be much more diversified. However, experience with international commodity agreements (ICAs) has not in general been a happy one; as noted in the previous section, the 1980s and 1990s have witnessed the breakdown of numerous agreements. On both political and economic grounds the prospects for ICAs playing a role in addressing the issues raised by recent international commodity price behavior appear somewhat dim.

b. Domestic stabilization schemes

As noted earlier, often the principal concern is with the fluctuations in government revenues and a fund is established which is designed to act as a buffer for government expenditures and financing. The Mineral Resource Stabilization Fund in Papua New Guinea provides one example where there has been a clear attempt to provide an institutional framework to try to smooth government revenue streams. The Copper Stabilization Fund in Chile is another example of a formal institutional structure being put in place to save at least part of gains by state-owned mining companies considered likely to be temporary for use when copper prices dropped.

The other principal type of institutional structure for government intervention has been the state-owned agricultural stabilization fund or board. These are usually charged with a domestic price stabilization objective, the transfer of explicit export taxes to central government, and with a role in determining the extent to which operating surpluses are channelled into a formal stabilization fund or are transferred directly to central government (or to other uses). In Côte d'Ivoire, for example, such a fund operated relatively successfully until international prices began dropping in 1986 and exerted an ever-increasing pressure on the fund's financial position. 1/ While similar schemes operated elsewhere in Africa, some other countries operated agricultural stabilization schemes quite differently. Papua New Guinea, for example, had schemes for coffee, cocoa, copra, and palm oil which used a 10-year moving average of inflation-adjusted commodity prices as basis for paying bounties and mounting levies on actual FOB prices. Assets of the various stabilization funds were placed mainly with commercial banks and the Bank of Papua New Guinea. The schemes achieved some degree of success until the mid- to late 1980s when as international prices declined drawdowns began to exhaust the funds.

1/ Post 1985, the French franc (to which the CFA franc is pegged) appreciated considerably against the U.S. dollar. As international prices expressed in U.S. dollar terms fell, the appreciation added to the difficulties of the stabilization board in maintaining fixed producer prices in domestic currency terms.

The experience with stabilization schemes (principally those in the agricultural sector), which transfer most of the commodity price risk to government, suggest that these policies may be particularly prone to exacerbating a country's fiscal performance. This reinforces the point made earlier that while it may well be advisable for governments to share more of the commodity price risk with the private sector, reforms can also be undertaken to remove certain impediments (such as strict capital controls) which hinder the private sector's ability to handle fluctuations in commodity incomes. 1/

c. External compensatory finance

Another means of trying to smooth out the effects of temporary commodity price shocks has been external compensatory finance from the Fund under the CFF (and subsequently the CCFF) and from the EC under the STABEX scheme. 2/ How the Fund's CCFF has evolved over recent years is well documented elsewhere, but since 1983 the access limit for compensatory finance on minimum conditionality has been reduced and higher levels of access have been subject to a similar order of conditionality as is applied to drawings in the upper credit tranches. 3/ In large measure these steps were taken because of the increasing difficulty of distinguishing between the effects of temporary shocks to export earnings and the need to address more deep-seated balance of payments difficulties and structural issues. Indeed, with the benefit of hindsight, the shock decompositions presented earlier provide evidence why the distinction was increasingly seen to be an important issue affecting access to the Fund's resources. However, in supporting the adjustment policies of member countries, the Fund has been attaching greater importance to protecting programs from commodity price shocks through the use of contingency mechanisms (with and without additional finance) as a means of improving policy responses.

d. Dealing with volatility: Market-related instruments

In addition to the option of reacting **ex post** to commodity price risk, it is possible to limit such risk by the use of financial risk management techniques. Rising short-run volatility of commodity prices in 1980s and 1990s has increased the attractiveness of high-frequency smoothing. In addition to well-developed futures and options markets with short-dated instruments for commodities that account a significant part of total commodity trade, financial innovation has led to developments in other instruments (commodity swaps, commodity options, commodity-linked bonds,

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1/ This does not mean that the agricultural sector should not be taxed; rather it means that the form of taxation needs to be reformulated.

2/ It should be noted that such compensatory finance is a loan or a grant to the monetary authority or government of the country concerned. It need not, therefore, **necessarily** find its way to those most directly affected by an export shortfall.

3/ See, for example, Kumar (1989).

forwards), which have increased the scope for hedging commodity risk. Such financial instruments have the attractive feature that they transfer much of the risk to parties outside the country concerned. Nevertheless, establishing a coherent hedging strategy is not a straightforward proposition and the use by developing countries of futures and derivative markets has only increased relatively slowly. It was for these reasons that both the World Bank and UNCTAD created technical assistance programs focused on increasing awareness of external exposure in developing countries and providing assistance in risk management implementation. 1/

There are costs associated with hedging strategies; these take the form of brokerage fees and the need for agents to fulfill margin requirements (and prospective margin calls) or pay options premia in order to gain access to the market. There are other impediments as well. Creditworthiness considerations may make it difficult for developing countries to access financial markets, particularly for nonstandard contracts and longer-dated instruments that allow risk to be hedged more fully over time. Forward, swap, and option sales contracts all require consideration of the counterparty's creditworthiness, and as the length of a contract and the period of potential price movement extends out over time, the greater the risk that an intermediary in over-the-counter (OTC) markets assumes. Overcoming high levels of sovereign risk by such means as collateralization and guarantee mechanisms are being investigated by OTC intermediaries and international organizations. 2/

3. Government policies for the longer term

The previous sub-sections have discussed policies aimed at smoothing and mitigating the impact of international commodity price variability. But commodity-exporting countries have also had to come to terms with the downward trend in real prices. The earlier analysis suggests that it would be unwise to base policies on the assumption that the weakness in real commodity prices will be quickly overcome. A stronger growth performance over the medium term in the industrial countries would certainly help, as would continuing high rates of growth in the NIEs. Some supply-side factors may ease over time (e.g., recent shocks to metals markets from the former Soviet Union), but other factors (e.g., technological innovation) seem unlikely to be reversed. If such is the case, those countries most seriously affected by permanent or highly persistent commodity price declines must face the necessity of adjusting to the shocks and orienting their macroeconomic and structural policies towards this end.

1/ Among countries assisted by the World Bank have been Chile, Colombia, Costa Rica, Indonesia, Papua New Guinea, Poland, Tunisia, and Uganda. See, for example, Claessens and Varangis (1993)

2/ The International Finance Corporation (IFC), for example, has recently acted as a guarantor in several commodity swaps for companies in developing countries.

In assessing adjustment strategies it is useful to examine the dependence of countries on a limited range of export commodities, the extent to which export structures have changed over time, and how primary-product export volumes (and market shares) have evolved in recent years. As Tables 9 and 10 show, in addition to diversifying into manufacturing exports (Table 1), a number of countries in Asia widened the range of primary commodities they exported and sharply expanded primary product export volumes (and market shares). Latin-American countries did not match the Asian performance, while countries in the African region fared poorly in terms of both diversification and volume of exports.

In light of these marked regional divergences, a number of policy issues arise with respect to adjustment strategies. First, an important element of an adjustment strategy will be the extent to policy changes in primary-product exporting countries can facilitate the process of output and export diversification over time. Various types of diversification can be distinguished. In the agricultural sector, for example, farmers may respond to incentives to broaden their crop patterns to increase output of food crops to meet growing local demand. In many of the poorer countries, a significant proportion of the growth in demand has in the past been met by imports. Also within the agricultural sector, diversification can consist of expansion or entry into less traditional activities (e.g., dairying, aquaculture, horticulture, fruit growing) on a commercial basis to satisfy urban demand or to be exported. And lastly, there is diversification into manufactures and their export.

The recent review of the high performing Asian economies (HPAEs) provides some guidance as to the strategies to facilitate diversification. 1/ First, while agriculture's share of output and employment in the HPAEs has declined significantly over time, growth in agricultural output and productivity was much higher than in other developing countries. Apart from policies that generally provided a stable macroeconomic environment, the governments of the HPAEs provided support to the agricultural sector through extension services, agricultural research, pilot schemes, significant investment in irrigation and rural infrastructure (roads, bridges, transportation, electricity and water supplies), and nonpunitive crop taxation. The experience of the HPAEs (and the experience of the now-industrialized countries in the 19th century) indicates that a dynamic agricultural sector constitutes an important phase in the diversification process; for lower-income countries the message is that failure to attach a sufficiently high priority to agriculture in favor of other sectors is likely to be counterproductive. Second, the HPAEs facilitated the more general process of diversification by public investment and institution building, by dismantling many of the regulatory barriers to resource reallocation, and by adopting policies or reforms which produced fewer distortions than in many other developing countries.

1/ "The East Asian Miracle: Economic Growth and Public Policy", The World Bank, 1993.

Table 9. Changing Export Structure: Selected Developing Countries, 1970 and 1990

	1970		1990	
	d 1/	c 2/	d 1/	c 2/
Africa				
Burundi	0.923	0.826	0.970	0.744
Côte d'Ivoire	0.863	0.422	0.878	0.345
Kenya	0.813	0.336	0.675	0.239
Mauritania	0.952	0.864	0.938	0.621
Senegal	0.793	0.311	0.831	0.251
Tanzania	0.848	0.255	0.844	0.250
Asia				
Malaysia	0.792	0.371	0.581	0.184
Pakistan	0.823	0.264	0.845	0.226
Philippines	0.855	0.324	0.693	0.285
Sri Lanka	0.935	0.584	0.806	0.279
Thailand	0.834	0.262	0.598	0.098
Latin America				
Argentina	0.764	0.222	0.650	0.142
Bolivia	0.891	0.542	0.906	0.321
Brazil	0.718	0.335	0.529	0.101
Colombia	0.773	0.622	0.710	0.296
Mexico	0.584	0.116	0.497	0.311
ruguay	0.874	0.409	0.754	0.223

Source: NCTAD, Handbook of International Trade and Development Statistics, various issues.

1/ "d" is a measure of diversification and "c" is a measure of concentration. Both indices range between zero and 1. The smaller d is, the more diversified exports are. Similarly, the higher c is, the more dependent an economy is on a small range of products.

Table 10. Value and Volume Indices for Agricultural Exports
(1979-81 = 100)

	1970	1975	1980	1985	1991
			Value Indices		
N. America	19	57	104	76	105
W. Europe	19	53	105	96	175
Africa 1/	42	66	105	87	94
Latin America	26	58	104	101	104
East Asia 2/	23	52	105	104	158
			Volume Indices		
N. America	46	65	103	80	95
W. Europe	54	73	99	129	150
Africa 1/	130	112	101	94	106
Latin America	79	80	92	127	127
East Asia 2/	62	74	102	134	168

Source: FAO, Trade Yearbook, various issues

1/ Excluding South Africa.
2/ Market economies excluding Japan.

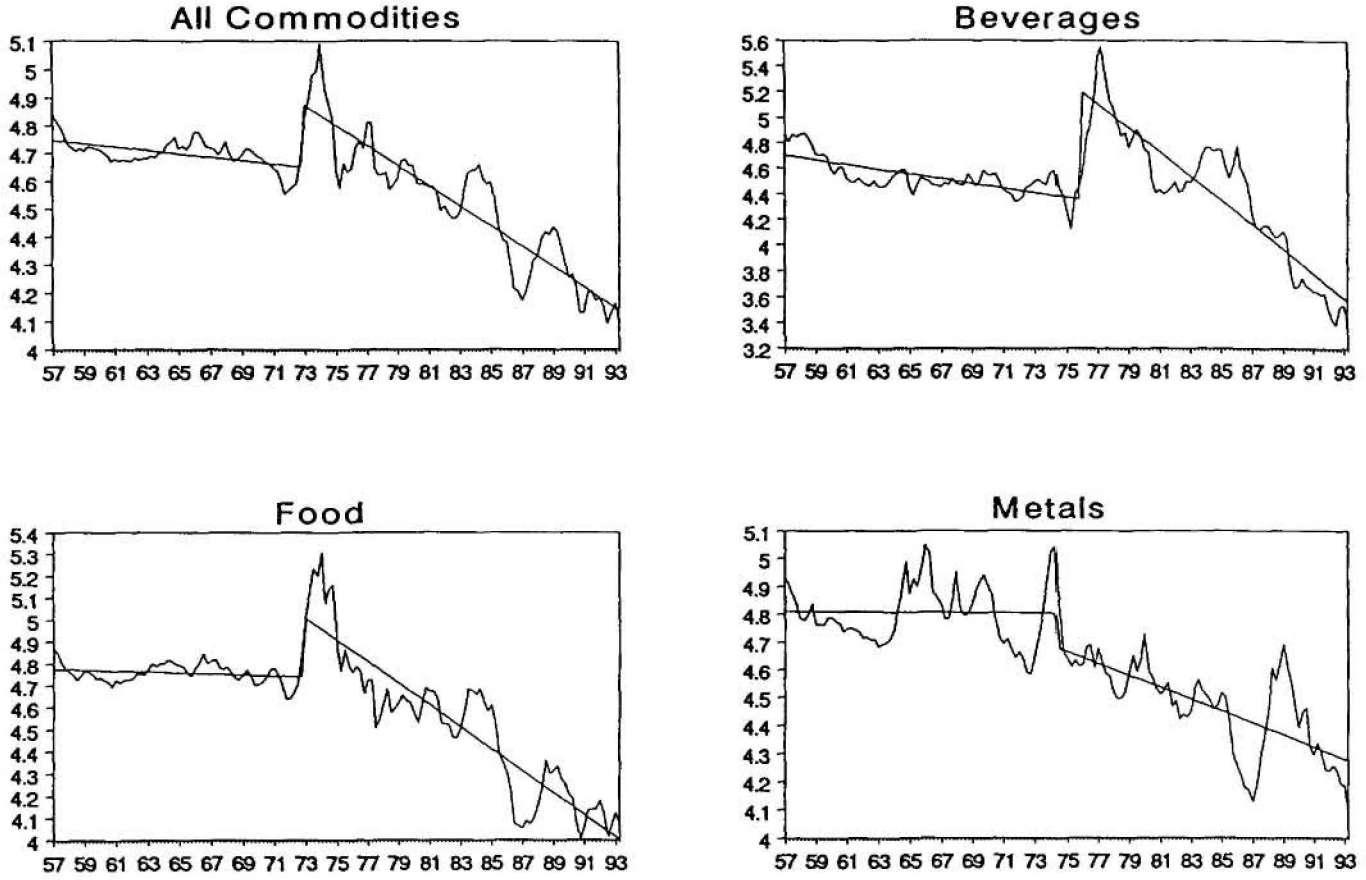
In sum, the empirical regularities that have characterized the behavior of commodity prices in recent years highlight the importance of structural policies that facilitate the diversification of the export base and foster increases in productivity in the primary commodity-producing sector. Similarly, the increasing volatility of commodity prices stress the importance of precautionary saving and hedging. While there is scope for stabilization funds, the design of these schemes should take into account the presence of a secular downward trend in the relative prices of most commodities. In addition, the evidence suggests that even temporary shocks tend to persist over several years.

Table A1. Beveridge-Nelson Decompositions
Modelling the Change in the Permanent Component as an ARMA Process 1/

Dependent variable:	All Commodities	Beverages	Food	Metals
		Annual: 1964-92		
ARMA(p,q)	ARMA(5,1)	ARMA(4,1)	ARMA(4,1)	ARMA(5,1)
Constant	0.003	0.017	0.002	0.007
	(0.008)	(0.026)	(0.013)	(0.007)
AR(1)	-0.880	-0.567	-0.646	-1.203
	(0.351)	(0.146)	(0.656)	(0.191)
AR(2)	-0.912	-0.128	-0.535	-0.832
	(0.266)	(0.298)	(0.247)	(0.278)
AR(3)	-0.629	-0.167	-0.420	-0.942
	(0.371)	(0.271)	(0.476)	(0.263)
AR(4)	-0.374	-0.195	-0.295	-0.645
	(0.269)	(0.101)	(0.149)	(0.288)
AR(5)	-0.118	******	******	-0.315
	(0.253)			(0.236)
MA(1)	0.817	1.352	0.754	1.476
	(0.333)	(0.386)	(0.554)	(0.439)
R^2	0.469	0.341	0.311	0.617
Q statistic	9.085	5.981	13.842	6.267
Significance level	(0.826)	(0.967)	(0.461)	(0.959)
		Quarterly: 1962:I-1993:II		
ARMA(p,q)	ARMA(20,4)	ARMA(20,4)	ARMA(16,4)	ARMA(16,4)
R^2	0.465	0.454	0.393	0.371
Q statistic	8.567	10.966	14.183	15.560
Significance level	(0.999)	(0.999)	(0.998)	(0.996)

1/ All commodity price indices are deflated by the export unit values of manufactures. Standard errors are in parentheses. The models were estimated using log-differences. All series were allowed to have a breaks in their rates of change in 1973. The Q-statistics tests whether the regression residuals are white noise. The significance level is the probability that the actual Q-statistic value will be observed under the null hypothesis that the residuals are white noise.

Chart A.1 Real Commodity Prices: Testing for a Break in Trend 1957:I - 1993:II



Sources: International Financial Statistics, IMF and the authors.
Notes: The broken straight line is a fitted trend (by OLS) that allows for a change in intercept and slope at 1973:I for the all-commodity and food indices. For beverages and metals the breaks occur at 1976:1 and 1974:III, respectively.

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