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The 1984-86 Commodity Recession: An Analysis of the Underlying Causes

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Abstract

The large and broad-based decline in non-oil primary commodity prices during 1984-86 is shown to be fundamentally different from the declines in the four previous cycles since 1970 which had been caused largely by weak demand. Rising supplies of food and the lagged effects of increased production capacity of industrial raw materials, were major factors depressing primary commodity markets in the 1980s and particularly in 1984-86. The econometric results also suggest that economic growth in the industrial countries must, on average, be over 3.3 percent per year to contribute positively to commodity prices by offsetting negative longer term structural changes.

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Contents

I. Introduction

One of the most troubling aspects of the period of world economic recovery following the 1981-82 recession from the point of view of developing countries has been the steep and broad-based decline in primary commodity prices that occurred from mid-1984 to 1986. In spite of continuing but decelerating economic growth in the industrial countries, non-fuel primary commodity prices in real terms fell to their lowest levels since at least the 1930s. The occurrence of a recession-like decline in commodity prices during the upswing of the business cycle has raised concerns about the nature and causes of the decline, particularly whether the causes may be related more to structural factors rather than to short-term, temporary factors, and the implications of this division for the timing of, and prospects for, a recovery. For example, it has been recently stated that "the primary-products economy has come 'uncoupled' from the industrial economy" (Drucker, 1986) and that "economic growth is no longer accompanied by increased consumption of basic materials" (Larson et al, 1986).

The concern about the 1984-86 commodity recession is particularly serious when viewed from the perspective of developing countries that depend heavily on exports of primary commodities. The adjustment efforts undertaken in recent years by many of these countries, especially the heavily indebted countries, depend critically on growth of primary commodity exports. The purpose of this paper is to provide an analysis of the underlying causes of the recent decline in commodity prices and to examine the implications for a possible recovery. After briefly describing the fall in commodity prices in 1984-86 and comparing it to previous cycles in section II, this paper presents the analytical framework in section III and empirical results in section IV. A conclusion is provided in section V.

II. The 1984-86 Commodity Price Decline

a. Description of the decline

After reaching their trough in the fourth quarter of 1982, commodity prices began to recover in the first quarter of 1983 in tandem with the recovery in economic activity in the industrial countries. The recovery in commodity prices continued for six consecutive quarters until prices by the second quarter of 1984 were about 20 percent higher in dollar terms than in the last quarter of 1982. All commodity groups participated in this recovery, with the prices of food and beverages advancing the most (by approximately 25 percent) and metals the least (by 8 percent). Beginning in the third quarter of 1984, commodity prices started their steep decline, thus breaking their rather close positive relationship to economic activity in industrial countries in previous years (Chart 1 and Table 1).

Table 1. Indices of Primary Commodity Prices, 1974-86 1/

(1980=100) 2/

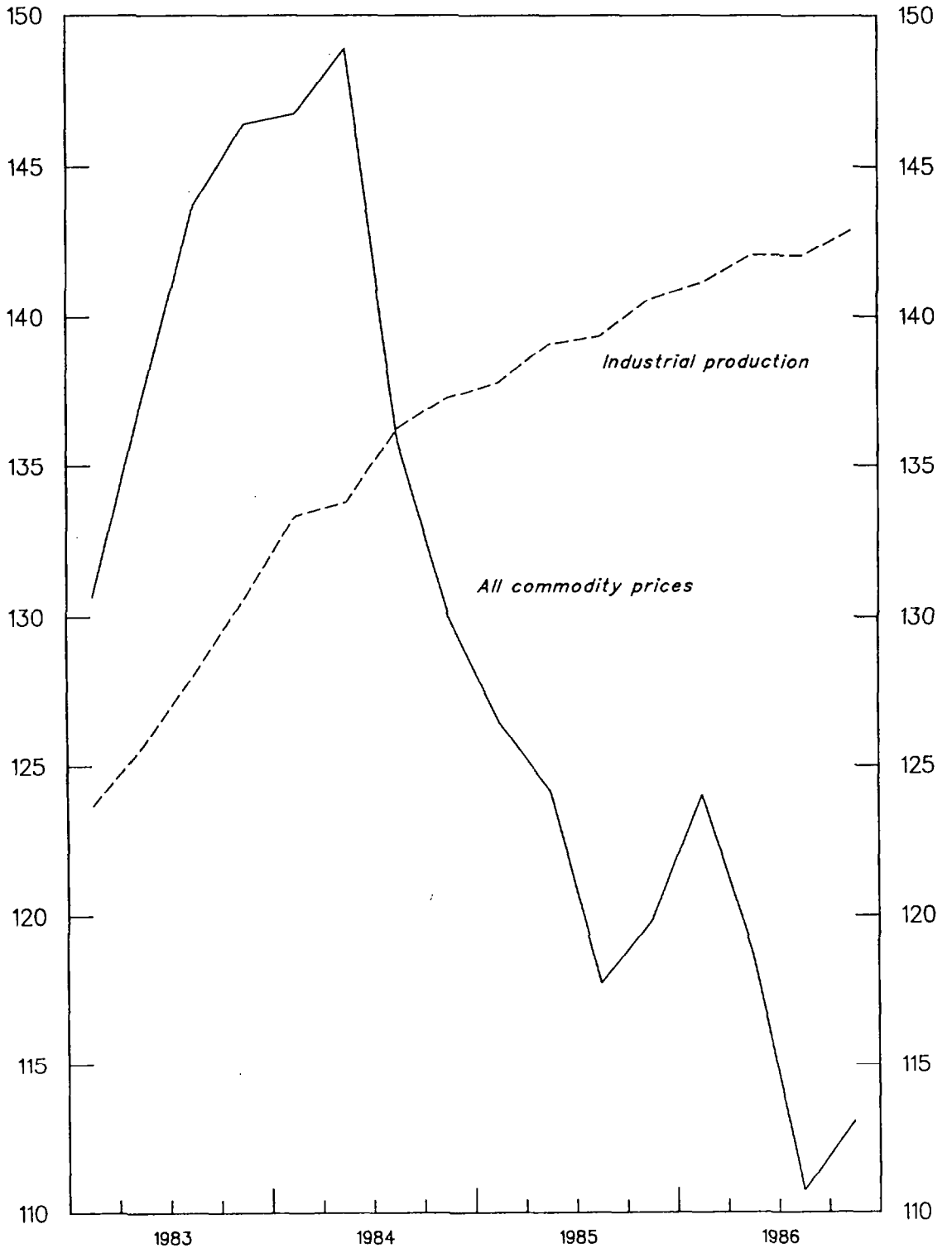
	All Commodities		Food	Beverages	Agricultural Raw Materials 3/	Metals 4/
(Weights)	(100.0)	(100.0)	(42.9)	(11.8)	(23.3)	(22.0)
	(US$)	(SDRs)	---------- (In terms of US$) ----------			
1974	76.3	82.6	95.4	48.6	55.7	75.8
1975	63.9	68.5	76.5	45.7	47.5	66.6
1976	69.3	78.2	71.7	84.6	60.8	65.5
1977	76.7	85.6	69.7	147.0	62.1	68.3
1978	77.8	80.9	78.9	109.9	66.7	70.3
1979	94.5	95.2	92.1	114.4	92.0	91.3
1980	100.0	100.0	100.0	100.0	100.0	100.0
1981	89.9	99.3	96.8	79.3	87.5	84.8
1982	80.6	95.0	82.1	79.6	83.7	74.8
1983	85.6	104.2	89.3	86.1	85.2	78.5
1984	87.4	111.0	88.6	100.0	91.4	74.2
1985	76.0	97.4	74.9	88.3	77.7	69.7
1986	73.1	81.1	65.9	101.8	79.0	65.5
1984						
Q1	91.0	112.9	92.4	103.8	93.8	78.3
Q2	92.7	115.4	95.2	103.5	97.8	77.0
Q3	84.7	109.0	86.2	96.8	88.9	71.2
Q4	81.3	106.4	80.8	96.0	85.2	70.2
1985						
Q1	79.1	106.4	80.3	92.6	77.7	71.0
Q2	77.7	101.8	77.4	85.7	78.7	72.8
Q3	72.9	92.4	70.8	81.0	76.4	69.2
Q4	74.4	89.9	71.2	94.0	78.4	65.9
1986						
Q1	77.7	89.9	71.7	116.0	79.8	66.0
Q2	74.5	83.5	69.1	101.1	79.4	65.4
Q3	69.8	75.5	60.9	98.0	76.2	64.9
Q4	70.5	76.1	61.5	92.1	80.4	65.7

1/ Indices comprise 39 price series for 34 primary commodities.
2/ Weights are based on 1979-81 average earnings.
3/ Includes forestry products.
4/ Includes phosphate rock.
5/ Index uses weights for individual commodities based on average export earnings in 1979-81 for the group of countries specified.

CHART 1

ALL COMMODITY PRICES AND INDUSTRIAL PRODUCTION

(Indices, 1975=100)



Commodity prices in U.S. dollar terms fell by a cumulative 26 percent from the second quarter of 1984 to the third quarter of 1986. Food prices fell the most (by 35 percent), followed by the prices of agricultural raw materials (25 percent), metals (17 percent), and beverages (5 percent). The only group whose prices did not exhibit a fairly persistent downward trend over this two-year period was beverages, whose prices declined until the end of 1985, when they increased sharply in response to the impact of a drought in Brazil on coffee prices (Chart 2). By the third quarter of 1986, nominal dollar commodity prices had fallen to their lowest level since 1976.

Real commodity prices (that is, nominal prices deflated by the price of manufactured exports of industrial countries) declined even more sharply than nominal prices (Chart 3). After increasing more than nominal prices during the 1983-84 recovery as manufactures prices were declining, real commodity prices fell by a cumulative 36 percent from the second quarter of 1984 to the third quarter of 1986. Manufactures prices reversed a trend of four consecutive years of decline with a small increase in 1985 and a much larger rise in 1986. In real terms, food prices fell by 45 percent from 1984 II to 1986 III, followed by declines of 34 percent for agricultural raw materials, 28 percent for metals, and 19 percent for beverages. During the last three decades, real commodity price declines of these magnitudes were only experienced in the 1975 recession, and that decline was from a major price boom in 1973-74 and was followed quickly by a fairly strong recovery in 1976. The recent decline was from a brief recovery after the 1981-82 recession, persisted for two years, and appears less likely to be followed by a strong recovery in the short-run.

The pace of the commodity price decline from 1984 II to 1986 III has varied, with no apparent acceleration or deceleration during the period. The largest declines in each of the three years have occurred in the third quarter, largely due to declines in food prices as expectations of three successive large harvests had their largest seasonal impacts in those quarters (Chart 4). The only large quarterly price increases during the period were for beverages, where substantial quarterly increases in 1985 IV and 1986 I limited the 1984-86 price decline for that group.

b. Comparison with previous cycles

Since the beginning of the 1970s, the amplitude of commodity price cycles has increased substantially (Chart 5). 1/ The most recent phase of price decline, which persisted from the third quarter of 1984 through the third quarter of 1986, amounted to a cumulative price decline of 26 percent (in U.S. dollar terms). Commodity prices have begun to recover in 1987, but it is too soon to say whether this is the beginning of another upward

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1/ While Chart 5 depicts commodity price movements as deviations from a 19-quarter moving average for visual purposes, commodity price cycles in this paper are defined as cumulative percentage declines (from quarterly peak to trough) and recoveries (from quarterly trough to peak).

swing in the next price cycle, or simply a short-term deviation. The cumulative price decline in 1984-86 was the largest of the four previous declines that occurred since 1970, including those experienced in the 1975 and 1981-82 recessions.

The 1984-86 commodity price decline in real terms (-36 percent) and in terms of SDRs (-35 percent) has also been large when compared to downturns in the four previous cycles. In real terms, the only other decline that was as large as the 1984-86 decline was the 1975 decline, and in SDR terms none of the other downturns were nearly as large.

The length of the 1984-86 commodity price decline at nine quarters equalled the longest decline of the four previous downturns which occurred from 1980 IV to 1982 IV and which was accompanied by a prolonged recession. In comparing the 1984-86 price decline with the two largest previous declines in 1975 and 1981-82, it is apparent that it is the length of the decline rather than the pace of the decline that has determined the overall severity of a downturn (Table 2). The pace of the decline has been similar in all these declines, at between 11-12 percent per year.

It is also noteworthy that the 1984-86 price decline follows a relatively brief and small recovery compared to previous recoveries. The 1983-84 price recovery lasted six quarters compared to an average of nine quarters for the previous three recoveries. In addition, the cumulative price recovery in 1983-84 was only 19 percent, also quite small when compared to previous recoveries. When viewed from this perspective, and in light of the large and prolonged price decline in 1981-82, it is not surprising that commodity prices in the third quarter of 1986 were at their lowest level since 1976, even in nominal terms.

The sources of the 1984-86 commodity price decline in terms of commodity groups are broadly similar to those of previous declines. Commodity prices, with the possible exception of beverage prices, have tended to move together in the 1970s and 1980s. Large price declines in food, agricultural raw materials, and metals were primarily responsible for the overall commodity price decline in 1984-86, and it has been these same groups that have, in different proportions, contributed the most to the earlier commodity price declines.

Movements in the major demand-side determinants of commodity prices during the cycles are presented in Table 2. Although the influence of these determinants and of supply-side factors are examined in a systematic fashion in section IV, it is useful to note at this stage an aspect of the 1984-86 price decline that has concerned many observers. In contrast to the other two major downturns in commodity prices in 1975 and 1981-82, during which aggregate demand also declined, the 1984-86 commodity price decline has been accompanied by an increase in demand. While the annual rate of increase of demand in 1984-86 was a modest 3 percent, this annual rate matches the annual rate in the 1977-80 recovery during which commodity prices rose substantially.

CHART 2

PRICES FOR ALL AND COMMODITY GROUPS

(Indices, 1975=100)

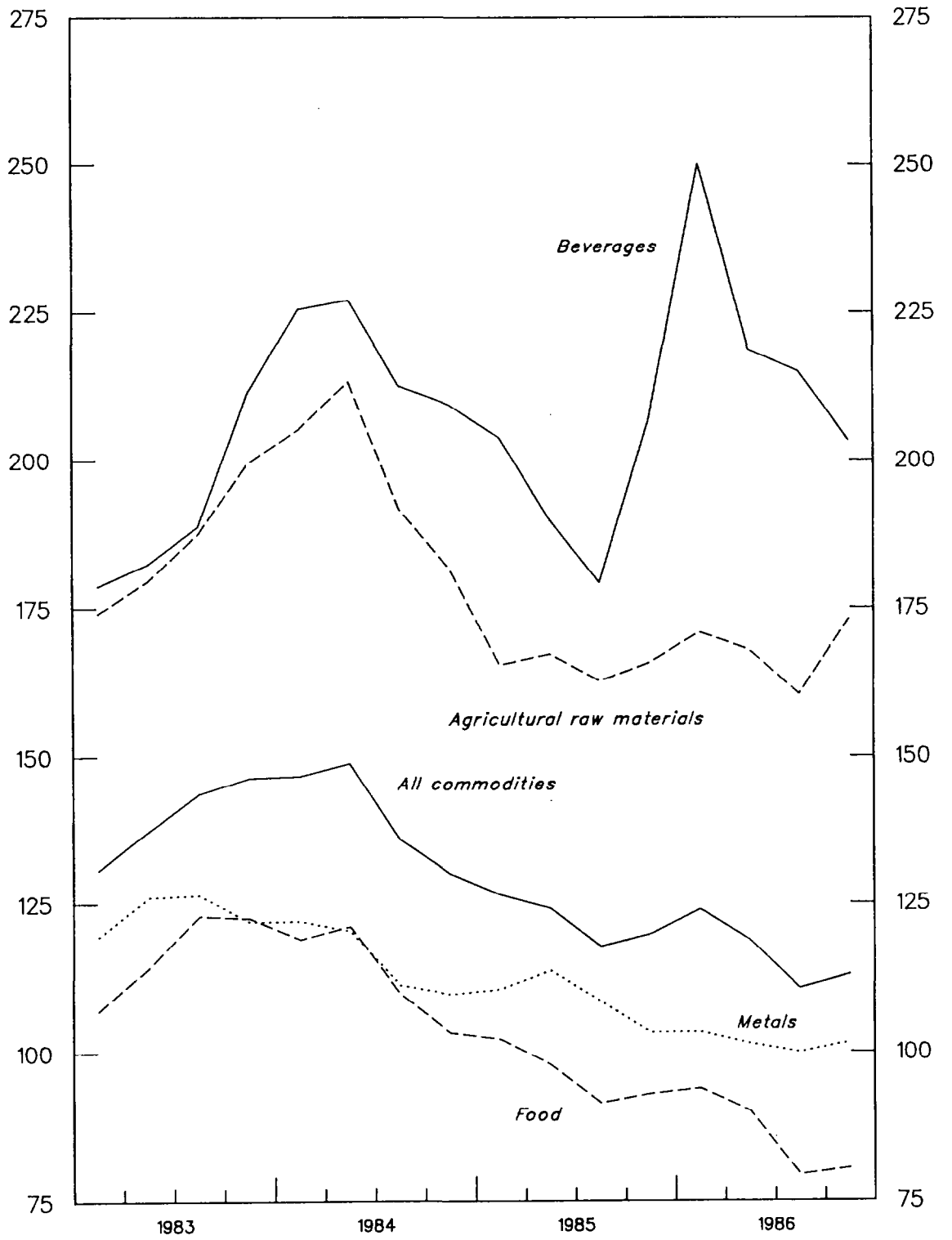

CHART 3

REAL PRICES FOR ALL AND COMMODITY GROUPS

(Indices, 1975=100)

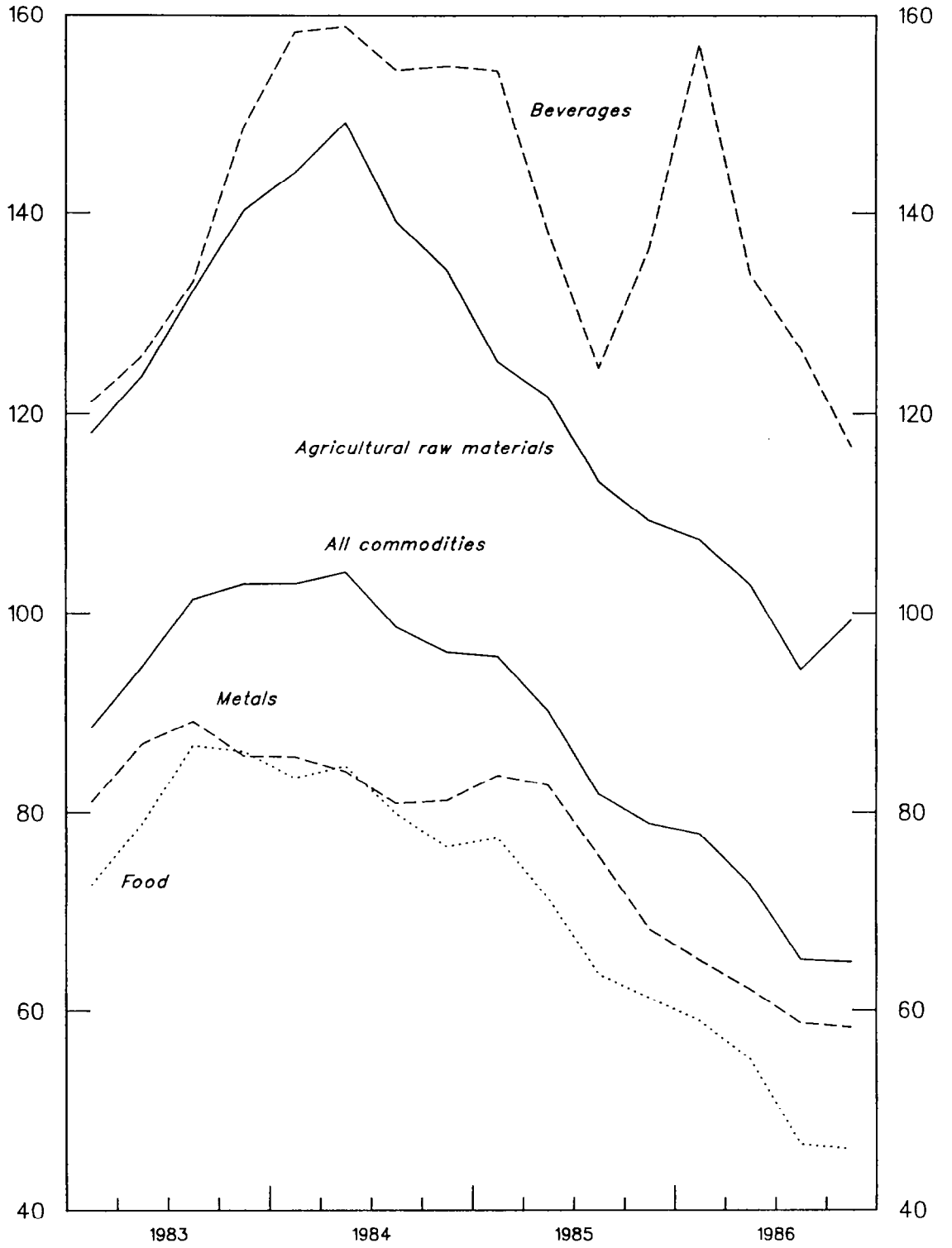

CHART 4

THE 1984–86 COMMODITY PRICE DECLINE

(In quarterly percent changes)

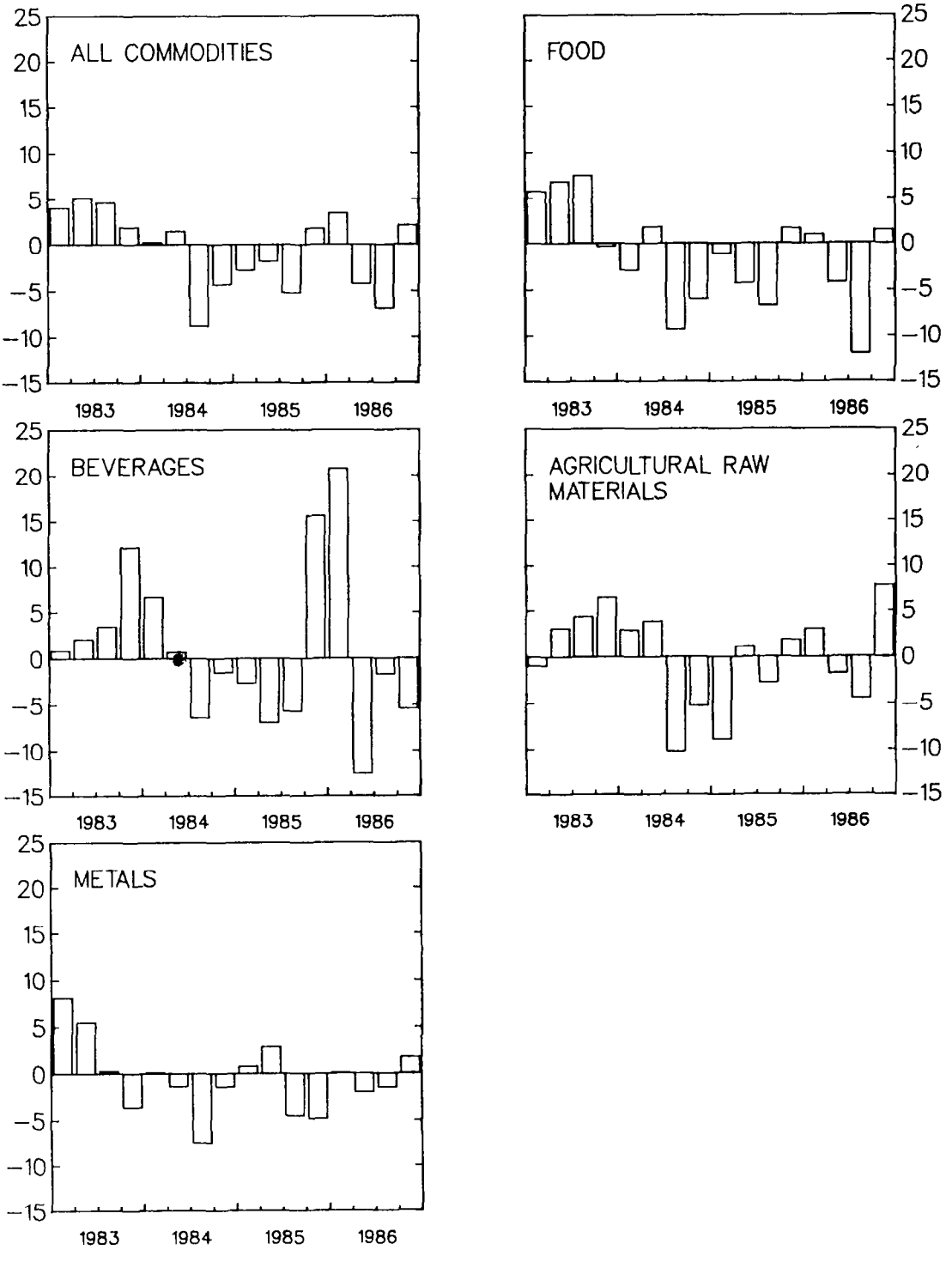

CHART 5

NON–OIL COMMODITY PRICES
PERCENTAGE DEVIATIONS FROM 19–QUARTER
MOVING AVERAGE, 1959–86

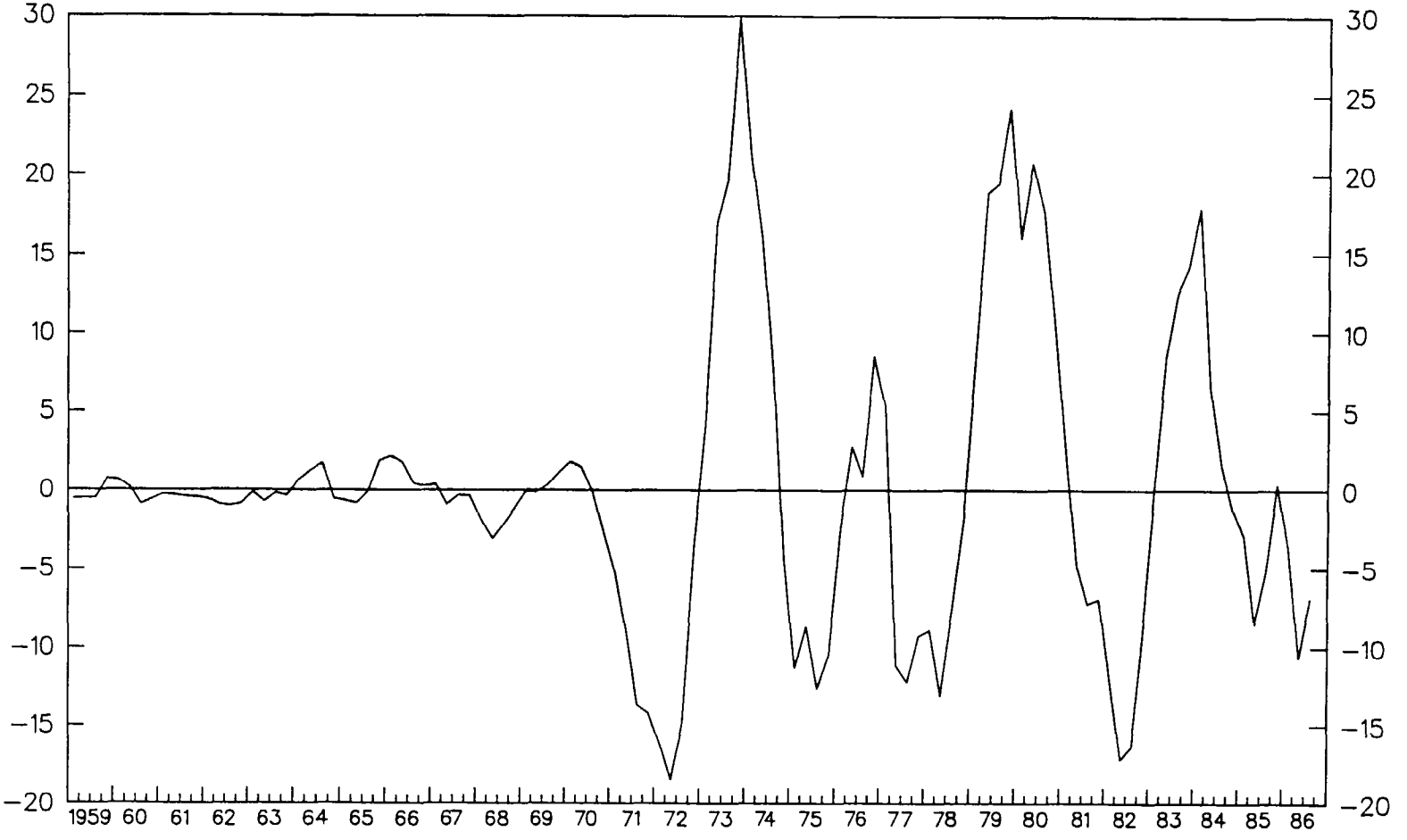

Table 2. Commodity Prices and Their Major Determinant
Changes from the 1970-74 Cycle to Present Downturn

	1970-74 Cyle		1974-77 Cycle		1977-80 Cycle		1980-84 Cycle		1984- Cycle	
	Decline	Recovery	Decline	Recovery	Decline	Recovery	Decline	Recovery	Decline	Recovery
Period	1970III-1971IV	1972I-1974I	1974II-1975IV	1976I-1977I	1977II-1977III	1977IV-1980III	1980IV-1982IV	1983I-1984II	1984III-1986III	19861-
Length (in quarters)	6	9	7	5	2	12	9	6	9	
					Commodity Prices					
Cumulative										
All commodities: nominal prices	-4	118	-19	27	-11	49	-25	19	-26	
Food	2	154	-25	1	-16	71	-27	20	-35	
Beverages	-13	72	9	206	-13	-32	-13	28	-5	
Agricultural raw materials	-1	125	-26	34	-6	72	-21	21	-25	
Metals	-13	80	-13	16	-6	49	-29	9	-17	
All commodities real prices	-12	65	-34	17	-14	1	-16	20	-37	
prices in SDRs	-5	83	-17	29	-12	32	-9	22	-35	
Annual rate										
All commodities	-3	42	-11	21	-21	14	-12	12	-12	
Food	1	51	-15	1	-29	20	-13	13	-17	
Beverages	-9	27	5	145	-24	-12	-6	18	-2	
Agricultural raw materials	-1	43	-16	26	-11	20	-10	14	-12	
Metals	-9	30	-8	12	-11	14	-14	6	-8	
All commodities: real prices	-8	25	-21	13	-26	0	-7	13	-19	
prices in SDRs	-3	31	-10	22	-22	10	-4	14	-18	
					Major Determinants					
Cumulative										
Industrial production	4	18	-7	11	-1	10	-2	10	6	
United States	3	15	-6	11	4	5	-5	20	3	
Europe	3	15	-6	10	-4	7	-3	4	6	
Japan	3	26	-15	14	-0	19	2	15	5	
Wholesale price	4	36	16	13	3	35	19	10	2	
United States	4	30	20	6	3	40	10	4	-4	
Europe	6	32	16	16	3	28	23	11	2	
Japan	-2	48	8	6	-0	25	2	-3	-12	
Exchange Rate	-3	-6	2	3	-1	-11	38	9	-12	
Europe	-5	-7	-2	7	-3	-11	46	24	-23	
Japan	-9	-11	5	-6	-7	-17	19	-12	-32	
Oil price	30	320	28	12	3	147	-0	-12	-60	
Interest Rate	-29	43	-25	-25	22	95	-18	15	-45	
Annual Rate										
Industrial production	3	8	-4	9	-2	3	-1	6	3	
United States	2	6	-3	9	8	2	-2	13	1	
Europe	2	6	-4	8	-7	2	-1	2	3	
Japan	2	11	-9	11	-1	6	1	10	2	
Wholesale price	3	15	9	10	5	11	8	7	1	
United States	3	12	11	5	5	12	4	2	-2	
Europe	4	13	9	13	7	9	10	7	1	
Japan	-1	19	5	-1	8	8	1	-2	-6	
Exchange Rate	-2	-3	1	2	-2	-4	15	6	-6	
Europe	-4	-3	-1	6	-5	-4	18	15	-11	
Japan	-6	-5	3	-5	-14	-6	8	-8	-18	
Oil Price	19	89	15	9	6	35	-0	-8	-34	
Interest Rate	-20	17	-15	-20	48	25	-8	10	-25	

In summary, the 1984-86 decline in dollar commodity prices, when compared with other declines since 1970, is very large both in terms of its magnitude and its duration. When measured in real terms or in terms of SDRs, the decline is even larger. Finally, the cause of the 1984-86 commodity price decline cannot be attributed to a downturn in aggregate demand as were the other previous large declines in commodity prices since 1970.

III. Analytical Framework

Two theoretical models (Chu and Morrison (1984) and (1986)) are adapted in this paper in order to explain the 1984-86 decline in commodity prices. Each model has its own particular strengths and weaknesses, depending primarily on the trade-off between greater theoretical precision on the one hand and data limitations on the other. The earlier study is based on a relatively simple model that explains commodity prices with a few demand-side variables that are readily available on a quarterly basis. The later study is somewhat more complex, as it takes into account the influence of short-term supply changes as well as the medium-term interaction between production capacity and prices. In order to estimate this model, however, it was necessary to shift to data on an annual basis and to utilize somewhat imperfect measures of supply changes. Both of these models are used in this study in order to quantify to the extent possible the factors that have contributed to the weakness in commodity prices in recent years. In the discussion that follows, each model is briefly presented, along with a description of certain modifications that were made (primarily in the form of a more comprehensive sample and improved operational definitions of variables) in the process of re-estimating each one. The modifications, however, do not necessitate changes in the underlying theory of the two models.

a. Demand-driven quarterly model

In an attempt to explain commodity price movements surrounding the 1981-82 recession, Chu and Morrison (C-M) (1984) constructed a largely demand-oriented system of structural equations describing a competitive world commodity market. The reduced-form equation estimated on the basis of this model, in logarithmic first-difference form, was as follows:

$$\theta_1 \Delta p_t = \theta_0 + \theta_2 \Delta y_t + \theta_3 \Delta pd_t - \theta_4 \Delta ed_t \theta_5 \Delta^2 i_t + \theta_6 s_t \quad (1)$$

where the θ_is ($i = 1,2,\ldots,5$) denote lag polynomials of finite orders, with the variables defined in logarithms as follows:

p = non-oil commodity prices in dollars

y = economic activity in industrial countries

pd = domestic prices of substitutes in consuming countries

ed = exchange rates of the dollar vis-a-vis the currencies of consuming countries

i = interest rates

s = supply shocks

Δ = change

The hypotheses underlying the relationship between the independent variables and commodity price changes are fully described in C-M (1984), but they may be summarized briefly here. Economic activity is the major variable that positively affects commodity prices through changes in real income or industrial demand in consuming countries. Inflation in importing countries, unless fully offset by exchange rate movements, also positively influences commodity prices by raising the domestic price of substitutes and perhaps through raising inflationary expectations. Clearly, exchange rate movements (importing countries' currencies against the dollar) also could have an effect independent of inflation because changes in relative prices (of commodity prices in domestic currency relative to the prices of substitutes) affect quantities demanded. Interest rate changes would be expected to be inversely related to commodity price changes through the demand for stocks. Supply shocks on food and beverage prices are expected because demand is relatively stable, while supply may shift markedly in the short run due, for example, to changes in weather patterns.

The results of the C-M (1984) study were generally consistent with the results of other studies of the determinants of commodity price movements. Earlier studies had found significantly positive results for economic activity and inflation (Enoch and Panic (1981) and Grilli and Yang (1981)), and subsequent studies have supported the inverse exchange rate relationship (Gilbert (1986) and Goldsbrough and Zaidi (1986). Grilli and Yang also found some support for the inverse interest rate relationship.

b. Fully specified (demand/supply) annual model

Recognizing the inadequate treatment of supply in their first study, Chu and Morrison (1986) constructed a second model in which commodity supply is determined both by short-term factors influencing capacity utilization and by medium-term factors influencing production capacity. Commodity supply so determined then influenced, along with the demand-side factors, current commodity prices.

Several earlier studies also had attempted to test the significance of supply in explaining commodity prices. Hwa (1979), using a dynamic disequilibrium model of price adjustment in competitive markets, found significantly negative coefficients for both production and stocks in

equations explaining prices of seven individual industrial commodities. Cooper and Lawrence (1975) and Bosworth and Lawrence (1982) had some success in using supply variables to explain prices of groups of commodities.

C-M (1986) recognized that the supply characteristics of food commodities are likely to be different than those of agricultural raw materials and metals. They found that concurrent production and prices of food commodities were inversely correlated, whereas production and prices of agricultural raw materials and metals were positively correlated. This was because production of the latter groups of commodities can be more easily adjusted in the short-run to market conditions, while food production is virtually fixed in the short run. Conversely, for agricultural raw materials and metals, production capacity is less easily adjusted in the short-run than is capacity of food production. The reduced form price equations, therefore, suggested an inverse relationship with current production for food prices, and an inverse relationship with production capacity for prices of agricultural raw materials and metals. The reduced form equation for food commodities was: 1/

$$\Delta p_t = \Theta_o + \Theta_2(\Delta pd_t - \Delta ed_t) - \Theta_3 \Delta q_t + \Theta_5 \Delta y_t, \qquad (2)$$

with $\Theta_o = \gamma_o/\gamma_1, \Theta_2 = 1, \Theta_3 = 1/\gamma_1 > 0$, and $\Theta_5 = \gamma_2/\gamma_1 > 0$

and for agricultural raw materials and metals was:

$$\Delta p_t = \Theta_o + \Theta_1(\Delta ps_t - \Delta es_t) + \Theta_2(\Delta pd_t - \Delta ed_t) - \Theta_4 \Delta qc_t + \Theta_5 \Delta y_t, \qquad (3)$$

with $\Theta_o = (\gamma_o - \alpha_o)/(\alpha_1 + \gamma_1)$, $\Theta_1 = \alpha_1/(\alpha_1 + \gamma_1) > 0$, $\Theta_2 = \gamma_1/(\alpha_1 + \gamma_1) > 0$, $\Theta_4 = 1/(\alpha_1 + \gamma_1) > 0$, and $\Theta_5 = \gamma_2/(\alpha_1 + \gamma_1) > 0$.

with the variables defined in logarithms as follows:

p_t = international price of commodities in U.S. dollars

pd_t = domestic prices of importing countries

ed_t = exchange rates of importing countries (in relation to the U.S. dollar)

1/ The system of structural equations that correspond to the reduced form equations is fully described in C - M (1986); it is repeated in section C of the Annex for convenience.

q_t = world production of commodities

y_t = industrial production in importing countries

ps_t = domestic price levels in exporting countries

es_t = exchange rates of exporting countries (in relation to U.S. dollar)

qc_t = production capacity of commodities

The price equation for all commodities was simply a weighted aggregation of estimated prices of the four commodity groups.

c. Scheme of analysis

In the present analysis of the recent decline in commodity prices, both the quarterly and annual models described above are used to investigate the causes of the decline. Each model has its advantages and disadvantages. The quarterly model makes it possible to analyze better the contributions of explanatory factors during the course of the decline. It can also identify more precisely any lags in the relevant relationships. The larger number of observations provides substantially greater degrees of freedom and potentially could result in more reliable estimates of coefficients for the demand-side variables than in the annual model. During periods when supply changes are not substantial and the business cycle is the dominant factor influencing commodity prices, such as in the 1970s and early 1980s, this demand-driven model may explain a large part of the variation in commodity prices.

The annual demand-supply model, on the other hand, can be quite useful during periods when movements in the business cycle are not extreme and aggregate supply changes are significant, such as during 1984-86. Because it includes both demand and supply-side factors, the annual model is a theoretically more complete model. In general, the annual model should perform better than the quarterly model in explaining the prices of food and beverages, which are influenced to a relatively greater degree by supply factors than are the prices of agricultural raw materials and metals. These latter two groups of industrial raw materials may be better explained by the quarterly demand-driven model. In employing the annual model, however, the greater precision of timing and larger degrees of freedom of the quarterly model are sacrificed for the increased explanatory power provided by supply-side factors. The measurement of the supply-side factors themselves is imperfect as it is based on data of uneven consistency. Nevertheless, it is felt that, in combination with the results of the quarterly model, the annual model can provide some useful insights into the supply factors that appear to have been particularly relevant in recent years, and it thus provides a more complete picture of the combination of factors influencing commodity prices.

In section IV the results of the re-estimation of the two models are presented and compared with previous results. The estimated equations are then used to analyze the contributions of the various explanatory factors to price movements in the 1980s for all commodities and for each of the four commodity groups. The contributions are calculated for quarters, for years, and for the whole period of price decline between 1984 and 1986. Not only are the factors that contributed to actual price declines identified, but factors that are primarily responsible for generating errors are also identified. The extent to which different factors exerted different degrees of influence during the course of the price decline is also explored. Large residuals are investigated with a view to identifying explanations that would not be picked up by the model.

An important aspect of this analysis is to see whether short- and medium-term factors can explain a large part of the commodity price decline in 1984-86. If a large part of the price decline cannot be explained by short- and medium-term factors, more weight is given to the possibility that long-term structural factors may be responsible. This latter possibility, of course, would not bode well for an early recovery of commodity prices. The analysis of long-term vs. short-term factors is performed for all commodities and for each of the four commodity groups. Medium-term factors related to production capacity are included in the equations for agricultural raw materials and metals, and therefore their inference can be explored for these groups.

Many observers have considered the large commodity price decline in recent years, at a time of concurrent economic expansion in industrial countries, to be perverse. The results of our analysis does shed some light on this matter by focussing the analysis on the mix of short-, medium-, and long-term factors affecting commodity prices.

IV. Empirical Results

a. Quarterly model

(i) Regression results

We introduced several modifications in re-estimating the C-M (1984) model (equation (1), section IIII.a. above). In order to define both the overall period of estimation and the short-term commodity price cycles, we first reviewed the recent historical evidence on the variations in non-oil commodity prices (Chart 5). As is clear from the chart, from the mid-1950s through the end of the 1960s, there was little variation in prices. However, beginning in 1970, and continuning to the present, commodity prices have fluctuated widely. On the basis of Chart 5 we decided to re-estimate the model for the two separate periods,

1957 Q3 to 1969 Q2 and 1969 Q3 to 1986 Q2 1/. For the latter period we identified five full commodity price cycles, incorporating both declining and recovery phases; these were identified in Table 2. According to this scheme, it appears that prices are now at or near the turning point in the fifth, and current cycle.

Besides the difference in estimation periods, the current study also utilizes somewhat different weights and weighting procedures in the construction of the operational variables than were used in C-M (1984). The new procedures are described in full in the Annex to this paper. Briefly, weights used in aggregating the price, production, production capacity, and supply variables were updated and expanded from average relative shares in developing country exports in 1968-70 to shares in world exports in 1979-81, in order to better reflect the current structure of world trade in non-oil primary commodities. In terms of country representation in the sample, the present study expands the coverage on the demand side from 7 to 13 countries (Annex Table A2). In addition, geometric weighting procedures were used throughout in order to give more appropriate weight to extreme observations, particularly in the case of real exchange rate changes in high inflation countries.

The results of estimating the model's coefficients using OLS are presented in Table 3 for all commodities, and for each of the four major commodity subgroups (food, beverages, agricultural raw materials, and metals). The results for 1957-69 show that the model has very little explanatory power for this period, largely because there is very little variation in commodity prices to explain during this period (see Chart 5). However, during 1969-86, when the macroeconomic environment had changed markedly, i.e. to floating exchange rates, unstable oil prices, relatively high inflation, and an accentuated business cycle, the model works reasonably well, considering its inherent limitations (essentially no supply side) and the fact that what is being explained is changes in levels, not the levels themselves.

All the estimated coefficients have the expected signs, reasonable magnitudes, and several are statistically significant at conventional levels; in addition, the overall levels of explanatory power (indicated by the adjusted R-squared) are reasonably high. As with most earlier work, these results suggest that economic activity remains the single most import short-run determinant of commodity prices on the demand side, although inflation and exchange rate changes are also influential. Some evidence also is found of the importance of changes in interest rates, but the magnitude of these effects is small.

1/ The latest data available on some of the independent variables when the regressions were run were for 1986 Q2. Subsequently, when data for 1986 Q3 became available, they were used in the contributions calculations discussed below, but the coefficients were not re-estimated.

Table 3. Quarterly Price Equations, 1957-1986 1/

	Constant	Economic Activity Δy_t	Economic Activity Δy_{t-1}	Inflation $\Delta pd_t - \Delta ed_t$	Inflation $\Delta pd_{t-2} - \Delta ed_{t-2}$	Interest Rate $\Delta^2 i_{t-1}$	Supply Stocks Food SF_t	Supply Stocks Beverages SB_t	R^2	D-W	SEE
All commodities											
1957-69	-0.011*	0.482*	0.183	0.092	0.137	-0.015			0.10	1.69	0.015
	(-2.21)	(2.07)	(0.86)	(0.29)	(0.43)	(-0.84)					
1969-86	-0.022**	1.534**	0.637	0.310	0.439**	-0.061*	0.088**	0.005	0.59	1.78	0.035
	(-3.78)	(4.00)	(1.65)	(1.85)	(2.76)	(-2.61)	(3.76)	(0.23)			
Food											
1957-69	-0.003	0.266		0.178	0.294				--	2.00	0.021
	(-0.53)	(0.907)		(0.56)	(0.658)						
1969-86	-0.019		1.379*		0.677*		0.145**		0.34	2.09	0.063
	(-1.95)		(2.47)		(2.63)		(3.71)				
Beverages											
1957-69	-0.004	-0.225		0.547					--	1.44	0.048
	(-0.36)	(-0.39)		(0.38)							
1969-86	-0.009		2.692**	0.227				0.188**	0.29	1.50	0.090
	(-0.68)		(3.66)	(0.56)				(3.51)			
Agricultural raw materials											
1957-69	-0.016	0.851*		-0.332		-0.026			0.08	1.75	0.026
	(-1.96)	(2.61		(-0.68)		(-0.83)					
1969-86	-0.020*	2.280**		0.767**		-0.052			0.39	1.51	0.054
	(-2.42)	(5.37)		(3.60)		(-1.50)					
Metals											
1957-69	-0.005	0.249		2.252		0.015			0.08	1.72	0.039
	(-0.44)	(0.51)		(1.94)		(0.32)					
1969-86	-0.017*	1.436**		0.819**		-0.087			0.35	1.53	0.049
	(-2.39)	(3.72)		(4.38)		(-2.76)					

1/ Estimation from 1957 Q3 to 1969 Q2 and from 1969 Q3 to 1986 Q2 for equations with one lag; those with two lags begin in Q4 1957 and in Q4 1969. The dependent variable in all equations is Δp_t. The level of statistical significance is indicated by one (99 percent) or two (99 percent) asterisks. $\bar{R}^2$ is the adjusted R^2, D-W denotes the Durbin-Watson statistic, and SEE is the standard error of estimate.

It is worth noting that the results generally show a significant constant term, on the order -0.02. In the context of this model this coefficient should be interpreted as the rate of change per unit of time --i.e., holding the explicit variables in the model constant, commodity prices are seen to drift downwards at the rate of about 2 percent per quarter, or 8-9 percent per year. Although we might have expected some downward drift over time, due mainly to longer-term structural changes on the demand side, the exceptionally large magnitude of the constant is undoubtedly due to the fact that some supply-side influences are reflected in this term.

(ii) Disaggregation of commodity price movements: contributions from major variables in the quarterly model.

The contributions of the demand-side variables in the quarterly model to commodity price movements were calculated for the decline and recovery phases of the four complete price cycles since 1970 and for the decline phase of the current cycle, from mid-1984 to 1986 1/. As shown in Chart 6, the performance of this demand-driven model in predicting the phases of the four cycles from 1970 to 1984 was quite good. The direction of movement in commodity prices was correctly predicted in seven of the eight phases. Even in the phase that was not correctly predicted, the decline phase of the 1970-74 cycle, a small increase was predicted compared to a small actual decline and the absolute prediction error was not significant.

The dominant variable explaining commodity price movements in the three cycles in the 1970s was economic activity in the industrial countries (Table 4). Economic activity during this period became much more unstable than during the previous decade. Inflation also accelerated substantially in the 1970s and was a major factor influencing commodity prices, especially during the recovery phases of the three cycles. Even during the "commodity price boom" from 1972 to 1974, when speculative forces and special supply factors were thought to have exerted significant influence, economic actvitiy and inflation together contributed to a large part of the price increase. Movements in the U.S. dollar exchange rate did not contribute substantially to commodity price movements until the recovery phase of the 1977-80 cycle when the depreciation of the U.S. dollar put upward pressure on commodity prices expressed in U.S. dollars. The trend term of -9 percent per year was a significant contribution throughout the period.

The 1980-84 cycle was somewhat different from the three cycles in the 1970s. Although economic activity continued to exert a major influence, the contribution of inflation moderated considerably while

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1/ The coefficients used in the analysis were those estimated for 1969-86. To simplify the calculations, the coefficients on all current and lagged variables were summed and then applied to changes in the relevant variables during the current period.

Table 4. Commodity Prices and Their Major Determinants: Changes During Five Recent Cycles

Cyclical Phase	Percentage Change In Commodity Prices		Contributions Made By Major Determinants			
	Actual	Predicted	Economic Activity	Inflation	Exchange Rate	Trend
			1970-74 Cycle (15 quarters)			
Decline (6 quarters) 1970 Q3-1971 Q4	-4	1	9	3	3	-14
Recovery (9 quarters) 1972 Q1-1974 Q1	118	73	40	23	4	6 1/
			1974-77 Cycle (12 quarters)			
Decline (7 quarters) 1974 Q2-1975 Q4	-19	-21	-15	11	-1	-16
Recovery (5 quarters) 1976 Q1-1977 Q1	26	21	24	9	-2	-10 2/
			1977-80 Cycle (14 quarters)			
Decline (2 quarters) 1977 Q2-1977 Q3	-11	-4	-2	2	1	-5
Recovery (12 quarters) 1977 Q4-1980 Q3	49	25	22	22	8	-27
			1980-84 Cycle (15 quarters)			
Decline (9 quarters) 1980 Q4-1982 Q4	-25	-34	-4	13	-23	-20
Recovery (6 quarters) 1983 Q1-1984 Q2	18	8	21	7	-7	-13
			1984-Present Cycle (9+ quarters)			
Decline (9 quarters) 1984 Q3-1986 Q3	-26	4	13	1	10	-20

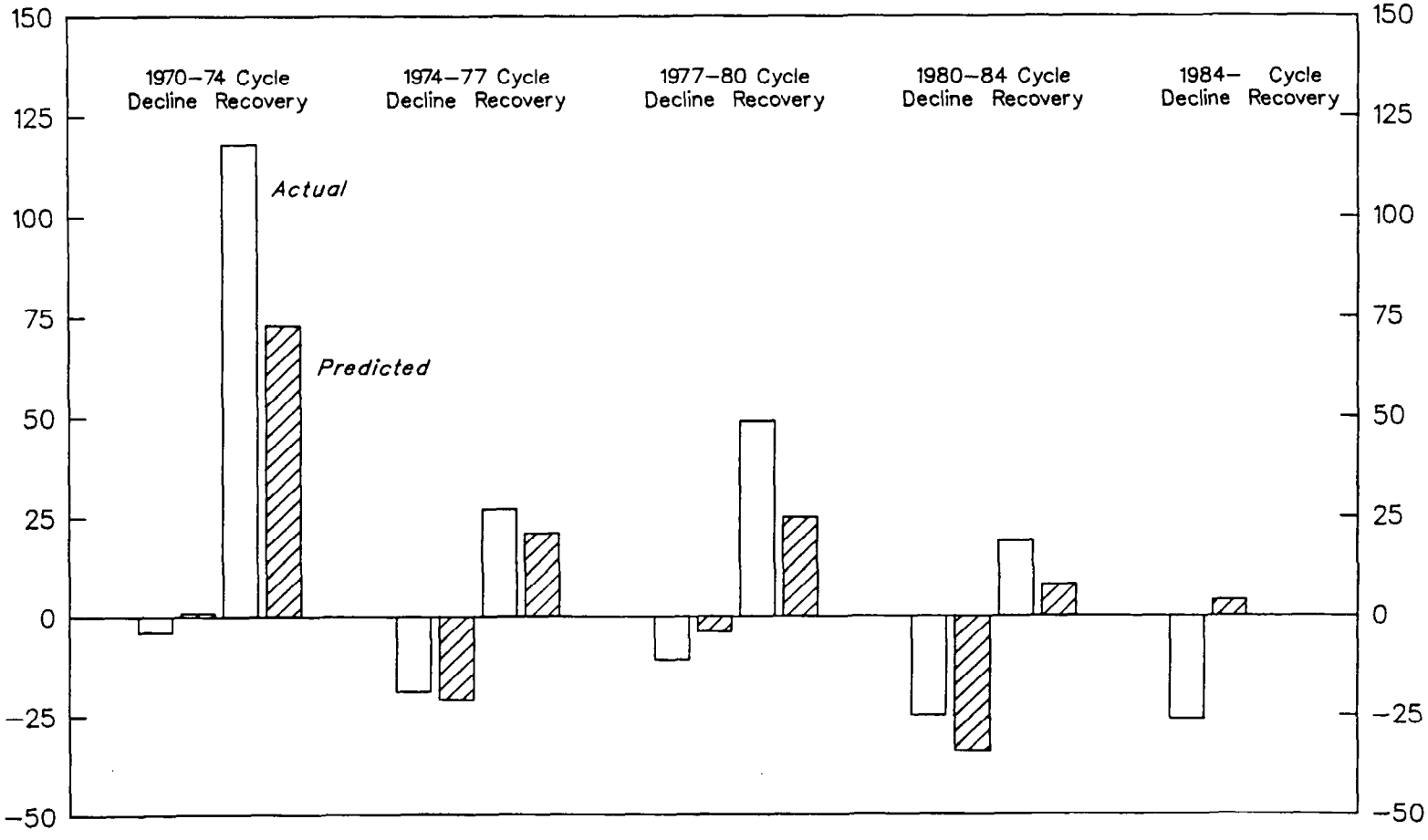
1/ Net contribution from trend (-20) and food dummy (26).
2/ Net contribution from trend (-11) and beverage dummy (1).

CHART 6

COMMODITY PRICE CYCLES

ACTUAL AND PREDICTED

(Percentage change)



[1] See Table 11 for quarters included in each phase of each cycle.

the contribution of the U.S. dollar exchange rate increased. Indeed, the strong appreciation of the U.S. dollar during 1981-82 constituted the largest contribution to the sharp decline in commodity prices during this period, accentuated by the decline in economic activity associated with the recession. The major contribution to the recovery phase of this cycle, however, was again the rise in economic activity during 1983 and the first half of 1984.

Given the good performance of the quarterly demand-driven model in predicting commodity price movements over the last four cycles, the large prediction error for the decline phase of the current cycle (mid-1984 to 1986) is all the more noteworthy. All three of the demand-side variables resulted in positive contributions and together with the trend term predicted an increase in commodity prices from 1984 III to 1986 III of 4 percent. Actual commodity prices, however, declined by 26 percent over this period, a steep and prolonged decline that was broad-based and characteristic of a recession-like decline. Econonic activity, although decelerating from an annualized rate of 6 percent during the 1983-84 recovery to 2 percent, still represented a positive contribution. Inflation, while similarly decelerating from an annualized rate of 7 percent during 1983-84 to 2 percent, also constituted a small but positive contribution. Perhaps the most unexpected development was that the strong positive contribution of the large depreciation of the U.S. dollar did not appear to be reflected in actual commodity price movements.

The poor performance of the quarterly model in predicting the price decline phase of the current cycle in the face of its rather consistently good performance in the four previous cycles from 1970 to 1984 suggests that important factors not included in the model and unique to the current cycle are influencing commodity prices. An obvious candidate for the missing variables would be the supply side, and this possibility is explored in the next section. In summary, the main contribution of the quarterly model to this analysis is to show quite clearly the inability of demand-side factors, which were previously rather successful in predicting commodity prices, to explain the sharp and prolonged commodity price decline in 1984-86.

b. Annual model

(i) Regression results

As was the case in the quarterly model, the re-estimations undertaken of the annual model included some modifications in specification of variables. The most important of these concerns the supply variables for the food crops. Since the C-M (1986) study was completed, an index of non-oil commodity supply was developed that is compatible with the IMF commodity price index. This index of total supply, which includes beginning stocks plus current production, was used in the present study as the supply variable in place of production in the food and beverage

equations. Because of this improvement in operationalizing the supply variables, dummy variables to account for the significant effects of stock movements in certain years are no longer necessary. 1/

The estimated reduced-form price equations for the food crop groups are reported in Table 5 (upper panel). In estimating equation (2) (section III.b above) we followed the method of C-M (1986) of imposing the constraint $\theta_2 = 1$ by transposing $(\Delta pd_t - \Delta ed_t)$ to the lefthand side of the equation and defining a new dependent variable.

The results of the estimation show that the dominant factor in yearly variations in food and beverage prices is variations in supply, which of course, is inversely related to the corresponding price movements. It is also noteworthy that real income or economic activity in consuming countries also remains very important. As is emphasized in C-M (1986), this specification incorporates a maintained hypothesis that inflation in importing countries $[(\Delta pd_t - \Delta ed_t)]$ is a significant variable in determining commodity prices. The opposite is true of price changes in producing countries, which is another way of saying that we have assumed a short-run price elasticity of supply of zero for the food crops.

As is explained in C-M (1986), the equation for agricultural raw materials and metals (equation (3) in section III.b) cannot be estimated directly because two independent variables (inflation in the exporting and importing countries) are highly correlated since industrial countries dominate in both exports and imports (see the Annex, Table A2). To solve this problem and obtain valid results for the inflation terms, we again followed the procedure used in C-M (1986), i.e., by noting that since θ_1 and θ_2 in equation (3) should sum to unity, one can rewrite equation (3) as:

$$\Delta p_t - (\Delta pd_t - \Delta ed_t) = \theta_0 + \theta_1 (\Delta ps_t - \Delta es_t - \Delta pd_t - \Delta ed_t) - \theta_4 \Delta qc_t + \theta_5 \Delta y_t \qquad (4)$$

Unfortunately, while this solves the multicollinearity problem, it does not yield separate inflation effects for the producing and consuming countries. For such a disaggregation we used the same procedure as C-M (1986)--i.e., we used the estimated coefficients from equation (4) to obtain the following two equations:

$$\Delta p_t - \theta_0 - \theta_2 (\Delta pd_t - \Delta ed_t) + \theta_4 \Delta qc_t - \theta_5 \Delta y_t = \theta_1 (\Delta ps_t - \Delta es_t) \qquad (5)$$

1/ Additional details on the sample countries, weighting procedures, etc., are covered in the Annex.

Table 5. Annual Price Equations

Commodity Group	Weights in Overall Index	Equation Number	Constant (θ_0)	Coefficient: Inflation 1/ — Inflation Differential 1/ $\Delta pes_t - \Delta ped_t$ (θ_1)	Coefficient: Inflation 1/ — Producing Countries Δpes_t (θ_1)	Coefficient: Inflation 1/ — Consuming Countries Δped_t (θ_2)	Coefficient: Supply — Supply Δs_t ($-\theta_3$)	Coefficient: Supply — Production Capacity Δqc_t (θ_4)	Coefficient: Industrial Production Δy_t (θ_5)	R^2	D-W	SEE
All 2/	100.0		-0.051	—	0.206	0.794	-1.087	-1.039	1.541			
Food Crops												
Food 3/	42.9	(2)	-0.050 (-1.50)	—	—	1.0	-1.846 (-1.94)		1.553** (3.25)	0.75	1.63	0.062
Beverages 4/	14.2	(2)	-0.050 (-1.24)	—	—	1.0	-2.081** (-4.24)		1.126 (1.72)	0.60	1.70	0.130
Industrial Raw Materials												
Agricultural raw materials	20.9	(4)	-0.024 (-0.309)	0.846 (1.29)				-4.623 (-1.02)	1.807** (3.74)	0.32	1.84	0.095
		(5)			0.032 (0.02)					—	2.39	0.520
		(6)				1.231** (4.54)				0.40	2.06	0.108
Metals	22.0	(4)	-0.077* (-2.56)	0.132 (0.24)				-0.330 (-0.39)	1.534** (3.15)	0.27	1.92	0.089
		(5)			0.307 (1.34)					0.10	2.23	0.080
		(6)				0.850** (4.28)				0.47	2.25	0.080

Note: The sample estimation period is 1961-85. R^2 is the adjusted coefficient of determination; DW is the Durbin-Watson test statistic; and SEE is the standard error of estimate. One asterisk indicates significance at the 5 percent level, two asterisks indicate significance at the 1 percent level; t-statistics of estimated coefficients appear in parenthesis.

1/ Note that $\Delta pes_t = \Delta ps_t - \Delta es_t$ and $\Delta ped_t = \Delta pd_t - \Delta ed_t$.

2/ Reduced-farm coefficients for the overall community price equation are obtained as a weighted average of the four constitutent groups, where the weights (shares in world exports during 1979-81) are those used in the Fund's price index. The inflation terms for agricultural raw materials and metals are based on the estimate of θ_1 in equation (4) and the assumption that the sum of coefficients is unity.

3/ Two dummy variables are included in the equation for food to account for price shocks that occurred, but which were due to factors that are not captured in the model. In 1973 a price shock occurred as a result of a significant shift in Russian policy with respect to the maintenance of cattle stocks in the face of bad harvests. Prior to that year, the size of the herd was adjusted to the available grain supply, but this change in policy meant that Russia had to import very large quantities of grain in early 1973. Since most of these purchases were completed before news of the policy shift was widely disseminated, and because poor harvests in 1972 were also experienced in southern Asia in grains and in Peru in anchovies, panic and speculative buying of the remaining available grains on the world market drove prices to very high levels in 1973. At the beginning of 1983, the U.S. Department of Agriculture announced the introduction of a large-scale program that paid farmers to remove land from cultivation in return for grain supplies from U.S. government stocks. The real effects of the so-called "PIK" (payment in kind) program were reflected in grain prices in late 1983, and the supply channel through which the impact was transferred is captured in the model. However, the "announcement effect" of the PIK program caused prices to rise sharply in early 1983, and this effect is not captured in the model. The values (and t-statistics) for the 1973 and 1983 dummy variables for food were: 0.371** (5.56) and 0.170* (2.624), respectively.

4/ Two dummy variables were included in the equation for beverages in 1974 and 1977 in order to account for persistent price increases that followed two consecutive production shortfalls in 1972-73 and 1975-76. The values (and t-statistics) were: 0.143 (1.06) and 0.462** (3.47), respectively.

$$\Delta p_t - \theta_0 - \theta_1(\Delta ps_t - \Delta es_t) + \theta_4 \Delta qc_t - \theta_5 \Delta y_t$$
$$= \theta_2(\Delta\ pd_t - \Delta ed_t) \qquad (6)$$

The estimation results for equations (4), (5), and (6) are reported in Table 5 (lower panel). The results suggest that it is only inflation in the consuming countries that is important in commodity price fluctuations. This finding is somewhat different from the results reported in C-M (1986) for equations (5) and (6), although the latter are not given much weight in C-M (1986) compared to the results based on equation (4).

In the top line of Table 5 the estimated reduced-form coefficients of the explanatory variables are aggregated on the basis of world export shares (Annex, Table A1). Constrained to sum to unity, the coefficients (elasticities) for the inflation terms are estimated at 0.206 for inflation in exporting countries and 0.794 for inflation in the consuming countries. This result is nearly identical to that of C-M (1986) for equation (4), i.e., 0.267 and 0.733, respectively. The elasticity for industrial production is estimated at 1.5, compared with 2.0 in C-M (1986) and somewhat lower levels in other studies. Thus, the results are broadly comparable to earlier findings.

With respect to the production capacity variable, the results seem to suggest that medium-term supply response through expansions in output capacity could be quantitatively important for agricultural raw materials (although the coefficient is not significant at conventional levels of confidence), but this is probably not the case for metals. Indeed, for annual changes in metals prices, these results suggest that only industrial production is important.

Finally, it should be noted that the estimated constant term in the annual model shows a downward drift in commodity prices on the order of 5 percent per year for all commodities. As discussed earlier, the demand-oriented quarterly model had a rate of 9 percent per year for this downward drift. The drop in the constant term in the annual model is undoubtedly due to the incorporation of the supply side into the model, as these new variables have absorbed some of the "responsibility" for the downward movements of prices. The remaining downward trending of about 5 percent per year over the past decade and a half could be associated with structural shifts that tend over time to reduce demand (e.g., "downsizing", substitution of synthetic materials for natural products, shifts in the production structure of industrial countries towards a service-based economy, etc.) and to increase supply (e.g., technological change embodied in new high-yielding varieties, etc.).

ii. Disaggregation of commodity price movements: contributions from major variables in the annual model

The annual model is theoretically more complete than the quarterly model in that it takes into account, in addition to demand-side factors, changes in current supplies of food and beverages and changes in

production capacity of agricultural raw materials and metals. In order to accommodate these vairiables, however, it was necessary to estimate the model on the basis of annual data, thus losing some of the precision of the first model in analyzing developments during the phases of a cycle. Thus, it is not possible to track the commodity price cycles as was done with the quarterly model. Nevertheless, predictions on an annual basis still make possible an analysis of whether the weakness in commodity prices during 1984-86 is explained.

As shown earlier, the quarterly model did not predict the large commodity price decline that occurred from 1984 to 1986, but rather predicted a continuing but decelerating recovery in prices. The annual model, on the other hand, does predict the beginning of a new cycle in 1984-85 with overall commodity prices predicted to decline by 1.9 percent in 1984 and by 6.6 percent in 1985 (Table 6). 1/ In 1986, however, an increase of 10.6 percent is predicted, primarily on the basis of the large depreciation of the U.S. dollar. Demand in the annual model, as in the quarterly model, contributes positively to commodity prices during 1984 to 1986, although at a decelerating rate. Supply factors are the main reason for the predicted decline in commodity prices in 1984-85.

It has been argued that supply-side factors generally reinforced demand factors over the 1970s and early 1980s (C - M, 1986). This is consistent with the results of the quarterly model, which predicted commodity price movements in the right directions over this period, but generally underpredicted the extent of the price changes. It is also consistent with the proposition that supply factors since 1984 have worked in opposite directions to demand factors, which would explain the failure of the quarterly demand model to predict the price decline in this period.

The supply variables in the annual model (current supplies for food and beverages, and production capacity for agricultural raw materials and metals) appear to absorb some of the rather large trend term of -9 percent per year in the quarterly model. In the annual model, the trend term is reduced to -5 percent per year, and the difference appears to be accounted for by the two supply variables. Thus, almost half of the negative trend term in the quarterly model seems to be due to increasing commodity supply and production capacity over time.

The supply variables in the annual model, however, do not result in constant contributions to commodity price movements each year. Over the two-year period 1984-85, the negative contributions of food and beverage supplies to overall commodity price movements approximately doubled compared to 1983. Over this two-year period, the supplies of almost all agricultural commodities increased substantially because of

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1/ The calculated contributions in the annual model were based on the estimated coefficients of equation 2 and 4 in Table 5.

Table 6. Contributions to Commodity Price Movements: Annual Model, 1980-86 1/

(In annual percentage change)

	Trend	Supply	Industrial Production	Production Capacity	Inflation Terms: Supply (Inflation)	Inflation Terms: Supply (Exchange rate changes)	Inflation Terms: Demand (Inflation)	Inflation Terms: Demand (Exchange rate changes)	Predicted	Actual	Residual
1980	-5.0	-2.6	1.0	-2.0	2.7		9.6		3.7	6.1	2.3
					(2.8)	(-0.1)	(11.6)	(-2.0)			
1981	-5.0	-3.9	-0.2	-1.9	1.2		-3.1		-13.0	-11.8	1.2
					(2.5)	(-1.3)	(7.9)	(-11.0)			
1982	-5.0	-3.0	-3.0	-1.8	0.2		-3.8		-16.3	-10.9	5.4
					(1.6)	(-1.4)	(5.8)	(-9.6)			
1983	-5.0	-1.8	4.3	-1.8	-0.1		-2.5		0.5 2/	6.6	6.1
					(1.4)	(-1.5)	(4.3)	(-6.8)			
1984	-5.0	-2.5	9.8	-1.8	--		-2.4		-1.9	1.2	3.1
					(1.4)	(-1.3)	(5.5)	(-7.9)			
1985	-5.0	-3.6	4.9	-1.7	-0.7		-0.5		-6.6	-12.9	-6.3
					(1.2)	(-1.9)	(4.0)	(-4.5)			
1986	-5.0	-1.8	2.3	--	-0.4		14.6		10.6	-5.0	-15.6
					(0.3)	(-0.1)	(-0.4)	(15.0)			
1980-86	-34.9	-19.2	19.2	-11.0	3.7		12.0		-22.9	-26.7	-3.8
					(11.1)	(-7.4)	(38.6)	(26.6)			

1/ Components may not sum to totals due to rounding.

2/ Includes contribution of 7.3 for dummy for food commodities. At the beginning of 1983, the U.S. Department of Agriculture announced the introduction of a large-scale program that paid farmers to remove land from cultivation in return for grain supplies from U.S. government stocks. The real effects of the so-called "pik" (payment in kind) program were reflected in grain prices in late 1983, and the supply channel through which the impact was transferred is captured in the model. However, the "announcement effect" of the "pik" kprogram caused prices to rise sharply in early 1983, and this effect is not captured in the model. The value and (T-Statistic) from the 1983 dummy variable for food was: 0.170* (2.624).

generally favorable worldwide weather conditions, policies in producing countries that encouraged continued growth of production even in the face of falling world prices, and continued technological improvements that resulted in higher yields. Production capacity of agricultural raw materials, and to a lesser extent of metals, exerted a rather constant depressing influence on prices throughout the 1980s until 1986, when it appears that expansion of production capacity finally leveled off, probably in response to the persistently low prices. This is consistent with the mean estimated lags of response of production capacity to real commodity prices that were estimated at 5 years for agricultural raw materials and 7 years for metals (C - M, 1986). Real metal prices began to fall in the late 1970s and real prices of agricultural raw materials began to fall in the early 1980s. If capacity continues to adjust to the low real prices of the 1980s, it could help to support a recovery in commodity prices in the last years of the decade.

Not only does the annual model predict a commodity price decline in 1984-85, but it also reflects more accurately the considerable weakness that has characterized primary commodity markets throughout the 1980s. Because of the difficulty in matching the supply variables precisely with annual calendar year data for the other variables, the results of the annual model are probably better at predicting changes over a number of years than they are at year-to-year changes, which may be affected by the mismatching of variables. The actual cumulative commodity price decline of 27 percent from 1980 to 1986 is fairly accurately predicted at 23 percent by the model (Table 6). The major influences shown to be depressing commodity prices in the 1980s are the trend term, with a cumulative contribution of -35 percent, the supply of food and beverages with a cumulative contribution of -19 percent, and production capacity of agricultural raw materials and metals with a cumulative contribution of -11 percent. These were partially offset by positive contributions of 19 percent for economic activity and 16 percent for inflation (adjusted by exchange rate changes).

Although the annual model does predict a decline in commmodity prices during 1984-86, the extent of the actual decline is under-predicted. This still leaves some room for the explanations advanced by some observers that structural factors which depress prices and which are difficult to quantify, have intensified in the 1980s. These include a reduced intensity of commodity use in industrial countries due to the shift away from heavy industry and increased substitution toward lighter and new materials. However, since the model predicts fairly well the weakness in commodity prices throughout the 1980s, the underprediction of the 1984-86 price decline may be due simply to the lag problem mentioned above, or to special factors that have depressed prices in the last few years. It is noteworthy that the weakness in metal prices, which are most frequently associated with the structural explanation, was fairly well predicted by the model in the 1980s.

The main source of the underprediction of the 1984-86 commodity price decline (Table 7) occurred largely with respect to the food commodities, which have the largest weight in the total commodity basket at 42.9 percent. While food prices were predicted to increase by 9.7 percent, in fact, they declined by 13.9 percent. Although the model continued to predict a strong negative supply contribution to food prices in 1986 of a similar magnitude as in 1984 and 1985, the reason for the prediction of a food price recovery in 1986 was the strong positive contribution from the large depreciation of the U.S. dollar. Two somewhat related reasons may help to explain the prediction error for food prices in 1986. First, the enactment of the U.S. Farm Bill at the beginning of 1986 had a strong negative influence on food prices which is not captured in the model. This change in agricultural policy of the world's largest food exporting country significantly lowered support prices (e.g., by about 25 percent for cereals), and resulted in greater supplies for export being made available to the market at sharply lower prices. Second, partly due to the U.S. Farm Bill and also due to the cumulative effects of several years of large world food production, price competition in food export markets intensified significantly in 1986, largely negating the positive contribution of the depreciation of the U.S. dollar.

The results of the contribution analysis show that the main source of the commodity price decline 1984-86, aside from the trend term, was the supply variables. It may be appropriate, however, to look at the contribution of demand from a different viewpoint. Economic activity in the industrial countries must grow by at least 3.3 percent per year in order to offset the negative contribution of the trend term. In this sense, the large deceleration in economic activity from 1984 to 1986 represented a depressing influence on commodity prices. The contribution of economic activity net of the trend term went from 4.8 percent in 1984, to -0.1 percent in 1985, and to -2.7 percent in 1986. Although the depressive impact of the supply variables showed signs of beginning to moderate in 1986 in response to the low commodity prices, the sharply lower economic growth rates more than offset the improved supply situation.

V. Conclusion

Although a demand-driven model that had successfully tracked previous commodity price cycles does not predict the price decline in 1984-86, a similar model that incorporates the supply-side does predict, not only the downturn in 1984-86, but also the general weakness in commodity prices throughout the 1980s. Supplies of food and beverages and production capacity of agricultural raw materials and metals were shown to be major factors depressing primary commodity markets in the 1980s and particularly in 1984-86. Relatively low economic growth in the industrial countries has also been a depressing factor in the 1980s in the sense that in only one year (1984) was it high enough to more than offset the negative trend term, which in this model can be interpreted to represent long-term structural shifts in demand and supply of

Table 7. Annual Model Predictions of Commodity Price Groups, 1980-86

	Food		Beverages		Agricultural Raw Materials		Metals	
	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted	Annual
1980	5.3	8.3	-4.7	-13.5	-9.6	10.2	-6.7	7.8
1981	-12.0	-3.2	-33.2	-23.3	-3.7	-15.9	-7.2	-17.9
1982	-20.6	-16.5	-7.9	0.4	-7.8	-5.0	-9.9	-12.4
1983	8.4	8.4	-6.5	7.9	-2.7	3.1	-4.2	6.0
1984	-2.2	-0.7	-10.2	15.0	5.0	4.8	2.2	-6.2
1985	-8.2	-16.8	-5.5	-12.5	-5.6	-12.7	-3.4	-5.8
1986	9.7	-13.9	22.9	16.1	-14.1	2.0	-8.9	-6.4

commodities. Economic growth in the industrial countries must be at least 3.3 percent per year in order to contribute positively to commodity prices net of the negative trend term.

The implications of this analysis for the commodity price outlook in the short- and medium-term are somewhat encouraging for commodity producers, as much of the decline in commodity prices in 1984-86 can be explained by supply and demand factors that are reversible, rather than by long-term structural and irreversible factors. The actual reversal of these factors in favor of commodity prices, however, depends largely on developments in the industrial countries for which the outlook is perhaps not very encouraging. On the demand side, the record of economic growth in the industrial countries in the 1980s generally below 3 percent per year appears likely to continue in view of current estimates of expansion in potential output and continuing fears of inflation. Thus, a significant recovery in commodity prices will probably depend largely on a reversal of the oversupply and capacity overhang that have characterized commodity markets in recent years. Agricultural policies in industrial countries would have to continue in the direction begun in 1986 to lower producer prices to better reflect world prices, and idle production capacity for metals, much of which is also in industrial countries, would have to not be reactivated prematurely. While it may appear unusual to say that a recovery in commodity prices depends on supply restraint, this paper has shown that the downturn in commodity prices in 1984-86 was also unusual in that it was caused largely by supply factors.

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ANNEX

A. World Trade in Non-Oil Commodities: Sample Data

The sample data employed in this study were derived from world trade data on merchandise exports and imports. The commodity breakdown of the data was used to derive the weights for the commodity-related variables (prices and production), while the country breakdown was used for weighting the country-based economic variables, i.e. statistics on exchange rates, inflation, and industrial production.

Non-oil primary commodities accounted for about 44 percent of world exports of primary commodities during 1979-81 (Table A1). Relative shares of this world non-oil export total were used as weights in constructing the non-oil commodity price indexes and group subindexes and in the formulation of the production and production capacity variables. Within the total, the food group accounts for 55 percent (43 percent food crops and 12 percent beverages), while the industrial raw materials group constitutes the other 45 percent (divided about equally between agricutural raw materials, 23 percent, and metals and minerals, 22 percent).

Table A1. Weights Used to Aggregate Commodity Prices and Production Variables

Commodity group	Export Value 1/ 1979-81 Average (US$ millions)	Weight 2/
Total non-oil	149.9	100.0
Food crops	81.9	54.7
Food	64.3	42.9
Beverages	17.6	11.8
Industrial raw materials	67.9	45.3
Agricultural raw materials	35.0	23.3
Metals and phosphate rock	32.9	22.0
Memorandum:		
Crude oil	192.5	

1/ World Bank data series based on FAO and United Nations, Series "D" Trade Statistics covering 41 comodities and 175 countries.

2/ Same weights used for corresponding commodity groups in the Fund's non-oil commodity price index; for weights associated with individual commodities, see IMF (May 1986).

ANNEX

The breakdown of trade data by commodity group and country trading position (exporter or importer) provided the means to derive weights for the economic variables to be used on the supply and demand sides. In order to reduce the amount of data to be manipulated, countries accounting for less than 2 percent of world exports or imports were omitted. The resultant weighting scheme is shown in Table A2. The weights shown for any commodity group sum to unity ("sum of normalized weights" in Table A2), so the figures for individual countries may be thought of as relative percentages of the total sample for each group. The proportion of total world exports (supply) or imports (demand) which is accounted for by the appropriate group sample is also shown in Table A2 ("sum of raw weights"). This ranges from a low of 57 percent for exporters of agricultural raw materials to a high of 78 percent for importers of metals. As the data show, industrial countries dominate the trade in non-oil commodities, accounting for over 90 percent of imports of all commodities in the sample and for over 80 percent of exports of both the food and agricultural raw materials groups, in addition to about 60 percent of exports of metals and minerals.

B. Statistical Data

1. Commodity Prices

Thirty-nine representative international price series of 34 nonfuel primary commodities were included, with weights for commodity groups as shown in Table A1. These weights are the same as those employed in the Fund's commodity price index, details of which are contained in IMF, Primary Commodities: Market Developments and Outlook, (Washington: World Economic and Financial Surveys; May, 1986). The index used in this study differs somewhat from the Fund's official index because the latter utilizes an arithmetic weighting scheme, whereas the current study uses a geometric weighting scheme. The individual prices were obtained from the Fund's International Financial Statistics, Washington, various issues).

2. Production

Annual production series from different sources were used. Data for meat, bananas, wool, hides, jute, sisal, timber (roundwood), and phosphate rock were accessed through the data bank of the Economic Analysis and Projection Department of the World Bank; the original source of this data is the Production Yearbook series of the FAO. The series for cereals (coarse grain, wheat, rice), sugar, coffee, and tobacco were obtained from the United States Department of Agriculture (USDA). Data for oils and oilseeds were obtained from Oil World, except for the 1964 data or soyabeans, which was obtained from USDA. For the remaining commodities the sources were: cocoa (International Cocoa Organization -- ICO), tea (International Tea Council -- ITC), cotton (International Cotton Advisory Committee -- ICAC), rubber (International Rubber Study Group --IRSG), and metals (World Bureau of

Table A2. Sample Countries and Relative Supply and Demand Weights, by Commodity Group 1/

	Supply					Demand				
	Food	Beverages	Agricultural Raw Materials	Metals	All Commodities	Food	Beverages	Agricultural Raw Materials	Metals	All Commodities
United States	0.514	--	0.350	0.080	0.279	0.120	0.333	0.120	0.162	0.152
United Kingdom	--	--	--	0.034	0.018	0.105	0.080	0.088	0.076	0.086
Canada	0.064	--	0.157	0.202	0.092	--	--	0.034	--	0.024
Japan	--	--	--	--	--	0.187	0.057	0.314	0.308	0.228
Australia	0.096	--	0.103	0.114	0.077	--	--	--	--	--
New Zealand	--	--	0.049	--	0.020	--	--	--	--	--
Austria	--	--	0.040	--	0.008	--	--	--	--	--
Belgium	--	--	--	0.038	0.019	0.049	0.037	0.029	0.086	0.049
Finland	--	--	0.054	--	0.011	--	--	--	--	--
France	0.078	--	--	--	0.041	0.096	0.101	0.070	0.094	0.086
Germany, Fed. Rep. of	0.034	0.032	--	0.040	0.028	0.107	0.172	0.099	0.167	0.123
Italy	--	--	--	--	--	0.103	0.067	0.112	0.076	0.090
Netherlands, The	0.041	0.055	--	0.034	0.030	0.080	0.084	0.039	0.032	0.054
Norway	--	--	--	0.054	0.013	--	--	--	--	--
Sweden	--	--	0.061	--	0.016	--	0.029	--	--	0.010
Nigeria	--	0.037	--	--	0.004	--	--	--	--	--
Ghana	--	0.056	--	--	0.008	--	--	--	--	--
Cote d'Ivoire	--	0.127	--	--	0.016	--	--	--	--	--
Kenya	--	0.038	--	--	0.004	--	--	--	--	--
Morocco	--	--	--	0.034	0.006	--	--	--	--	--
Zambia	--	--	--	0.051	0.010	--	--	--	--	--
India	--	0.062	--	--	0.015	--	--	--	--	--
Malaysia	--	--	0.185	0.047	0.052	--	--	--	--	--
Philippines	--	--	--	0.033	0.020	--	--	--	--	--
Sri Lanka	--	0.032	--	--	0.005	--	--	--	--	--
Thailand	0.036	--	--	--	0.024	--	--	--	--	--
Argentina	0.069	--	--	--	0.031	--	--	--	--	--
Brazil	0.067	0.236	--	0.071	0.068	0.045	--	--	--	0.021
Chile	--	--	--	0.088	0.020	--	--	--	--	--
Colombia	--	0.168	--	--	0.019	--	--	--	--	--
Ecuador	--	0.032	--	--	0.005	--	--	--	--	--
El Salvador	--	0.050	--	--	0.006	--	--	--	--	--
Guatemala	--	0.034	--	--	0.006	--	--	--	--	--
Mexico	--	0.041	--	--	0.010	--	--	--	--	--
Peru	--	--	--	0.046	0.013	--	--	--	--	--
Spain	--	--	--	--	--	0.051	0.039	0.030	--	0.034
Korea	--	--	--	--	--	0.056	--	0.063	--	0.042
Zaire	--	--	--	0.033	0.008	--	--	--	--	--
Sum normalized weights	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Sum raw weights	0.729	0.656	0.572	0.702	0.796	0.551	0.750	0.725	0.779	0.698
Number of countries	9	14	8	16	34	11	10	11	8	13

1/ Data source same as Table A1, note 1.

Metal Statistics -- WBMS) except for iron ore (United Nations Committee on Trade and Development -- UNCTAD). Production series were not available for a few individual commodities in each group, so they were omitted from the aggregation process. Data were on a calendar year basis, except for some agricultural commodities (palm oil, coconut oil, groundnut oil, fish meal, tea, and rubber) which were on a crop year basis, i.e. 1984 data refer to crop year 1984/85.

3. Stocks

The supply variable combined data on opening stocks with production data in order to derive total supply availabilities during a year. For the few series for which stock data were not available, only production data were used for the supply variable. Stock figures referred to the beginning of calendar years, except for some agricultural commodities (palm oil, coconut oil, groundnut oil, and rubber) which were on a crop year basis, such that 1984 data refer to some point during 1984. For coarse grains, wheat, milled rice, sugar, tobacco, and soybeans (prior to 1964 data for soybeans was taken from Oil World), data came from the USDA. For the oil and oilseeds series (groundnut, coconut, and palm), data came from Oil World. The remainder of the commodities were from: cocoa (ICO), cotton (CAC), rubber (IRGS), metals (WBMS), except for copper (Commodity Research Bureau), and tin (International Tin Council).

4. Potential production

The methodology used to estimate potential production was the trend-though-peaks method developed by Klein and Summers (1966) and used in Chu and Morrison (1986); the latter paper also contains a discussion of the problems that arise with its use. In the present research the production series for individual commodities were first aggregated into the two subgroups (the capacity variable is used only in the equations for agricultural raw materials and metals) described above (section B2) using the same weights. The peaks of this aggregated series were then connected to obtain the capacity available.

5. Economic activity, world inflation, and exchange rates

The quarterly series used for the variables were obtained from the International Financial Statistics (IFS) data bank. For economic activity, data on industrial production were used. For 1986 a few countries had not yet reported data on the second quarter; in these cases, the growth rate for the first quarter was also used for the second quarter. For world inflation, wholesale price indices were used wherever available; if they were unavailable, indices on consumer prices were used. For exchange rates, the period average of national currency per U.S. dollar of market rates were used. All these variables were available for all countries in each sample (Table A2), with the exception of industrial production for Brazil.

C. Annual Model: Structural Equations

The structural equations of the annual model (C - M, 1986) are listed here for convenience of reference, so that the reduced form coefficients in section III.b of the text can be interpreted in terms of the model's structure. Variables are defined in the text.

Supply:

$$\Delta q_t^s = \Delta u_t + \Delta qc_t$$

$$\Delta u_t = \alpha_0 + \alpha_1 \Delta rps_t + \alpha_2 \Delta rps_{t-1} - \alpha_3 ss_t$$

$$\Delta rps_t = \Delta p_t + \Delta es_t - \Delta ps_t$$

$$\Delta qc_t = \beta_0 + \beta_1 k^{-1} \sum_{i=1}^{k} erps_{t-1}$$

$$erps_t = rps_t - \overline{rps}$$

Demand:

$$\Delta q_t^d = \gamma_0 - \gamma_1 \Delta rpd_t + \gamma_2 \Delta y_t$$

$$\Delta rpd_t = \Delta p_t + \Delta ed_t - \Delta pd_t$$

where (variables not defined in text are):

u_t = utilization

rps_t = real producer price

ss_t = supply stocks

$erps_t$ = average excess profits

$\overline{rps_t}$ = long-term average of rps_t