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The 1981-82 Recession and Non-Oil Primary Commodity Prices:
An Econometric Analysis

Prepared by Ke-young Chu and Thomas K. Morrison 1/

Approved by Nihad M. Kaibni

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I. Introduction

The depressed condition of non-oil primary commodity markets during 1981-82 has been unprecedented in the post-World War II period. The overall index of prices of primary commodities (other than gold and petroleum) declined by 12 percent in 1982 (in U.S. dollar terms), following a 15 percent fall in 1981. The cumulative two-year decline of 25 percent is the largest in more than three decades, and the protracted duration of the decline also is the longest over this period. In the last three decades, the largest annual decline occurred during the 1975 recession, when primary commodity prices fell by 18 percent, but they quickly recovered by 13 percent in 1976 and further by 21 percent in 1977. Commodity prices in real terms, estimated by deflating nominal prices by the United Nations price index of manufactured exports of developed countries, fell by 20 percent in 1981-82 to their lowest level in the postwar period. Commodity prices increased by about 14 percent in the first eight months of 1983, but the level of the aggregate index in August was 17 percent below the average for 1980.

The impact of the 1981-82 price decline on the export earnings of primary commodity exporting countries has been severe. After declining by about 10 percent during 1978-80, primarily because of the sharp rise in oil prices, the external terms of trade of these countries fell by a further 7 percent in 1981-82 notwithstanding a relative stability of oil prices during this period. Combined with a decline in the volume of non-oil exports, these price developments resulted in a sharply higher aggregate current account deficit of US\$108 billion in 1981 and US\$87 billion in 1982, approximately twice the average annual level of 1977-80. ^{1/} The low-income developing countries were the most adversely affected because of their higher dependence on primary commodities for export earnings.

The sharp decline in commodity prices during 1981-82 was a culmination of a pattern that began in the early 1970s. Although the rate of increase in nominal commodity prices sharply accelerated and there have been intermittent surges in real prices, the long-term downward trend in real prices from 1972 to 1982 has been more than twice as steep as that from 1957 to 1971. In addition, the degree of price instability ^{2/} of non-oil primary commodity prices from 1972 to 1982 has been more than three times

^{1/} Exports of primary commodities of the non-oil developing countries averaged about US\$120 billion annually in 1979-80. The declines in commodity prices in 1981 and 1982, therefore, accounted for reductions in their export earnings of approximately US\$20 billion and US\$15 billion, respectively. In other words, if 1980 commodity prices had been maintained along with constant import values and export volumes, the aggregate current account deficit of the non-oil developing countries could have been well under US\$60 billion in 1982 compared to the actual US\$87 billion.

^{2/} Instability of price is defined in this study as the average percentage deviation of the actual price from the trend for a certain period of time (See section II.2 for the exact definition).

that of 1957 to 1971, as the economic environment of industrial production, world inflation, exchange rates, and interest rates has also been significantly more unstable. Commodity price instability was one of the major causes of export instability for a large number of primary commodity exporting countries; 1/ export instability, in turn, could be a major cause of the instability in imports of consumption and capital goods. 2/

This paper analyzes the depressed state of primary commodity markets during 1981-82 in the context of developments over a historical period. The causes of primary commodity price movements are investigated along with the relatively high level of price instability in recent years.

The organization of the paper is as follows: Section II describes the historical movements of non-oil primary commodity prices, focusing particularly on the long-term movements of broadly aggregated prices vis-a-vis those of the prices of manufactures and petroleum, and on their short-run fluctuations; Section III consists of an analysis of the determinants of commodity prices, including the development of an analytical framework and an analysis of major causes of commodity price fluctuation over various phases of commodity price cycles; and Section IV presents conclusions. The annex includes a list of the sample commodities and some econometric results not reported in the main text. 3/

II. Historical Perspective

1. Long-term developments

The behavior of primary commodity prices has undergone a significant change since the early 1970s. After experiencing a high degree of stability and rather constant nominal prices during the two preceding decades, commodity

1/ L.M. Goreux, "Compensatory Financing: The Cyclical Pattern of Export Shortfalls," Staff Papers, International Monetary Fund (Washington), Vol. 24 (November 1977), pp. 613-641.

2/ For studies of the possible effects of export instability, see K. Chu, E.C. Hwa, and K. Krishnamurty, "Export Instability and Adjustments of Imports, Capital Inflow, and External Reserves: A Short-Run Dynamic Model," in D. Bigman and T. Taya, eds., Exchange Rate and Trade Instability: Causes, Consequences, and Policies (Cambridge, Massachusetts, Ballinger, 1983). C. Rangarajan and V. Sundararajan, "Impact of Export Fluctuations on Income-- A Cross-Country Analysis," Review of Economics and Statistics, Vol. 58 (August 1976); and S. Schiavo-Campo, "Instability of Developmental Imports and Economic Growth: A Theoretical Framework," Weltwirtschaftliches Archiv, Vol. 117 (September 1981), pp. 562-573.

3/ A more concise analysis of the determination of non-oil primary commodity prices and their behavior during the 1981-82 recession is given in World Economic Outlook, International Monetary Fund (Washington, 1983), Appendix A.9.

prices have exhibited marked cyclical behavior at significantly higher nominal price levels since 1972 (Chart 1 and Table 1). ^{1/} During 1973 and 1974, the overall commodity price index approximately doubled, with virtually all primary commodities participating in this sharp upward movement. When the world experienced a major recession in 1975, commodity prices fell by 18.2 percent from the record high level of the previous year. Although this was the largest one-year decline in the last three decades, prices were still 60 percent higher in nominal terms than in 1972.

As the world economy recovered in 1976 and 1977, commodity prices rose at annual rates of 13.0 percent and 20.7 percent, respectively. This rise was temporarily reversed by a 4.7 percent decline in 1978, which was due entirely to a 27.4 percent cyclical fall in beverage prices; the prices of food, agricultural raw materials, and metals all increased in 1978. With a recovery in beverages and continuing increases in other commodities, overall commodity prices rose by 16.5 percent in 1979 and by 9.7 percent in 1980. Thus, at the end of the decade, commodity prices in nominal terms were almost three times the 1970 level. Commodity prices over the 1970s averaged almost twice their average levels during the 1960s.

In 1981, with the world entering another recession, commodity prices declined by 14.8 percent with every major commodity group participating in this decline. The recession continued into 1982 and commodity prices fell further by 12.1 percent, in what turned out to be the largest continuous decline in the last three decades. ^{2/}

Because the U.S. dollar has appreciated over the 1981-82 period, the cumulative two-year decline in overall commodity prices in SDR terms over 1981-82 is about 12 percent, compared to 25 percent in U.S. dollar terms. If deflated by the UN price index of manufactured exports of developed countries, real commodity prices have declined by an estimated 20 percent from 1980 to 1982.

^{1/} The commodity price index used in this study, unless indicated otherwise, is the IMF Research Department Index of International Market Prices, in terms of U.S. dollars, for Primary Commodities Exported by Primary Producing Countries, 1975=100, the same index as reported in the International Financial Statistics. The All Commodities Index includes 35 wholesale price series chosen as representative of the 30 commodities exported by primary producing countries. It excludes petroleum and gold. The commodity price indices are weighted by average export earnings during the years 1968 through 1970 in 98 countries which do not include industrial and major oil exporting countries. See Annex for a list of commodities.

^{2/} A longer-term perspective of commodity price developments can be obtained by reference to the Economist index for all nonfuel commodities, which is available since 1860. The largest annual decline in commodity prices was a 33 percent drop from 1920 to 1921. The largest cumulative decline occurred from 1924 to 1932, over which period commodity prices fell every year for a total of 47 percent, representing also the greatest length of price decline. Cumulative price declines exceeding the decline of 25 percent recorded during 1981-82 have occurred only four times in the last 120 years (28 percent from 1864 to 1869, 40 percent from 1920 to 1922, 47 percent from 1924 to 1932, and 26 percent from 1951 to 1953).

Table 1. Indices of Primary Commodity Prices 1

Year	Nominal (U.S. Dollar Terms)					Deflated (By the Price of Manufactures) 2/				
	All	Food	beverages	Agricultural Raw Materials	Metals	All	Food	beverages	Agricultural Raw Materials	Metals
(1975=100)										
1957	57	40	77	74	59	127	90	171	103	131
1958	53	38	77	61	55	118	84	172	138	123
1959	52	38	65	68	53	117	85	147	154	121
1960	52	37	60	71	54	115	82	134	158	121
1961	50	36	57	66	54	109	79	129	145	119
1962	49	37	56	43	53	106	80	121	138	115
1963	52	44	54	65	52	113	93	135	142	114
1964	55	42	62	69	65	116	90	134	139	139
1965	54	39	57	63	71	113	82	118	132	149
1966	56	39	59	65	77	114	80	121	133	158
1967	52	40	59	59	65	106	81	119	119	132
1968	52	39	60	57	67	106	75	121	116	137
1969	56	42	62	61	74	110	82	121	119	147
1970	58	44	70	55	78	127	82	130	103	147
1971	55	45	65	55	67	96	78	119	96	118
1972	62	51	71	72	68	100	83	113	116	109
1973	95	79	87	129	99	132	109	121	176	136
1974	122	127	104	125	125	139	143	110	143	142
1975	100	100	100	100	100	100	100	100	100	100
1976	113	82	192	124	106	112	61	189	123	100
1977	137	79	332	128	114	125	72	304	117	100
1978	130	90	241	136	120	103	71	192	109	9
1979	152	102	255	166	156	106	71	178	117	109
1980	166	137	224	175	172	105	86	141	110	106
1981	142	118	174	158	148	94	75	114	100	98
1982	125	93	176	136	135	84	61	111	92	91
1983 3/132	103	103	164	145	135	69	70	125	98	92
(Annual percentage change)										
1950	-8.3	-7.2	-0.7	-16.6	-6.9	-7.4	-6.2	0.4	-11.8	-9.9
1959	-1.5	0.3	-15.7	19.8	-3.0	-0.4	1.4	-16.8	12.1	-2.0
1960	0.0	-1.4	-6.7	4.5	2.0	-2.0	-3.3	-4.5	2.5	0.0
1961	-4.1	-3.1	-6.0	-6.8	-0.2	-5.4	-4.4	-7.3	-8.0	-1.3
1962	-1.6	2.0	-2.2	-3.3	-2.5	-2.1	1.5	-2.7	-1.7	-3.4
1963	5.7	18.6	-2.5	2.3	-1.5	6.2	19.3	-2.0	2.6	-1.1
1964	6.6	-3.3	15.3	0.2	24.4	4.3	-3.4	12.6	-1.9	21.7
1965	-2.1	-6.9	-9.3	-2.9	10.1	-4.5	-9.2	-11.6	-3.5	7.4
1966	3.5	-0.1	4.4	2.6	7.6	1.0	-1.9	2.9	0.7	3.6
1967	-6.0	-1.9	-0.6	-9.2	-14.7	-7.5	0.3	-1.6	-10.6	-16.1
1968	-0.6	-3.2	0.9	-2.5	2.7	-0.2	2.7	1.4	-2.7	3.3
1969	7.4	8.3	3.7	6.0	10.1	3.9	0.8	0.3	2.0	0.0
1970	3.4	5.3	13.1	-6.8	6.4	-2.3	-0.9	6.8	-13.9	0.5
1971	-4.8	2.0	-7.6	-6.5	-13.6	-13.0	-5.2	-13.3	-6.5	-16.9
1972	13.3	14.4	9.3	30.6	0.2	6.0	3.0	0.9	20.0	-7.1
1973	53.2	54.1	23.5	79.2	46.8	31.8	32.6	6.2	54.2	20.3
1974	28.0	60.0	19.3	-3.5	25.0	4.6	39.6	-2.5	-21.2	2.1
1975	-18.2	-21.2	-3.8	-19.8	-19.4	-27.6	-30.3	-14.9	-29.0	-28.0
1976	13.0	-18.4	91.6	24.3	6.0	12.4	-19.1	90.5	23.3	0.2
1977	20.7	-3.7	73.2	3.2	7.5	11.0	-11.4	59.3	-5.1	-1.2
1978	-4.7	14.0	-27.4	7.6	5.4	-17.3	-1.0	-37.0	-6.0	-6.5
1979	16.5	14.0	5.8	21.9	29.6	6.6	0.4	26.8	7.4	14.1
1980	9.7	34.2	-12.2	5.1	10.0	-1.3	20.8	-21.0	-6.3	-0.2
1981	-14.8	-13.9	-22.3	-9.7	-16.7	-1.1	-9.2	-16.1	-1.6	-9.3
1982	-12.1	-21.0	-2.5	-13.7	-9.2	-10.3	-19.4	2.5	-11.9	-7.4
1983 4/	3.0	4.3	4.4	3.8	-1.1	4.2	5.3	5.7	5.1	5.1

1/ Peaks and troughs in deflated prices for the sample period are indicated by rectangles and circles.

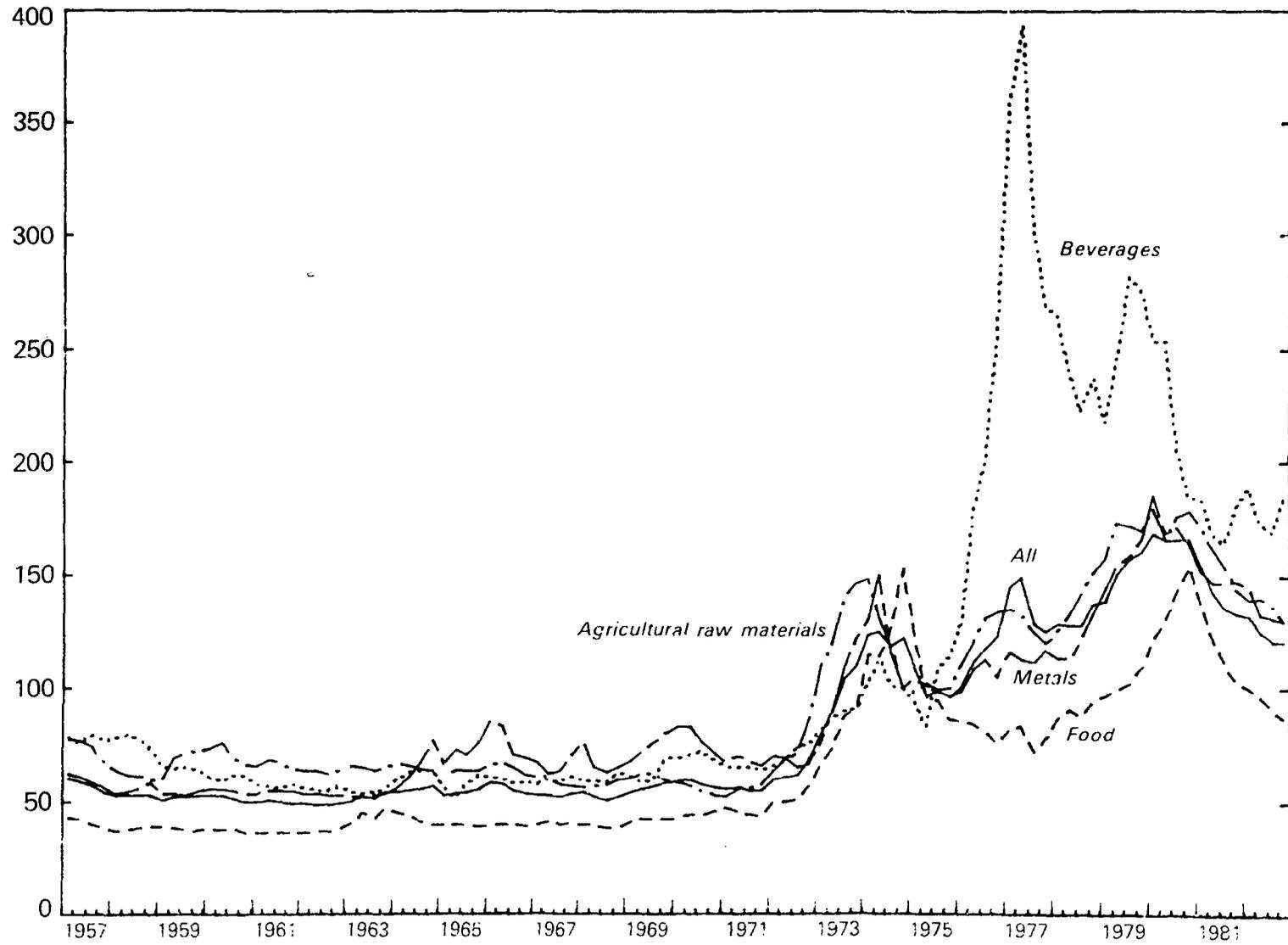
2/ Based on the U.S. index of the prices of manufactures exported by developed countries.

3/ January 1983 to August 1983 average.

4/ First eight months of 1983 over the first eight months of 1975.

CHART 1
COMMODITY PRICES: LONG-TERM DEVELOPMENTS

(1975=100)



Since 1957, non-oil primary commodity prices have increased at a rate of 5.1 percent per year (Table 2). This long-term period, however, is comprised of two rather distinct subperiods: the first from 1957 to 1971, when prices followed a growth rate of 0.4 percent, and the second from 1972 to 1982, when the growth rate was of the order of 6.5 percent. ^{1/} Virtually all commodity groups followed a similar pattern, with the growth rate of food prices increasing from 1.0 percent during 1957-71 to 4.6 percent during 1972-82, beverage prices from -0.6 percent to 11.1 percent, agricultural raw materials prices from -1.6 percent to 5.8 percent, and metal prices from 2.5 percent to 6.6 percent.

The average annual growth of 5.1 percent from 1957 to 1982 in non-oil primary commodity prices was lower than the rates for both oil prices and manufactures prices during the same period. Vis-à-vis oil prices, primary commodity prices fell by 7.4 percent per annum (86 percent cumulatively); vis-à-vis prices of manufactures, they fell by 0.6 percent per annum (14 percent cumulatively) (Chart 2). The declines in the terms of trade were particularly notable during 1972-82.

In order to investigate the relative price movements of the four major commodity groups, the average indices for each of these groups were compared with the all commodities index for the periods 1957-71 and 1972-82 (Table 3). The average indices for food prices were below the overall index during both periods, while for beverages and agricultural raw materials, the indices were above the overall index for both periods. Metal prices were marginally above the overall index during 1957-71 and substantially below during 1972-82. The largest changes that occurred between the two periods were for beverages, whose relative index (1971-72=100) increased by 21 percent, and for metals, whose relative index declined by 15 percent.

In 1981, real commodity prices reached their lowest level in the postwar period. In 1982, they declined further by about 10 percent to a level 16 percent below the level reached during the 1975 recession, as commodities classified as beverages are the only group that in 1982 did not experience postwar lows in real prices, but real beverage prices have experienced the sharpest declines in recent years from the extraordinarily high level reached in the late 1970s.

Real commodity prices were on a steady long-term downward trend before they jumped by 39 percent in 1973-74. Virtually all commodities participated in varying degrees in this sharp upward movement. Then in 1975, as the world moved into recession, real commodity prices fell by 27.6 percent, again reflecting declines in all major commodity groups. The recession was relatively severe, but of short duration, and real commodity prices recovered at an average annual rate of 12 percent during 1976-77. They then declined by 17.3 percent in 1978, led by a 37.0 percent fall in real beverage prices. It is noteworthy that both the rise in real commodity

^{1/} See subsection III.2.c. for reasons for this division of the sample period.

Table 2. Long-Term Price Trends 1/

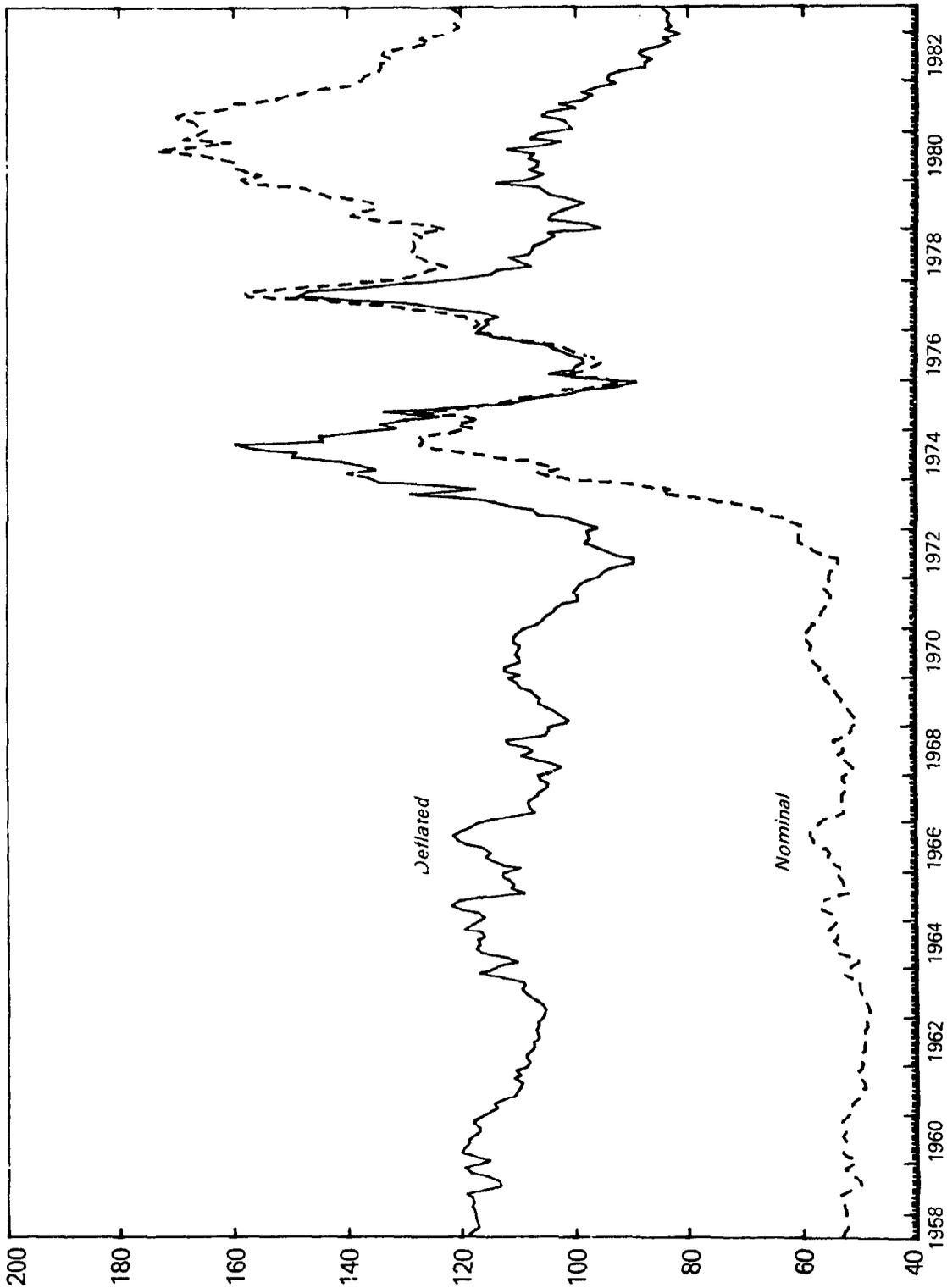
	Annual Percentage Change		
	1957-82	1957-71	1972-82
<u>Nominal (in U.S. dollar terms)</u>			
Primary commodity prices			
Non-oil	5.1	0.4	6.5
Food	5.4	1.0	4.6
Beverages	6.1	-0.6	11.1
Agricultural raw materials	4.2	-1.6	5.8
Metals	4.6	2.5	6.6
Oil	13.3	-0.3	28.3
Manufactures	5.8	1.5	9.8
<u>Deflated</u>			
Non-oil primary commodity prices deflated by			
Oil price <u>2/</u>	-7.4	0.7	-16.7
Manufactures prices <u>3/</u>	-0.6	-1.1	-2.7

1/ The long-term trend is defined as the exponential trend estimated from a semi-log regression of quarterly price on time for each sample period; the rates of change are annualized. The percentage increase for the whole period could therefore be lower or higher than either for the 1957-71 or the 1972-82 period.

2/ Oil price is the weighted average of the official prices of Libya, Saudi Arabia, and Venezuela.

3/ Manufactures price index is the U.N. price index of manufactures exported by developed countries.

CHART 2
INDEX OF PRIMARY COMMODITY PRICES
ALL COMMODITIES: NOMINAL AND DEFLATED¹
(1975 = 100)



¹Deflated by the price index of manufactured exports of developed countries.

prices in 1976-77 and the subsequent decline in 1978 would have been substantially less, virtually eliminating this cycle, if beverage prices were excluded.

In 1979, real commodity prices rose by 2.6 percent before beginning a decline in 1980 that has continued through 1982. The sharp fluctuation in nominal prices from 1979 to 1982, when prices increased by 28 percent during 1979-80 and then declined by 25 percent during 1981-82, is virtually eliminated when prices are expressed in real terms because of the sharp acceleration in inflation in the late 1970s.

Table 3. Commodity Prices for Groups Relative to Aggregate Commodity Prices

(1971-72=100)

	Average	
	1957-71	1972-82
All commodities	100	100
Food	91	97
Beverages	102	123
Agricultural		
raw materials	110	101
Metals	102	87

2. Price instability

Perhaps the most salient feature of commodity price behavior in the 1970s compared with the rest of the postwar period is the marked increase in price instability. Although this fact is vividly illustrated in Chart 1, it is useful to investigate further the characteristics of this increased instability. This section describes fluctuations around both long-term and medium-term trends for different commodity groups. ^{1/}

^{1/} The long-term trend is defined as the exponential trend estimated from a semi-log regression of quarterly price on time; the medium-term trend is defined as the 19-quarter average of quarterly prices. The high instability of commodity prices during 1972-82 is also obtained even if the instability is measured in terms of SDRs, or in real terms, i.e., deflated by the UN price index of manufactures. Moreover, the instability during 1972-82 is relatively large even in a long historical context: for example, based on the Economist index of commodity prices, the instability of primary commodity prices during 1911-56 is estimated at 6.4 (percent of the trend), compared with 3.8 for 1957-71. The instability for 1911-56, during which the world witnessed three major wars (the First and Second World Wars and the Korean conflict) and the Great Depression, was therefore almost twice as large as for 1957-71, while the instability for 1972-82 was more than three times as large as for 1957-71.

In order to examine the behavior of commodity price fluctuations since 1957, the period has been divided into two subperiods, 1957-71 and 1972-82. Although the choice of these two periods is somewhat arbitrary, it is based on an examination of Chart 1 and, as explained later in subsection III.2.c., the approximate time at which a number of factors affecting commodity price behavior underwent significant changes.

Primary commodity price instability, measured by the average percentage deviation of the overall index of quarterly prices from long-term trend, increased more than threefold between 1957-71 and 1972-82 (Table 4); the instability doubled if measured as the average of the instabilities of individual prices; and similar conclusions are obtained if the instability around the medium-term trend is examined. Oil prices underwent a similar change in the degree of their instability, increasing more than fivefold from 1957-71 to 1972-82 measured around long-term trends, and more than tenfold if measured around medium-term trends. Prices of manufactures also experienced higher instability, increasing threefold if measured around long-term trends and fivefold if measured around medium-term trends.

Price instability around long-term trends increased for all major commodity groups after 1971. The index of price instability for food exhibited the largest rise (fourfold), and the subgroup most responsible for this sharp rise is cereals, whose instability more than quadrupled. Price instability for beverages and for agricultural raw materials approximately trebled after 1971, with coffee and cotton experiencing the largest increases. Metal price instability rose by only 30 percent.

Beverage prices were the most unstable in the 1957-71 period, and retained this rank in the 1972-82 period when the level of beverage price fluctuations was on average more than twice that for all commodities. Metal price instability, which had been nearly as high as that for beverages in the 1957-71 period, dropped to the lowest rank of the four commodity groups during 1972-82. Price fluctuations of food and agricultural raw materials, which had been relatively small during 1957-71, both increased sharply after 1971 to occupy the second and third rank, respectively.

The difference in the relative behavior of metal prices in the two periods is noteworthy. Relative to the other commodity groups, both the level of nominal prices and the degree of instability declined significantly after 1971. There are several reasons for this. Metal prices experienced the highest average growth rate over the 1957-71 period, at 2.5 percent, compared to negative or barely positive rates for the other groups. Metal prices rose particularly fast in the early 1960s, which encouraged a rapid expansion of capacity by the end of the decade. During the 1960s, copper output increased by 47 percent, nickel by 93 percent, and aluminum by 127 percent. With lower than expected rates of metal consumption growth in the 1970s, an excess capacity situation developed that limited nominal price increases and contained price instability relative to the other commodity groups that were more subject to supply constraints.

Table 4. Instability of Primary Commodity Prices (1)

	1957-82		1957-71		1972-82	
	(In percent)					
	(A) 1/	(B) 2/	(A) 1/	(B) 2/	(A) 1/	(B) 2/
<u>Around the long-term trend</u>						
Primary commodities						
Non-oil based on						
Aggregate index	17	(21)	4	(5)	13	(20)
Aggregation of individual instability indices 3/						
Food	19	(23)	5	(6)	19	(24)
Beverages	32	(36)	9	(11)	31	(36)
Agricultural raw materials	20	(25)	4	(6)	14	(18)
Metals	12	(16)	9	(10)	12	(16)
Oil	50	(56)	5	(7)	27	(31)
Manufactures	15	(17)	2	(3)	6	(9)
<u>Around the medium-term trend</u>						
Primary commodities						
Non-oil 3/						
Aggregate index	7		3		10	
Aggregation of individual instability indices 3/						
Food	9		4		14	
Beverages	10		4		23	
Agricultural raw materials	9		4		10	
Metals	10		7		10	
Oil 4/	10		1		14	
Manufactures	3		1		5	

1/ Instability in column (A) is measured by the average of the absolute values of percentage deviations of quarterly price from the trend: the long-term trend is estimated by the semi-log regression of quarterly price on time; the medium-term trend by the 19-quarter moving average of actual price. In estimating the instability around the medium-term trends, 1957-58 and 1981-82 are excluded from the sample years because the 19-quarter moving average of the prices could not be obtained for these years.

2/ For the instability around the long-term trend, the standard error of estimate (in percent) of the semi-log regression is also reported in column (B) in parantheses.

3/ Figures represent the weighted average of instability indices of all individual non-oil primary commodities, which reflect offsetting price movements that are not reflected in the aggregate index.

4/ Unlike other prices, oil prices in nominal terms were relatively stable except in 1973-74 and 1979-80, during which periods they increased sharply; the instability index should therefore be interpreted against this particular behavior of oil prices.

A further breakdown into roughly half-decade periods provides additional insight about the nature of the price instability during the 1970s (Table 5). It appears that price instability for all commodities peaked in the first half of the 1970s, reflecting both the 1973-74 price boom and the 1975 decline. It then moderated somewhat in the latter half of the 1970s, but was still sharply above the instability experienced before 1970. The prices of food, agricultural raw materials, and metals all followed this same pattern to varying degrees. Beverage prices were the exception, as they were most unstable in the latter half of the 1970s as a result of the Brazilian frost in 1975 that caused a sharp rise in coffee prices in 1976-77.

In summary, commodity price instability was much more pronounced in the 1970s than in the rest of the postwar period. This result holds for virtually all non-oil primary commodities irrespective of whether the instability is measured around a long-term or medium-term trend.

Table 5. Instability of Primary Commodity Prices (2) 1/
(1957-82)

Whole Period	Sub-Periods							
	1957-71	1957-60	1961-65	1966-71	1972-82	1972-75	1976-82	
(Percent of the trend)								
All exports	<u>6.70</u>	<u>2.25</u>	<u>0.87</u>	<u>1.44</u>	<u>2.06</u>	<u>13.37</u>	<u>14.40</u>	<u>11.40</u>
Food	6.62	1.88	0.54	2.44	0.78	13.71	15.79	9.91
Beverages	15.54	2.94	2.32	2.89	2.55	34.43	18.49	45.86
Agricul- tural raw materials	8.78	3.71	4.17	1.31	3.11	16.39	21.68	10.85
Metals	8.77	5.01	1.13	4.17	6.39	14.41	15.56	11.96

1/ Instability is defined as the average of the absolute values of percentage deviations of the quarterly price from the 19-quarter moving average.

III. The Determinants of Primary Commodity Prices

The decline in non-oil primary commodity prices in 1981-82 reflected both cyclical and trend factors. These factors are analyzed in this section by examining the statistical relationships since 1957 between commodity prices and their main determinants. The tentative nature of this analysis is acknowledged, as commodity markets are influenced by a wide range of factors, many of which are not easily quantifiable.

A model of commodity price determination is derived and estimated for major groups of commodities for various time periods. The main determinants of commodity prices are then analyzed specifically with regard to their relative impacts during the 1975 and 1981-82 world recessions.

1. The model

We start with a simple model incorporating the fundamental features of a competitive international commodity market in which the price of the commodity is quoted in U.S. dollars; we then apply the model to broadly aggregated commodities. The model consists of demand and supply functions.

a. Demand

Demand for the commodity is specified as

$$Q_t^C = A_0 (P_t ED_t)^{-\alpha_1} PD_t^{\alpha_2} Y_t^{\alpha_3} \quad (1)$$

where

Q_t^C = quantity demanded;

P_t = price (in U.S. dollars) of the commodity;

PD_t = average of the prices (in domestic currency) of substitutes in consuming countries;

ED_t = average of the exchange rates between the U.S. dollar and the currencies of consuming countries (national currencies/U.S. dollar);

Y_t = level of economic activity in consuming countries; and

$A_0, \alpha_1, \alpha_2, \alpha_3$ = parameters.

Equation (1) is typical demand function for a commodity which has substitutes. The meaning of PD_t or Y_t would depend on the nature of the commodity. For, say, natural rubber, PD_t could be the price of synthetic rubber, while for beef, it could be the prices of other meats. For meats as a group, PD_t could be the prices of other food substitutes which contain similar nutritional elements. It should be noted that PD_t is measured in the domestic currency of the consuming country. The meaning

of Y_t could be disposable income in the case of food or beverages, but it could also be automobile production in the case of natural rubber.

If commodities are storable, the transactional, or nonspeculative, demand for stocks of the commodity may be specified as: 1/

$$S_t^D = A_{01} - \alpha_{11}r_t + \alpha_{21}Q_t^D \quad (2)$$

where

S_t^D = transactional, or nonspeculative, demand for stocks of the commodity;

r_t = real rate of interest;

Q_t^D = total flow demand for the commodity (including both utilization and increase in stocks).

In Equation (2), the demand for stocks for transactional purposes is a positive function of total flow demand for the commodity and a negative function of the real interest rate; this specification is based on the recognition that consumers of commodities would attempt to economize the use of inventories as the cost of holding inventories rises. The equation may be written in the first difference form:

$$\Delta S_t^D = -\alpha_{11}\Delta r_t + \alpha_{21}\Delta Q_t^D \quad (2)'$$

where Δ denotes "change"; e.g., $\Delta S_t^D = S_t^D - S_{t-1}^D$. Equation (2)' suggests that the flow demand for stocks for transactional purposes would depend on the change in the real rate of interest and the change in the total flow demand for the commodity.

In principle, a price equation could be derived by equating total flow demand to supply; in practice, the nonlinearity of the total flow demand equation derived from Equations (1) and (2)' would cause a serious problem in reducing the system for the derivation of a price equation in a relatively simple form. Therefore, we postulate an equation for total flow demand (consumption plus desired increase in transactional stocks) as follows:

$$Q_t^D = Q_t^C + \Delta S_t^D = A_0(P_t E D_t)^{-\alpha_1} P D_t^{\alpha_2} Y_c^{\alpha_3} e^{-\alpha_4 \Delta r_t + \alpha_5 \Delta q_t^D} \quad (3)$$

1/ Stocks include those held in both exporting and importing countries. Although stocks would be held for various reasons, two obvious factors common to exporting and importing countries would be the volume of transactions of the commodity and the cost of holding stocks, which could be represented by the real rate of interest.

where $q_t = \ln Q_t$. Equation (3) does not straightforwardly combine Equations (1) and (2)', but it captures fairly faithfully the essential features of the relationship, specified in those two equations, between the flow demand and the set of explanatory variables. A number of these features may be summarized as follows:

(1) The basic features of the multiplicative consumption function in Equation (1) are retained in the new formulation.

(2) Equation (3) is reduced to Equation (1) if $\Delta r_t = \Delta q_t^D = 0$; i.e., the flow demand for stocks should be zero in such a case.

(3) In Equation (2), a negative Δr_t and a positive Δq_t^D imply an increase in the transactional demand for stocks; Equation (3) also captures this relationship.

In Equation (3), the coefficients (α_1, α_2) of $P_t ED_t$ and PD_t are specified to be different; in empirical estimation, we will also examine the case in which the two coefficients are constrained to be equal.

b. Supply

Production of the commodity may be specified as

$$Q_t^S = B_0 (P_t ES_t)^{\beta_1 - \beta_2} PS_t^{\beta_3} S_t \quad (4)$$

where

Q_t = supply (production) of the commodity;

PS_t = average of the production costs in exporting countries;

ES_t = average of the exchange rates between the U.S. dollar and the currencies of exporting countries (national currencies/ U.S. dollar);

S_t = exogenous supply shocks, such as weather, strikes, etc.; and

$B_0, \beta_1, \beta_2, \beta_3$ = parameters.

However, in view of the low short-run price elasticities (β_1, β_2) of supply of primary commodities, the equation may be approximated by a simpler form. 1/

1/ This extreme assumption of zero elasticities should yield an equation which would only approximate the real world. An equation which is based on the assumption of non-zero elasticities may yield estimates of the elasticities which are relatively small but statistically significant. Although it would be useful, the examination of such a case is left for a future study.

$$Q_t^S = B_0 S_t^{\beta_3} \quad (4)'$$

c. Determinants of price

The system consisting of Equations (3) and (4)' may be closed by the equilibrium condition

$$Q^S = Q^D, \quad (5)$$

and can be solved for the price: 1/

$$\begin{aligned} & [\alpha_1 - \alpha_4(1-L)^2] p_t \\ & = \alpha_0 - \beta_0 + \alpha_3 y_t + \alpha_2 p_d t - \alpha_1 e d_t + \\ & \quad - \alpha_4(1-L) i_t - \beta_3 [1 - \alpha_5(1-L)] s_t \end{aligned} \quad (6)$$

where

$p_t = \ln P_t$, $y_t = \ln Y_t$, $p_d t = \ln P D_t$, $i_t =$ nominal rate of interest,
 $s_t = \ln S_t$, $e d_t = \ln E D_t$, $\alpha_0 = \ln A_0$, $\beta_0 = \ln B_0$, and $L =$ lag operator
 (e.g., $L p_t = p_{t-1}$, $L^2 p_t = p_{t-2}$, etc.).

In deriving Equation (6) for price, the real rate of interest r_t is defined as

$$r_t = i_t - \Delta p_t \quad (7)$$

Equation (6) identifies major variables affecting commodity prices; they include three demand-side variables (economic activity, y_t ; price of substitutes, $p_d t$; and change in nominal interest rate, Δi_t , a supply-side variable (supply shocks, s_t), and exchange rate ($e d_t$). The equation is in a dynamic form, suggesting lagged responses of commodity prices to changes in the explanatory variables. The equation would have a more complicated dynamic structure if both the supply and demand equations took more proper dynamic forms to enable us to interpret α_i s ($i=1,2,\dots,5$)

1/ In closing the system in this manner, it is assumed that actual stocks are always equal to desired stocks. Equation (6) may be called a "transfer function," in the sense used by Zellmer and Palm, rather than a "reduced form." In the equation, all the current and lagged endogenous variables except for price are eliminated. In a typical reduced form, any lagged endogenous variables in the structural system could be present as explanatory variables. (See A. Zellmer and F. Palm, "Time Series Analysis and Simultaneous Equations Econometric Models," Journal of Econometrics (May 1974)).

and β_3 as truly short-run elasticities. The equation would have a still more complicated dynamic structure if recognition were given to the fact that the market may not always be in equilibrium.

In spite of all its simplicity, Equation (6) includes not only the important variables that affect commodity prices but also the parameters that determine the extent to which the variables affect the prices. The main features of the relationship are summarized in the following paragraphs:

(1) Economic activity

Economic activity affects commodity prices because demand for primary commodities is generated by economic activities in consuming countries. Unless the supply function is horizontal, the extent to which economic activity affects commodity prices is an increasing function of the elasticity of demand with respect to economic activity (α_3). Therefore, the effect of economic activity on commodity prices should be more pronounced for agricultural raw materials or metals, for which the parameter value is known to be relatively large, than for food or beverages.

(2) World inflation

Unless accompanied by offsetting movements of exchange rates, inflation in importing countries would affect commodity prices by raising the domestic price of substitutes in importing countries. Commodity prices could be affected not only by general inflation, but also by sharp increases in the prices of a specific commodity such as oil, being a major determinant of the prices of the synthetic substitutes of many primary commodities and of production costs of other commodities. Finally, inflation can also affect investor demand to the extent that storable commodities are purchased as a hedge against inflation.

(3) Exchange rates

The movements of the exchange rates of the currencies of importing countries vis-à-vis the U.S. dollar would affect commodity prices expressed in U.S. dollars because they affect the quantity demanded through changes in relative prices (commodity prices expressed in the domestic currency relative to the prices of substitutes or factors of production).

(4) Interest rate

Equation (6) shows that the level of commodity prices should be a negative function of the change in the nominal rate of interest. This implies that a relatively high rate of interest, unless it increases, should not affect commodity prices because it would keep the flow demand for stocks for transactional purposes at a constant level.

Interest rates can also affect user demand through their effect on the cost of credit sales, again contributing to an inverse relationship with commodity prices. Interest rates may also affect demand for primary

commodities through their impact on investor (or speculative) demand. Lower real interest rates encourage investor demand for commodities, while higher real interest rates increase the opportunity costs of holding commodities. This effect would also result in an inverse relationship between real interest rates and commodity prices. Finally, on the supply side, interest rates can affect commodity prices through their influence on production costs.

(5) Supply shocks

The role of supply shocks as determinants of commodity prices is particularly important for food or beverages for which demand is relatively stable but annual supply is unstable, compared with agricultural raw materials or metals, for which supply is relatively stable.

In analyzing the channels through which the major variables included in Equation (6) affect commodity prices, it is extremely important to distinguish between autonomous and induced changes in these variables. For example, a depreciation of the consuming countries' exchange rates vis-a-vis the U.S. dollar caused by an acceleration of the same magnitude in the domestic inflation in those countries may not affect commodity prices. Similarly, if worldwide inflation accompanied by restrictive monetary policies induces an acceleration in the increase in the nominal interest rate, the positive effects of the inflation on commodity prices could be more than offset by the negative effects of the interest rate movements and their possible dampening effects on economic activity.

d. Limitations of the model

The following limitations of the model should be noted:

(1) The model does not capture the role of speculative demand in the determination of commodity prices; anticipation does not play any role in the model. Accordingly, the model does not fully recognize primary commodities as assets. In view of the growth of futures markets for a number of commodities in recent years and also of the importance of some primary commodities as assets, a comprehensive model should incorporate the role of anticipation and the rates of return on commodities relative to those on other assets (i.e., major currencies and financial assets). The interest rate variable included in the equation, however, may reflect in an imperfect way the speculative demand for commodities, as it partially represents the opportunity cost of holding commodities. ^{1/}

^{1/} Although the anticipation of the future price movements does not play any role in the model, Equation (6) is not incompatible with models in which such anticipation is explicitly incorporated. For example, a partial adjustment commodity market model with a stock demand equation based on an adaptive price expectation scheme would yield a price equation similar to Equation (6), although restrictions on the parameters are different. (See B.T. McCallum, "Competitive Price Adjustments: An Empirical Study," American Economic Review, Vol. 64 (March 1974)).

(2) The model is essentially a short-run model, largely demand oriented. Therefore, it does not capture the longer-term dynamic interactions between price and supply.

(3) The model is based on the assumption that the causation between world inflation and commodity prices is unidirectional, from world inflation to commodity prices. To the extent that the causation also runs in the opposite direction, the conclusions would have to be qualified.

2. Applications of the model

On the basis of Equation (6) derived in subsection 1, historical data are used to estimate statistical relationships between commodity prices and a number of major explanatory variables identified in the equation. In this way, the effects of critical variables on commodity price movements can be analyzed. The focus of analysis will be on the role of the major variables included in Equation (6) in affecting commodity prices during various phases of price cycles, particularly during the 1975 and the 1981-82 recessions in the industrial economies.

a. Description of data

Equation (6), in first difference form, becomes:

$$\begin{aligned} & [\alpha_1 - \alpha_4(1-L)^2] \Delta p_t \\ & = \alpha_0 - \beta_0 + \alpha_3 \Delta y_t + \alpha_2 \Delta pd_t - \alpha_1 \Delta ed_t \\ & \quad - \alpha_4(1-L) \Delta i_t - \beta_3 [1 - \alpha_5(1-L)] \Delta s_t \end{aligned} \quad (6)'$$

The equation is estimated, with and without the equality constraint for the coefficients of Δpd_t and $-\Delta ed_t$, in the dynamic form of the following:

$$\Delta p_t = \theta_0 + \theta_1 \Delta y_t + \theta_2 \Delta pd_t - \theta_3 \Delta ed_t - \theta_4 \Delta^2 i_t + \theta_5 s_t \quad (6)''$$

where θ_i 's ($i=1,2,\dots,5$) are all expected to be positive and the order of the lag polynomial for each of the variables (all quarterly series) are to be determined empirically. The variables are defined in logs as follows:

p_t = aggregate index of non-oil primary commodity prices. All commodities, food, beverages, agricultural raw materials, and metals. Equations for these groups of commodities are estimated separately.

y_t = economic activity in industrial countries. Indices of industrial production for seven industrial countries (the United States, Japan, Canada, and four European countries: Germany, France, Italy, and the United Kingdom) are aggregated with their 1975 GNPs as weights.

pd_t = domestic price of substitutes. Ideally, the prices of substitutes should be used, but because of paucity of information the wholesale price indices (WPIs) of consuming countries are used as a proxy. The variable is defined in terms of domestic currencies. The same seven countries as in y_t are used with the same weights.

ed_t = exchange rate. Weighted average of the exchange rates of the seven countries vis-à-vis U.S. dollar. The same weights as in y_t are used.

i_t = world interest rate. Proxied by the London three-month Eurodollar rate. This represents primarily the cost of holding stocks. As argued in subsection 1, the price equation should have the change in the interest rate as an explanatory variable; the equation for the rate of change in price (Δp_t) should therefore have the second difference of the rate of interest ($\Delta^2 i_t$).

s_t = supply shocks. By examining the series of production of primary commodities and prices, the quarters in which supply shocks were unusually large were identified for food and beverages; for agricultural raw materials and metals, no such quarters were identified. *Dummy variables were created for the food and beverage groups.*

b. Behavior of the variables underlying commodity price movements

In this section, recent movements in the major explanatory variables regarding commodity price determination are first analyzed. These variables are then tested in the following subsection in a regression analysis according to the model developed in the previous section.

Important changes in the environment of commodity trade are summarized in Table 6 and illustrated in Chart 3. The first part of the table shows sharply higher average nominal commodity prices (122, with 1975=100) for the 1972-82 period relative to the average (53) for 1957-71 but the gain for the 1972-82 period is more than offset by the inflation that is indicated by the rise in the general price level in industrial countries. Although the rates of increase in economic activity slowed down, the average rates of increase in non-oil primary commodity prices were sharply higher during the 1972-82 period than during the 1957-71 period partly as a result of the sharply higher world inflation. The annual average rate of increase in industrial production declined from 6 percent during the 1957-71 period to 2 percent during the 1972-82 period, but the annual increase in the average WPI for industrial countries rose from 1 percent during the former

Table 6. Behavior of Variables Affecting Commodity Prices

	Average Level (1975=100) 1/			Average Percentage Change Per Annum			Instability 2/ Around Long-Term Trend		
	1957-82	1957-71	1972-82	1957-82	1957-71	1972-82	1957-82	1957-71	1972-82
Primary commodity prices									
All	82	53	122	5.1	0.4	6.5	21	5	20
Food	63	40	97	5.4	1.0	4.6	23	6	24
Beverages	110	63	178	6.1	-0.6	11.1	36	11	36
Agricultural raw materials	92	63	132	4.2	-1.6	5.8	25	6	18
Metals	87	63	122	4.6	2.5	6.6	16	10	16
Variables affecting commodity prices									
Economic activity									
GNP	84	66	109	4.2	5.0	2.2	4.2	1.4	2.1
Industrial production	87	68	114	4.6	5.9	2.3	7.1	2.6	4.3
Manufacturing output	85	66	111	4.5	5.7	2.6	6.6	3.3	3.8
Capacity utilization	95	97	93	-0.2	-0.4	-1.0	4.0	2.6	3.6
Inflation (domestic currency)									
WPI	81	57	116	5.0	1.4	9.5	15.0	2.3	4.2
CPI	81	55	119	5.5	3.0	9.4	11.3	2.2	1.8
Oil price (U.S. dollars)	72	16	148	13.3	-0.3	28.3	55.8	6.7	31.9
Exchange rate Of U.S. dollars vs. basket of 7 currencies									
SDR	106	110	101	-0.5	0.1	0.2	4.2	0.9	4.8
Interest rate Eurodollar rate (nominal)									
	102	74	142	5.7	7.5	8.5	25.0	17.2	30.4

1/ Except for capacity utilization, the unit of which is per cent.

2/ The standard error of estimate of the semi-log regression of price (quarterly data) on time multiplied by 100.

period to 10 percent during the latter; the average annual increase in commodity prices rose from less than 1 percent to 7 percent. The data in the table also help to explain the sharp increase in the instability in commodity prices during the 1972-82 period compared with the 1957-71 period. The instability of all major variables (economic activity, world inflation, exchange rates, and interest rates) affecting commodity prices was higher during the 1972-82 period than during the 1957-71 period. The following paragraphs summarize significant changes in the major determinants of commodity prices during the sample period.

(1) Economic activity

Industrial production of seven major industrial countries expanded at a rather steady rate from 1957 to 1971 (Chart 4). Thereafter, not only the trend became slower, but fluctuations around the trend increased markedly. The sharp increase in industrial production from 1972 to 1974 and the subsequent decline in 1975 coincided with similar movements in commodity prices over this same period. Industrial production then rose rather steadily until 1980 when it declined by about 1 percent. During this period, commodity prices also rose except for a one-year decline in 1978, caused largely by a sharp drop in beverage prices due mostly to supply factors. The decline that occurred in 1981 lagged the decline in industrial production by about three quarters.

It has been suggested that one of the reasons for the sharp rise and fall of commodity prices during 1972-75 was the fact that the business cycles of the major industrial countries were synchronized to an unusual degree during this period. ^{1/} Compared with previous cycles that were often at least partially offsetting, the synchronized expansion of the industrial countries from 1972 to 1974 placed great pressure on available commodity supplies. The subsequent decline in 1975, as shown in Chart 4, was also synchronized, placing equally strong downward pressure on commodity prices. Since 1975, however, the business cycles of the major industrial countries have not maintained this synchronization, although during 1981-82 (with the exception of Japan) they declined together. The synchronized cycle of 1972-75, therefore, does not appear to have been the beginning of a common business cycle, as some argued. Its occurrence, however, may have contributed to commodity price instability which, as shown earlier, reached its peak during the same period.

(2) World inflation

The rate of world inflation increased sharply after 1972 (Chart 5). The rate of increase in wholesale prices of the industrial countries reached its peak in 1973-74 at an average annual rate of 16 percent, coinciding with the peak in commodity price increases during the same period. The second highest level of wholesale price inflation occurred in 1979-80 and

^{1/} R. Cooper and R. Lawrence, "The 1972-75 Commodity Boom," Brookings Papers on Economic Activity, No. 3, Brookings Institution (Washington, 1975).

CHART 4 INDUSTRIAL PRODUCTION

(1975=100)

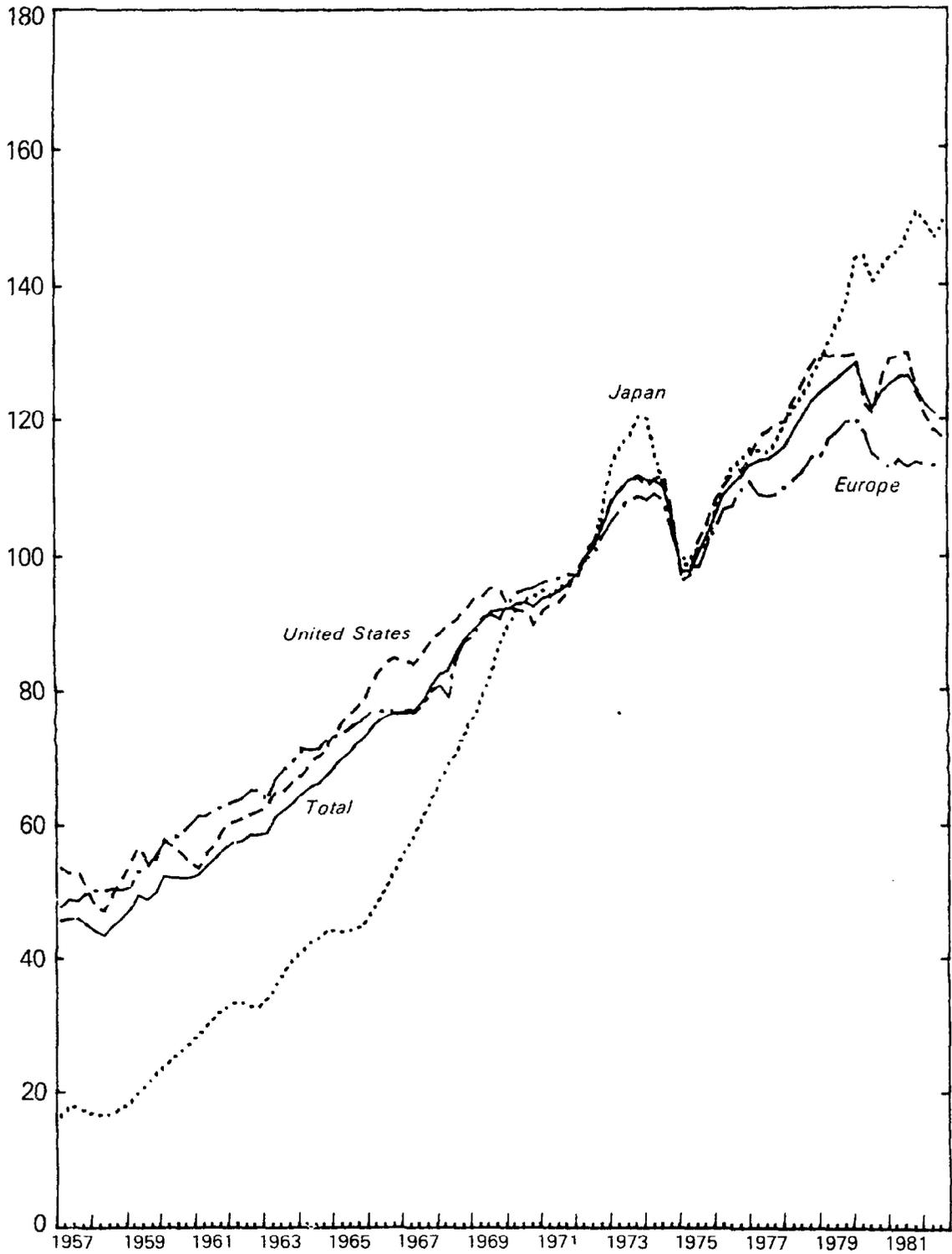
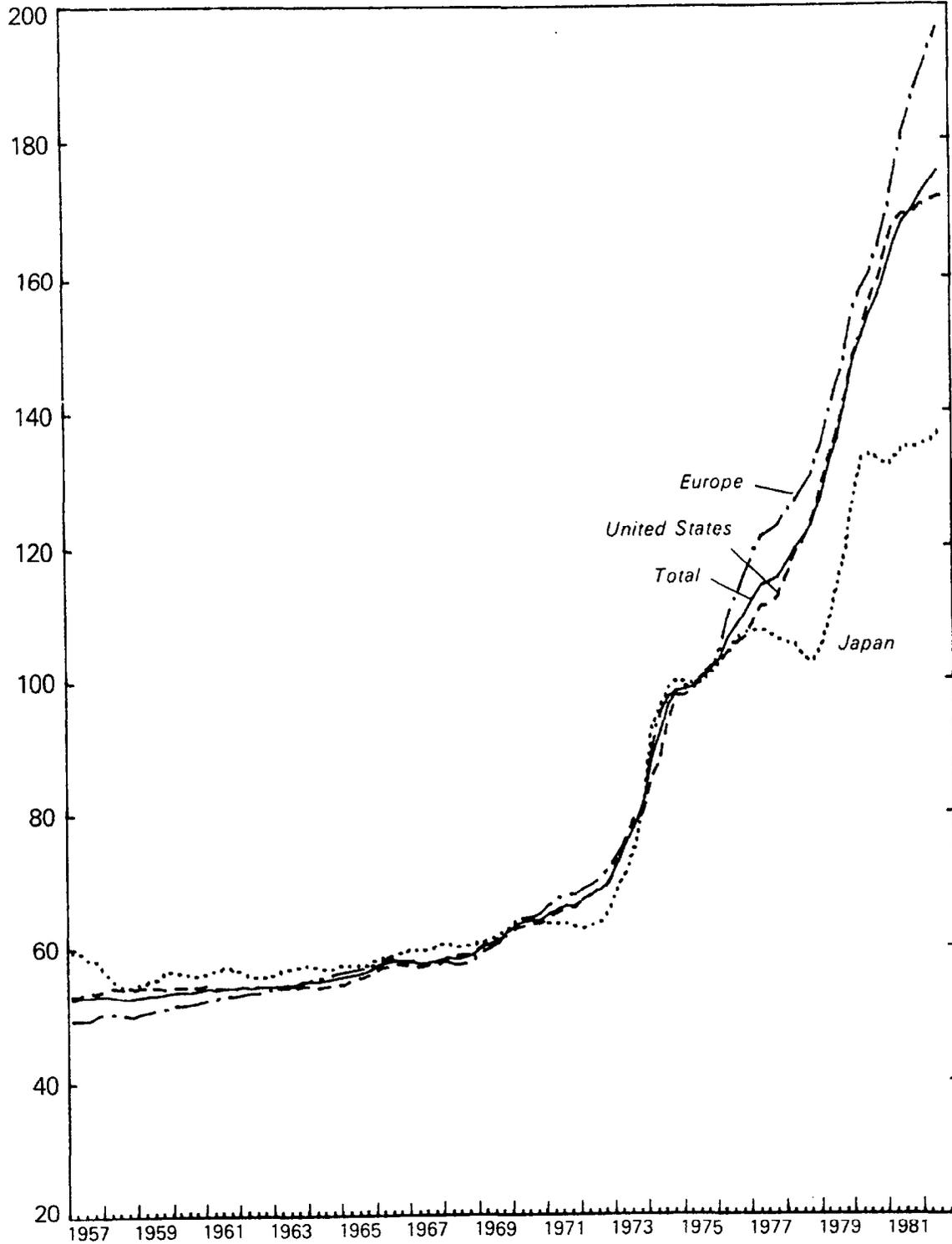


CHART 5 WHOLESALE PRICE INDEX

(1975=100)



was also accompanied by relatively high increases in nominal commodity prices. The price of petroleum experienced its greatest surges in these same two periods (Chart 6). Petroleum is a major component of the production costs of a wide range of primary commodities, in the form of energy costs for some (e.g., metals) and in the form of other inputs for others (e.g., fertilizers). Petroleum prices also strongly influence transportation costs and, in addition, petroleum-based synthetics comprise some of the most important substitutes for agricultural raw materials. Finally, movements in petroleum prices over the last decade have perhaps been as good an indicator as any of the trend in inflation, leading major surges in prices in both the early and late 1970s. Petroleum price movements may also influence commodity prices indirectly through their impact on the business cycle, but their impact on the business cycle is still a debatable issue. ^{1/} The role of petroleum prices in the fluctuations of non-oil primary commodity prices needs to be examined further.

(3) Exchange rate

Since the end of 1971, exchange rate fluctuations, particularly of the U.S. dollar with other major currencies, have been much greater than in the rest of the postwar period. For example, the U.S. dollar depreciated by about 14 percent against the basket of major currencies during 1971-74 (Chart 7). It then appreciated somewhat in 1975 before depreciating again during 1976-79 by about 12 percent. Finally, it appreciated sharply during 1981-82 by over 20 percent. These movements in the dollar exchange rate since 1971 appear to be inversely related to primary commodity price movements.

As indicated earlier, the impact of an exchange rate change on demand for a commodity depends on the relevant elasticities; an appreciation of the U.S. dollar would tend to reduce demand, whereas a depreciation should tend to increase demand. Exchange rate instability may influence speculative demand for primary commodities, with a higher degree of instability causing a greater demand for primary commodities as a hedge against exchange rate risk. ^{2/} Although other means of hedging exchange rate risks exist, primary commodities have the advantage of avoiding the problem of exchange restrictions. This impact of exchange rate fluctuations on commodity prices, however, does not necessarily result in an inverse relationship.

(4) Interest rate

Interest rates in the industrial countries have experienced much greater fluctuations in the 1970s than at any other time in the postwar period, and they have also reached postwar highs (in both nominal and real terms) during this period. Interest rates can influence commodity prices on both the demand and supply sides. High interest rates in the 1970s have

^{1/} M. R. Darby, "The Price of Oil and World Inflation and Recession," American Economic Review, Vol. 72 (September 1982), pp. 738-751.

^{2/} See E. Grilli and M. Yang, "Real and Monetary Determinants of Non-Oil Commodity Prices" (unpublished, World Bank Working Paper No. 1981-6, December 1981).

greatly increased the cost of holding inventories, thereby resulting in a rundown of user stocks of raw materials that has put further downward pressure on demand for current production. Several recent studies have related changes in the real rate of interest to changes in inventory levels and drawn implications for commodity prices. 1/

The generally higher real interest rates that prevailed in the 1970s compared with earlier levels have also resulted in producers holding lower levels of raw material inventories. For example, because of the increased cost of holding stocks in the 1970s, the major grain exporting countries moved from a policy of holding large stocks to a policy of production adjustments. 2/ This supply-side effect would not necessarily lead to an inverse relationship between interest rates and commodity prices, but it might well be one of the factors explaining greater commodity price instability in the 1970s. For example, it has been shown that in 1972, immediately preceding the commodity price boom, stocks as percent of trend production were lower than their 1965-70 averages across a wide range of storable raw materials. 3/

(5) Supply shocks

Except for the effect of interest rates on production costs, the determinants of commodity price behavior discussed so far have all been demand-related. For individual commodities, however, particularly food and beverages whose supply often depends as much on the weather as on expected demand, supply-related determinants may be quite important. It has been documented, for example, that in 1973 unusually poor growing conditions in much of the world were a major factor in the subsequent sharp increase in food prices, and that the 1975 frost in Brazil contributed significantly to the subsequent rapid rise in coffee prices.

In explaining movements in overall commodity prices, however, these supply factors are difficult to analyze, as supply-related data are often not available. Moreover, supply factors are usually impossible to forecast so that their usefulness for more than a very short-term outlook exercise is limited.

The rapid growth of futures trading has led some to attribute part of the increased commodity price instability in the 1970s to a rise in speculative demand. 4/ During the 1970s both the volume of futures trading

1/ E. Grilli and M. Yang, loc. cit., and P. Gotur, "Effects of Interest Rates on Commodity Prices: Some Empirical Results" (unpublished, International Monetary Fund, 1983).

2/ D. T. Morrow, The Economics of the International Stockholding of Wheat, Research Report 18, International Food Policy Research Institute (Washington, September 1980), pp. 2-23.

3/ B. Bosworth and R. Lawrence (1982), Commodity Prices and the New Inflation, The Brookings Institution (Washington).

4/ R. Cooper and R. Lawrence, loc. cit.; B. Bosworth and R. Lawrence, loc. cit.

CHART 6
PRICE OF MANUFACTURES AND OIL PRICE
(1975=100)

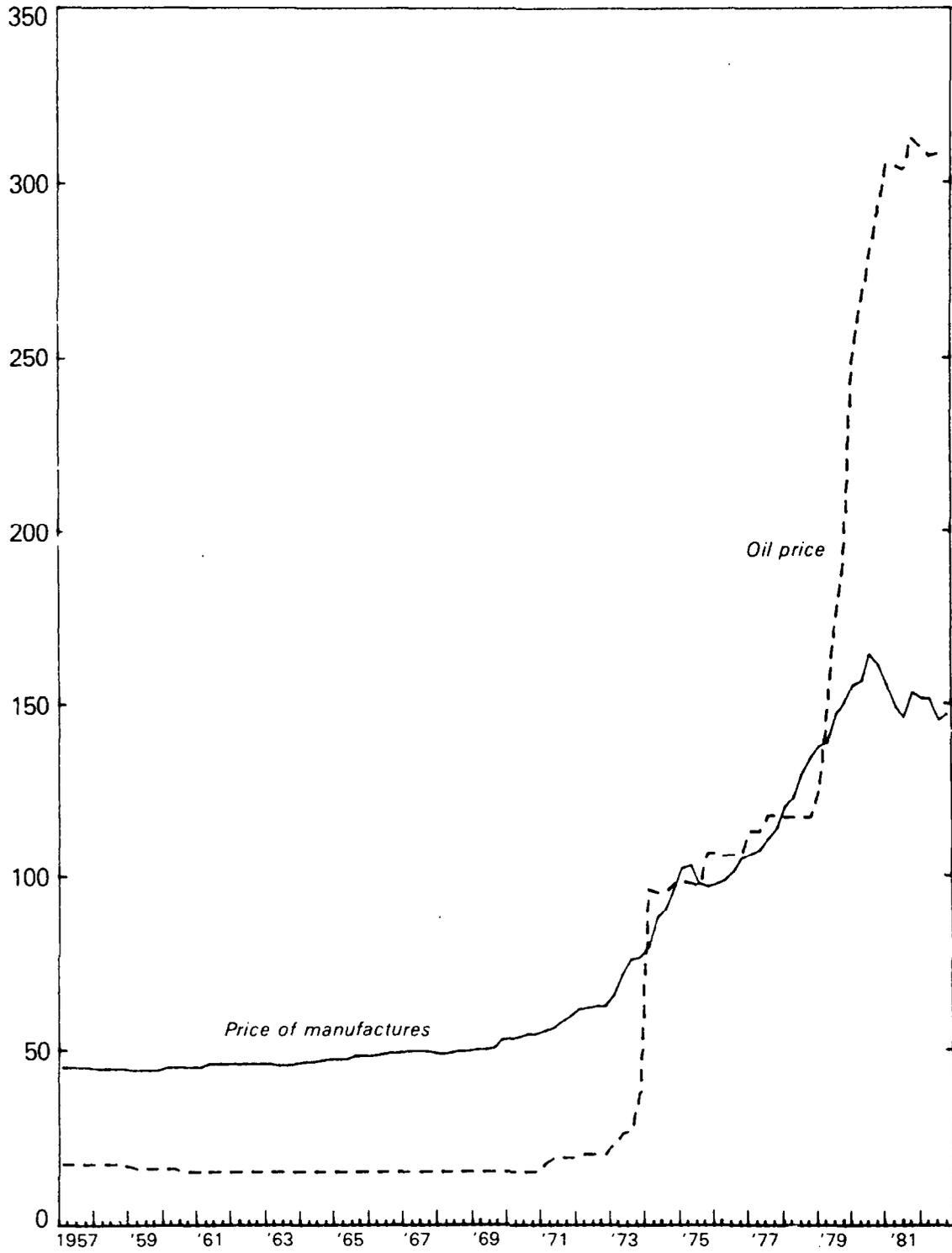
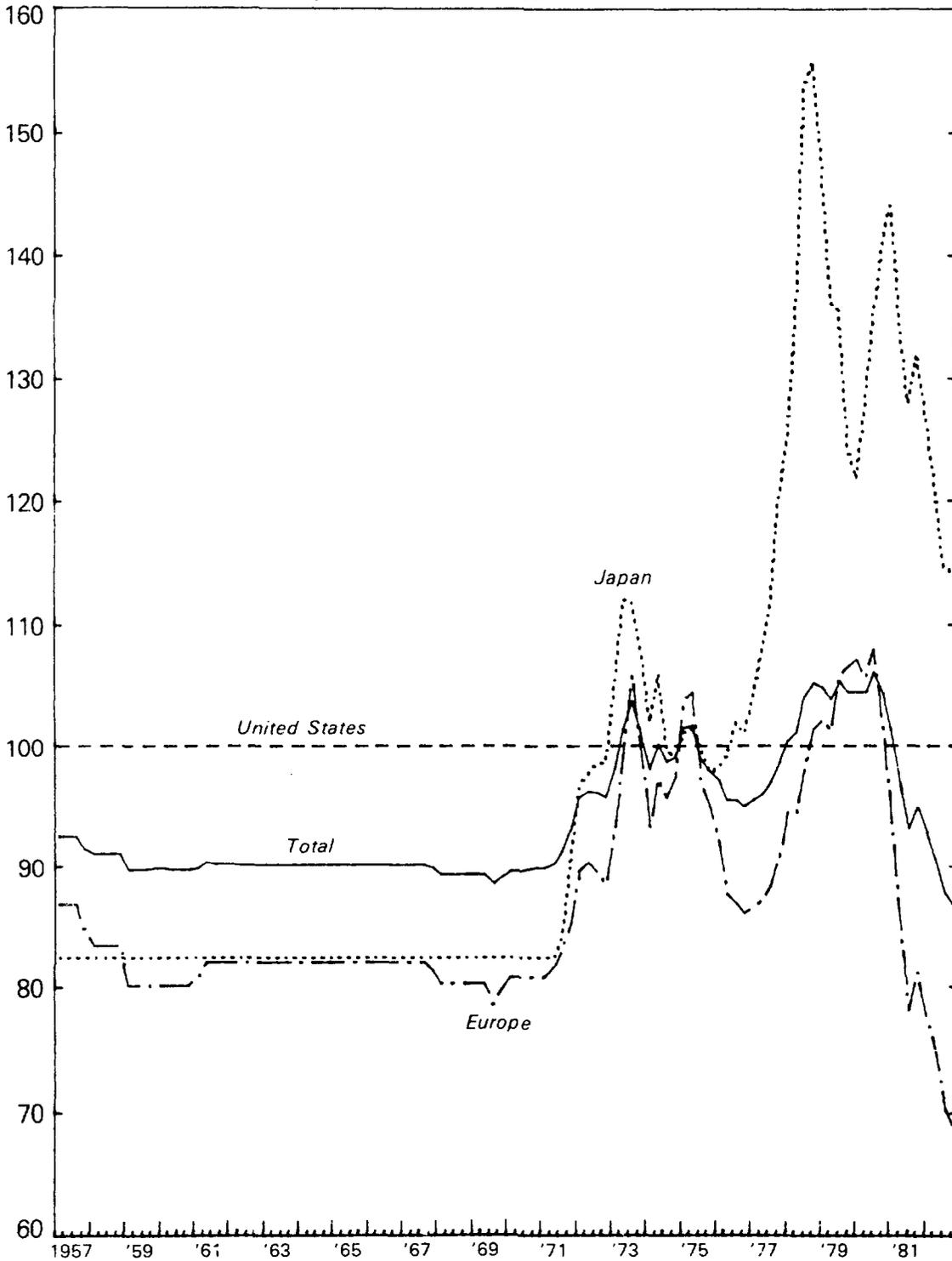


CHART 7 EXCHANGE RATES¹

(1975=100)



¹A decline indicates an appreciation of the U.S. dollar

and the number of contracts increased sharply. Trading volume (in millions of contracts) increased from 13.6 in 1970 to 92.1 in 1980, and the number of contracts traded increased from 40 to 82 over the same period.

Although the fact that speculative activity increased during the 1970s is not disputed, it is still questionable whether this increased speculation was a cause or an effect of increased commodity price instability. A recent study testing the direction of causation has lent support to the hypothesis that commodity price instability had led to greater speculation rather than vice versa. ^{1/} An extensive and inconclusive literature exists, however, on whether speculation is stabilizing or destabilizing, a question which is beyond the scope of this study.

c. Estimation results

Equations are estimated for each group of commodities (all commodities, food, beverages, agricultural raw materials, and metals) for three sample periods: 1958 Q1-1982 Q2, 1958 Q1-1971 Q4, and 1972 Q1-1982 Q2. The end of 1971 is used as the point for dividing the whole sample period into two subperiods because the fluctuation in commodity prices has become substantially more unstable since 1971 ^{2/} and a number of important events took place around that time: (i) major currencies began to float in the last quarter of 1971 following the breakdown of the system of fixed exchange rates; (ii) the large increase in oil prices in 1972 had far-reaching effects on the world economy, which has since been going through major structural changes; and (iii) the year 1972 was also the year in which the 1973-74 commodity price boom began and a number of futures markets were instituted for major primary commodities.

Table 7 summarizes the results of estimation of the price equation in the first difference form for groups of commodities. Suppressing weak variables, the estimation is carried out with and without the constraint for the variables pd_t and ed_t .

(1) Explanatory power of equations

The results are more satisfactory for the 1972-82 period than for the 1957-71 period. The adjusted coefficients of determination are higher for the 1972-82 period than for the 1957-71 period for all commodity groups. The variables included in the equation explain a substantial proportion of the variations in the rates of change in prices for all groups of commodities except for beverages. The adjusted coefficients of determination for the whole sample period (1957-82) range from 0.171 for beverages to 0.473 for all the commodities with the equality constraint for the coefficients for Δpd_t and Δed_t ; they range from 0.183 for beverages to 0.495 for all commodities without the constraint. These coefficients of determination

^{1/} D. Rutledge, "Trading Volume and Price Variability: New Evidence of the Price Effects of Speculation," International Futures Trading Seminar Proceedings, Vol. V (Chicago Board of Trade, 1979), pp. 161-174.

^{2/} See Chart 1 and Table 4.

Table 7. Price Equations (1)
(1958-82)

Dependent Variable: Price of Δp_t	Sample Period	Explanatory Variables								\bar{R}^2	DW	SEE		
		Constant	Lagged Price Δp_{t-1}	Economic Activity		Inflation		Interest Rate $\Delta^2 i_{t-1}$	Supply Shocks (Food) (Beverages)					
				Δy_t	Δy_{t-1}	Δp_t	Δe_t		s_f_t				s_b_t	
All commodities														
	1958-82	-0.028** (-5.07)		0.979** (3.66)	0.630** (2.64)		1.412** (6.37)		-0.003 (-1.56)	-0.028 (-1.37)	-0.068* (-2.51)	0.473	1.72	0.038
		-0.032** (-5.63)		1.005** (3.83)	0.655* (2.59)		1.794** (6.46)	-0.992** (-3.43)	-0.004 (-1.76)	-0.023 (-1.11)	-0.067* (-2.51)	0.495	1.66	0.037
	1958-71	-0.013* (-2.45)		0.560* (2.31)	0.106 (0.46)		1.054* (2.17)		-0.008 (-1.91)			0.143	1.87	0.023
	1972-82	-0.030* (-2.62)		1.179* (2.28)	1.044* (2.05)		1.385** (3.83)		-0.004 (-1.18)	-0.053 (-1.16)	-0.065 (-1.76)	0.522	1.74	0.050
Food														
	1958-82	-0.024** (-2.85)			0.900* (2.47)		1.838** (5.15)			-0.053 (-1.63)		0.280	2.09	0.062
		-0.030** (-3.40)			-0.873* (2.43)		2.388** (5.29)	-1.230* (-2.61)		-0.046 (-1.41)		0.301	1.99	0.061
	1958-71	-0.007* (0.99)			-0.381 (-1.32)		0.223 (0.33)					--	1.89	0.033
	1972-82	-0.047* (-2.57)			1.511* (2.33)		2.236** (3.86)			-0.062 (-1.41)		0.377	2.32	0.082
Beverages														
	1958-82	-0.011 (-0.94)	0.229* (2.16)		1.115* (2.25)		0.255 (0.54)				-0.134* (-2.00)	0.171	1.74	0.083
		-0.018 (-1.46)	0.210 (1.98)		1.107* (2.25)		0.843 (1.39)	0.414 (0.65)			-0.138* (-2.07)	0.183	1.75	0.083
	1958-71	-0.003 (-0.29)	0.188 (1.31)		-0.062 (-0.13)		0.249 (0.24)					--		
	1972-82	0.005 (0.19)	0.159 (0.95)		2.271* (2.42)		-0.232 (-0.29)				-0.136 (-1.44)	0.203	1.53	0.114
Agricultural raw materials														
	1958-82	-0.020** (-2.81)	0.299** (3.17)		1.490** (4.65)		0.858** (2.88)		-0.007* (-2.54)			0.416	1.82	0.047
		-0.018* (-2.32)	0.307** (3.22)		1.471** (4.55)		0.714 (1.90)	-1.005** (-2.65)	-0.007* (-2.50)			0.412	1.86	0.047
	1958-71	-0.020** (-2.93)	0.210 (1.80)		1.035** (3.17)		1.102 (1.64)		-0.016* (-2.54)			0.233	1.85	0.022
	1972-82	-0.011 (-0.79)	0.232 (1.44)		2.155** (3.40)		0.045 (1.48)		-0.007 (-1.93)			0.461	1.67	0.060
Metals														
	1958-82	-0.028** (-3.20)			1.533** (3.97)		1.797** (5.04)		-0.007* (-2.10)			0.276	1.84	0.063
		-0.027** (-2.88)			1.531** (3.94)		1.751** (3.84)	-1.851** (-3.78)	-0.007* (-2.07)			0.269	1.83	0.063
	1958-71	-0.028 (-1.40)			0.975 (1.60)		1.803 (1.43)		-0.002 (-0.16)			0.030	1.86	0.062
	1972-82	-0.037* (-2.46)			1.806** (3.33)		1.933** (4.18)		-0.008* (-2.05)			0.413	1.84	0.067

are somewhat higher than those of a previous study with a similar dependent variable but excluding the interest rate and exchange rate as independent variables. 1/ For the 1972-82 period, they range from 0.203 for beverages to 0.522 for all commodities. 2/

The results are less satisfactory for the 1957-71 period than for the 1972-82 period, probably because the fluctuations of the demand-side variables were substantially less during the former period than the latter, implying that in relative terms, supply shocks were more important in determining the fluctuations of commodity prices during the former period than during the latter. The results suggest that this was the case particularly for the food and the beverage groups.

(2) Effects of major explanatory variables on commodity prices

The model confirms the influence of the level of economic activity, world inflation, and exchange rates on commodity prices. For the period 1958-82, these variables are highly significant for all groups of commodities. The only exception is the coefficient of the inflation variable which is not significant for beverage prices; this result may be due to the dominance of supply shocks in the fluctuation of beverage prices.

The elasticity of overall commodity prices with respect to industrial production is estimated at about 2 for the 1972-83 period, higher than the estimated elasticity (about 1.7) for the 1957-71 period. As can be expected, the coefficients of the industrial production variables are larger for agricultural raw materials and metals than for food and beverages.

The elasticity of overall commodity prices with respect to inflation is somewhat larger than unity when the absolute values of the coefficients for the inflation (measured in domestic currencies) and exchange rate change variables are constrained to be equal. The coefficients vary substantially, among commodity groups, ranging from a value that is not statistically different from zero to a value close to 2.

The role of the exchange rate in the determination of commodity prices is indicated in the results of the regressions in which the exchange rate is included separately as an explanatory variable. The results support the hypothesis that exchange rate fluctuations are one of the major causes of observed instability of commodity prices for the 1972-82 period. 3/ The elasticity of overall commodity prices with respect to the U.S. dollar

1/ Enoch and Panic, "Commodity Prices in the 1970s," Bank of England Quarterly Bulletin, Bank of England (London), Vol. 1 (March 1981).

2/ The coefficients of determination between the actual and the predicted prices are far higher than the adjusted coefficients of determination from the regression based on the rates of change for all groups of commodities, ranging from 0.973 for metals to 0.993 for all commodities; they are also higher for the 1972-82 period than for the 1958-71 period.

3/ See the analysis at the end of this subsection.

exchange rate vis-a-vis major currencies is estimated as somewhat greater than unity. The coefficients vary among commodity groups; the coefficient is not significant for beverage prices.

The effects of interest rate changes on commodity prices are not sufficiently robust; the results reported in the table are based on the interest rate variable lagged by one quarter as an explanatory variable, and suggest an inverse relationship as indicated in the model introduced earlier. However, if the same equations are estimated with the current interest rate variable as an explanatory variable, the estimated coefficients become either positive or weakly negative. The results with a one-quarter lag are strong for agricultural raw materials and metals. 1/ Notwithstanding these rather inconclusive results, the unusually high levels of real interest rates during 1981-82 may have contributed to the downward pressure on commodity prices by encouraging inventory reductions, just as the predominantly negative real rates of interest during the 1970s may have exerted upward pressure on nominal commodity prices.

The strong negative constant term estimated for all groups of commodities except for beverages is also noteworthy. It reflects the effects of the secular drifts of the supply and the demand functions as specified earlier. For example, the supply function as specified in Equation (4)' does not include variables accounting for the long-term expansion in production capacity of primary commodities and the innovations in production technologies. Also, the demand function as specified in Equation (3) does not include variables accounting for secular drifts in the demand function that could have occurred because of the long-term growth in the production of synthetic substitutes. The estimated constant term measures the net effects of the omitted variables that influence the secular trend of commodity prices. In other words, the estimated coefficient suggests that had the expansion in production capacity, innovations in production technologies, and other secular factors occurred as they did, but had the variables, such as economic activity and relative prices, that are included in the equations, not changed, commodity prices would have declined by more than 2 percent a quarter. 2/

1/ A lagged effect of interest rate changes on commodity prices is consistent with a lag associated with expectations and the lags in delivery of inventory items ordered in the previous period. In the Grilli and Yang study, loc. cit., the interest rate variable was also significant with a one-quarter lag.

2/ Interpretation of this coefficient requires caution. Had demand not grown because of the long-term stagnation in economic activity, production capacity of primary commodities may not have grown as it did historically. Use of the equation, therefore, for long-term simulations and forecasts, should be conducted with these complex causal relationships fully recognized.

(3) Other results

The dynamic nature of the equations should be noted: in the equation for all commodities, both the coefficients for the current and lagged activity variables are significant; in the food and beverage equation, only the lagged activity variables are significant; and in the beverage and agricultural raw materials equations, the lagged dependent variables are significant. 1/

There is some indication that for beverages and agricultural raw materials, the responses of commodity prices to changes in the explanatory variables are not instantaneous, as suggested by the estimates of the coefficients for the lagged dependent variables which are in some cases significantly positive. The estimated coefficients for supply shocks all have the expected signs without exception; however, the supply shocks, being quantified as dummy variables distinguishing only those quarters during which conspicuous effects of supply shocks occurred, are not dealt with adequately in the model.

The results indicate that the values of some coefficients changed between the 1958-71 and the 1972-82 sample periods: in virtually all cases, the coefficients of economic activity variables became larger in absolute terms in the latter period than in the former, implying a greater fluctuation response of commodity prices in the latter period to variations in economic activity. 2/ A possible explanation for the greater response of commodity prices to changes in economic activity in the 1970s may be that larger absolute upward fluctuations in economic activity result in capacity constraints being reached and that larger downward fluctuations succeed in overcoming a ratchet effect that limits downward price movements in response to smaller declines in economic activity. The increased use of futures markets in the 1970s may also have resulted in greater responsiveness in commodity prices to underlying real and monetary variables.

Possible shifts of the coefficients between the two subperiods (1958-71 and 1972-82) have been tested separately for each coefficient with the maintained hypothesis that all the other coefficients have remained the same during the entire sample period. 3/ The tests suggest that the coefficient of economic activity may have shifted during the period for all commodities, beverages, and agricultural raw materials. No strong evidence is obtained for any other coefficient (Table 8).

1/ See Annex for the results of the tests on the significance of lagged dependent variables.

2/ These results are consistent with those obtained by Enoch and Panic, loc. cit., using a different model specification but a similar breakdown of time periods.

3/ A number of studies have tested various hypotheses on the structural shifts of the commodity markets. See E. Grilli and M. Yang, loc. cit., and E.C. Hwa, "Price Determinants in Several International Primary Commodity Markets," Staff Papers, International Monetary Fund (Washington), Vol. 26 1 (1979), pp. 152-88.

Table 8. Price Equations (2) 1/
(1958-82)

Dependent Variable: Price of Δp_t	Explanatory Variables							DW	SEE			
	Constant	Lagged Price Δp_{t-1}	Economic Activity $\Delta y_t \cdot \Delta t$	Inflation $\Delta p_t - \Delta e_t$	Interest Rate Δi_{t-1}	Supply Shocks (Food) sf_t	Supply Shocks (Beverages) sb_t			\bar{R}^2		
<u>All commodities</u>												
	-0.022** (-3.75)		0.896** (3.41)	0.174 (0.53)	1.035* (2.45)	1.214** (5.27)	-0.004 (1.95)	-0.026 (-1.32)	-0.061* (-2.30)	0.501	1.77	0.037
<u>Food</u>												
	-0.024** (-2.85)		0.900* (2.47)		1.838** (5.15)		-0.053 (-1.63)			0.280	2.09	0.062
<u>Beverages</u>												
	-0.001 (0.08)	0.168 (1.58)	-0.152 (-0.22)		2.414** (2.58)	-0.134 (-0.28)			-0.135 (-2.07)	0.219	1.67	0.081
<u>Agricultural raw materials</u>												
	-0.015* (-2.19)	0.213* (2.19)	0.861* (2.19)	1.402* (2.61)	0.793** (2.73)		-0.008** (-2.95)			0.450	1.75	0.045
<u>Metals</u>												
	-0.028** (-3.20)		1.533** (3.97)		1.797** (5.04)		-0.007* (-2.10)			0.276	1.84	0.063

1/ The level of significance is indicated by one (95 percent) or two (99 percent) asterisks. The variables d_t and d_{t-1} are dummy variables for which either 0 (for 1957-71) or 1 (for 1972-82) was assigned.

d. Comparison with other studies

As referred to earlier, other studies have developed and tested various models of commodity price determination. ^{1/} Like the present study, all of these studies analyze prices of groups of commodities except for the two studies by Hwa, which analyze six individual commodities. Unlike the present study, however, most of these studies use the relative price of commodities to manufactures prices as the dependent variable, except for Hwa (1979 and 1981) and Enoch and Panic, who use changes in the nominal price of commodities. The argument that world economic activity is positively related to non-oil primary commodity prices has been well established, as all of these studies obtained significant results for this relationship. The price of manufactured exports was shown to be positively related to commodity prices in one study (Enoch and Panic), and the price of oil and oil price shock dummy variables had significantly positive coefficients in other studies (Enoch and Panic, Gotur, and Grilli and Yang). In all these studies, however, the exchange rate variable was not tested separately. Inflationary expectations were shown to be positively related to the prices of several individual commodities (Hwa 1979). Two studies also found that the level of interest rate--not the change in interest rate as in the present study--is negatively associated with commodity price movements, especially in the case of metals and agricultural raw materials (Gotur, Grilli and Yang), but one found insignificant results (Enoch and Panic). Supply-side variables (such as production of a commodity or group of commodities, and stocks) were introduced in several studies which showed the expected inverse relationship with commodity prices (Bosworth and Lawrence, Cooper and Lawrence, Hwa 1979 and 1981). Finally, one study found that commodity prices are positively related to exchange rate variability (Grilli and Yang). The present study tests the level of exchange rate, not its variability, as a determinant of commodity prices.

e. Factors underlying the long-term trend and instability of commodity prices

Table 9 illustrates how the historical movements of the major explanatory variables identified in the study can help trace the long-term increase

^{1/} E. Bosworth and R. Lawrence, Commodity Prices and The New Inflation (1982), The Brookings Institution (Washington); R. Cooper and R. Lawrence, "The 1972-75 Commodity Boom," Brookings Papers on Economic Activity: 3 (1975), The Brookings Institution (Washington); C. Enoch and M. Panic, "Commodity Prices in the 1970s," Bank of England Quarterly Bulletin, March 1981; P. Gotur, "Effects of Interest Rates on Commodity Prices: Some Empirical Results," draft paper, IMF Research Department (1983); E. Grilli and M. Yang, "Real and Monetary Determinants of Non-Oil Primary Commodity Price Movements," World Bank Working Paper No. 1981-6 (December 1981); E. C. Hwa, "Price Determinations in General International Primary Commodity Markets: A Structural Analysis," Staff Papers, International Monetary Fund (Washington), Vol. 26, No. 1 (March 1979); E. C. Hwa, "A Simultaneous Equation Model of Price and Quantity Adjustments in Primary Commodity Markets," World Bank Working Paper No. 499 (October 1981).

Table 9. Factors Underlying the Long-Term Change and the Short-Term Fluctuation in Commodity Prices

	1958-71	1972-82
1. <u>Long-term change</u> <u>1/</u>		
1.1 Annual average change	0.4	6.5
Explained by change in		
1.2 Three major variables and time trend: (a)+(b)+(c)+(d)	-2.2	8.7
Annual average change in		
a. Industrial production	5.3	6.2
b. Wholesale price	1.7	11.5
c. Exchange rate	-0.1	0.1
d. Time trend	-9.1	-9.1
1.3 Residual: (1.1)-(1.2)	2.6	-2.2
2. <u>Fluctuations</u> <u>2/</u>		
2.1 Variation in the rate of change	6.4	52.9
Explained by variations in		
2.2 Three major variables: (a)+(b)+(c)	2.2	17.2
a. Industrial production	1.6	7.9
b. Wholesale price	0.3	3.5
c. Exchange rate	0.3	5.8
2.3 Error term <u>3/</u>	6.3	26.6
2.4 Residual: (2.1)-(2.2)-(2.3) <u>4/</u>	-2.1	9.1

1/ Per cent per year.

2/ Variance of the quarterly rate of change in percent.

3/ The error term reflects the significant variables left out of the equation, including production shocks that were not exceptional.

4/ The residual could be either positive or negative because it reflects covariances between the explanatory variables included in the equation.

and the short-term fluctuation in commodity prices. ^{1/} In the upper part of the table, the average rates of increase in the overall index of commodity prices are compared with the rates simulated on the basis of the rates of the increase in the three major variables and time trend. The simulations indicate that the dominant factor underlying the sharp acceleration in nominal commodity prices during 1972-82 was the acceleration in world inflation; the contribution made by the increase in industrial production was slightly higher in absolute terms, but lower in relative terms during 1972-82 compared with 1957-71. The increase in the contributions made by the increase in industrial production was purely because of an increase in the coefficient; the rate of increase in industrial production decelerated substantially during 1972-82.

The lower part of Table 9 illustrates major factors underlying the fluctuation in commodity prices. The variance of the rate of change in overall commodity prices is estimated at 6.4 for the period 1958-71; during this period, the variances of the three demand-side variables (industrial production, world inflation, and exchange rate) are estimated at 2.0, 0.2 and 0.2. ^{2/} Together with the estimates of the coefficients for these variables presented in Table 8, these estimates of the variances suggest that about a third of the variations in commodity prices during 1957-71 is accounted for by the variations in the three critical demand-side variables. ^{3/} Although the extent to which the variation in the rate of change in commodity prices was explained by the variations in the three variables remained the same (at about a third) during 1972-82, the degree of the variations in these variables was sharply higher in 1972-82 than in 1958-71 (Table 10). The variance of the rate of change in commodity prices was about nine times larger during the 1972-82 period than during the 1958-71 period. The variances for all the demand-side variables were higher, but the variance for industrial production was twice as large, while the variance for the inflation rate was more than 12 times larger; the instability was larger for both the wholesale prices and exchange rate, but it was sharply higher for the latter. At the same time, the variance of the random disturbance term, reflecting, among other factors, production shocks that were not exceptional during 1957-71, also became sharply higher during 1972-82, but its relative contribution to the variation in the commodity prices declined substantially.

^{1/} The following analysis is based on the coefficients estimated with the assumption of the equality between the coefficients of Δp_d and $-\Delta e_d$. If the coefficients estimated without such constraint were used, the effects of exchange rate movements on commodity prices would become relatively smaller, but the thrust of conclusions would not change.

^{2/} It should be noted that, as indicated in Table 11, the fluctuations in commodity prices and the underlying factors measured as the variances of the variables' rates of change are good indicators of the fluctuations in these variables measured as the average deviations from trends.

^{3/} The variance of the dependent variable (Δp_t) in Equation (6) can be expressed as the sum of the variances of the explanatory variables multiplied by their respective coefficients squared plus the variance of the disturbance term and a function of the covariances of the explanatory variables.

Table 10. The Two Recessions and Commodity Prices (1)

Period 1/	1975 Recession			1981-82 Recession	
	Price Increase	Decrease	Recovery	Price Increase	Decrease
	1972Q1-74Q2	1974Q3-75Q4	1976Q1-77Q2	1978Q4-80Q4	1981Q1-82Q4
Lengths in quarters	10	0	0	9	5
Commodity prices: (Percentage change)					
<u>Cumulative</u>					
All: nominal	131	-23	56	30	-28
Food	161	-24	54	76	-36
Beverages	78	1	256	-17	-9
Agricultural raw materials	136	-24	32	25	-27
Metals	129	-36	17	35	-21
All: real 2/	57	-30	30	4	-26
<u>Annual rate</u>					
All	40	-16	34	12	-15
Food	57	-17	29	29	-25
Beverages	26	1	129	-8	-9
Agricultural raw materials	40	-16	21	10	-15
Metals	39	-26	11	14	-11
Major determinants: (Percentage change)					
<u>Cumulative</u>					
Industrial production	19	-12	15	11	-9
United States	20	-13	16	9	-11
Europe	13	-9	11	10	-12
Japan	28	-17	15	23	3
WPI	40	10	12	30	12
United States	35	16	9	12	8
Europe	44	6	26	26	19
Japan	53	5	5	28	3
Exchange rate	-10	2	2	-9	26
Europe	-17	2	9	-4	59
Japan	-22	8	-9	9	23
Oil price	382	12	6	149	3
<u>Annual rate</u>					
Industrial production	7	-8	9	5	-5
United States	8	-9	10	4	-6
Europe	5	-6	7	4	-5
Japan	10	-12	10	10	1
WPI	14	7	8	12	6
U.S.	13	10	6	13	7
Europe	16	4	13	12	9
Japan	18	3	3	12	2
Exchange rate	-3	2	1	-9	16
Europe	-5	2	6	-2	22
Japan	-7	6	-6	4	11
Oil price	85	8	4	65	3

1/ The periods for the commodity price indices. In the case of the explanatory variables, the periods chosen for various phases of the two cycles are the same as for the commodity prices except for the following:

(a) Industrial production. (i) The 1975 recession: Increase (1971Q3-1973Q4); decrease (1974Q1-1975Q2); and recovery (1975Q3-1976Q4). (ii) The 1981-82 recession: Increase (1978Q1-1980Q1); decrease (1980Q2-1982Q4).

(b) Exchange rate. The 1975 recession: Increase (1971Q2-1974Q2).

2/ Deflated by the US index of manufactures prices.

Table 10. The Two Recessions and Commodity Prices (1)

Period 1/ Lengths in quarters	1975 Recession			1981-82 Recession	
	Price Increase	Decrease	Recovery	Price Increase	Decrease
	1972Q1-74Q2	1974Q3-75Q4	1976Q1-77Q2	1978Q4-80Q4	1981Q1-82Q4
Commodity prices: (Percentage change)					
<u>Cumulative</u>					
All: nominal	131	-23	56	36	-28
Food	161	-24	-4	76	-43
Beverages	78	1	256	-17	-1
Agricultural raw materials	130	-24	32	25	-17
Metals	129	-36	17	33	-21
All: real 2/	57	-30	40	4	-26
<u>Annual rate</u>					
All	40	-16	34	12	-18
Food	57	-17	-2	29	-25
Beverages	26	1	129	-8	-1
Agricultural raw materials	40	-16	21	10	-15
Metals	39	-26	11	14	-11
Major determinants: Percentage change					
<u>Cumulative</u>					
Industrial production	19	-12	14	11	-9
United States	20	-13	16	9	-11
Europe	13	-9	11	10	-12
Japan	28	-17	13	23	3
WPI	40	10	12	30	12
United States	35	16	9	32	8
Europe	44	6	20	28	19
Japan	53	5	5	26	3
Exchange rate	-10	2	2	-1	20
Europe	-17	2	9	-4	49
Japan	-22	8	-9	9	23
Oil price	362	12	6	149	1
<u>Annual rate</u>					
Industrial production	7	-8	9	5	-4
United States	8	-9	10	4	-4
Europe	5	-6	7	4	-5
Japan	10	-12	10	10	1
WPI	14	7	8	12	6
U.S.	13	10	6	13	3
Europe	16	4	13	12	9
Japan	18	3	3	12	2
Exchange rate	-3	2	1	-1	16
Europe	-5	2	6	-2	22
Japan	-7	6	-6	4	11
Oil price	88	8	4	68	3

1/ The periods for the commodity price indices. In the case of the explanatory variables, the periods chosen for various phases of the two cycles are the same as for the commodity prices except for the following:

(a) Industrial production. (i) The 1975 recession: Increase (1971Q3-1973Q4); decrease (1974Q1-1975Q2); and recovery (1975Q3-1976Q4). (ii) The 1981-82 recession: Increase (1976Q1-1980Q1); decrease (1980Q2-1982Q4).

(b) Exchange rate. The 1975 recession: Increase (1971Q2-1974Q2).

2/ Deflated by the UN index of manufactures prices.

The long-term upward trend of commodity prices in nominal terms has been sharply steeper since the early 1970s, reflecting higher world inflation, while, in real terms, the long-term downward trend of commodity prices has been steeper, reflecting higher and sustained inflation of manufactures prices as well as their downward rigidity. The variation in commodity prices has been sharply larger since the early 1970s as a result of the greater instability of the economic environment in the 1970s. The preceding analysis focused largely on the characteristics of the behavior of commodity prices during 1972-82 as a whole, compared with those during 1957-71. The analysis therefore has not focused specifically on price developments in very recent years. A close examination of the price decline in 1981-82 and the price increase preceding the decline will help illustrate how commodity prices move as a consequence of movements of the underlying factors studied in this paper.

f. Comparison of the 1975 and the 1981-82 recessions

In this section the commodity price cycle of 1979-82 is analyzed and compared with the previous major price cycle of 1972-76. The commodity price declines of 1981-82 and 1975 were both preceded by relatively large commodity price increases, but the increase preceding 1975 was far greater. Although both increases occurred over seven quarters, the cumulative increase preceding the 1975 decline was 131 percent compared with 30 percent preceding 1981-82. Movements of the explanatory variables are consistent with the greater strength of the pre-1975 commodity price boom. Industrial production rose by a cumulative 19 percent in 1973-74 compared with 11 percent for 1979-80, and inflation by a cumulative 40 percent compared with 30 percent. The U.S. dollar depreciated by a cumulative 10 percent prior to 1975 compared with no change prior to 1981-82 and the oil price increased by 382 percent compared with 149 percent (Table 10). The real interest rate (Eurodollar rate) declined by 9.8 percentage points prior to 1975 compared with an increase of 11.2 points in 1979-80, which also is consistent with a stronger commodity price boom for pre-1975.

The period of commodity price decline was six quarters for 1975 and eight quarters for 1981-82. The cumulative decline for the first period was 23 percent and for the second 28 percent. Industrial production declined by a cumulative 12 percent during the 1975 recession and by 9 percent during 1981-82, indicating that economic activity appears to have been a more important factor with respect to the 1975 decline. The WPI increased by 10 percent in the earlier period compared with 12 percent in the latter period. The U.S. dollar appreciated by 2 percent during the 1975 recession, while it appreciated by 20 percent during 1981-82, indicating a significantly greater impact on commodity prices in the latter period. The real interest rate increased by 8.7 percentage points during the 1975 recession, while it has declined by 4.8 points during 1981-82. Real interest rates, however, were at significantly higher levels in 1981-82 compared with negative rates during 1975.

The commodity price recovery in 1976-77 lasted six quarters, during which prices increased by 56 percent. During this same period, industrial production increased by 14 percent and inflation by 12 percent. The U.S.

dollar depreciated by 2 percent and the real interest rate declined by 12.9 percentage points. The strong recovery in economic activity was accommodated by a rather expansionary monetary policy.

In Table 12, major demand-side factors that have been identified as determinants of commodity prices are used to "simulate" the changes in the aggregate index of commodity prices during the various phases of the two commodity price cycles around the 1975 and the 1981-82 recessions.

For the price cycle around the 1975 recession, the demand-side variables produce a path of commodity prices roughly similar to the historical path. The model based on the demand-side variables, however, substantially underpredicts the price increases during the pre-recession period and during the recovery period. This probably results from the fact that, as indicated in the right half of the table, supply shocks for beverages substantially reinforced the demand-side variables during the two phases of the cycle. During the entire phase of the cycle, economic activity and inflation dominated the exchange rate as causes of the price movements; however, inflation was more important for the price increase preceding the recession, but economic activity was relatively more important for the price increase following the recession. There is an indication that supply shocks for food were also responsible for the price increase preceding the recession. There is a fairly strong indication that supply shocks for food reinforced the demand side variables during the recession, and similar shocks for beverages played the same role during the recovery period.

For the part of the cycle that resulted in the 1981-82 price decrease, the demand-side variables overpredict both the price increase and the subsequent decrease. The simulated path, however, is fairly close to the actual path of prices. A notable aspect of the result is the role played by the exchange rate in the price decrease. Unlike the 1975 recession, the exchange rate movements seem to have dominated the other two demand-side variables in the decline of commodity prices.

IV. Conclusions

The results of this study demonstrate that the behavior of non-oil primary commodity prices underwent a significant change in the 1970s. Both the level of nominal commodity prices and the degree of price instability increased markedly in the 1970s by comparison with the 1960s. The major variables identified in this study that are shown to have some power in explaining this changed behavior are the level of economic activity, world inflation, the U.S. dollar exchange rates vis-à-vis other major currencies and supply shocks. There is also some evidence to support the hypothesis that changes in interest rates inversely affect commodity prices. The limitations of this study previously explained should be noted when considering these results. In particular, the implications of commodity price fluctuations for world inflation have not been dealt with in this paper.

Table 12. Two Recessions and Commodity Prices (2)

	Percentage Change in Commodity Prices		Demand Side Variables				Supply Shocks				
	Actual	Simulated*	Trend	Contributions Made by Major Factors			Excess or Shortfall (-) in Annual Percentage Change in Production 1/				
				Economic Activity	Inflation	Exchange Rate	Food	Beverages	Agricultural Raw Materials	Metals	
<u>(1975 Recession)</u>											
Price Increase	131	78	-22	30	48	12	Price Increase	-21	-7	1	4
Decrease	-23	-28	-13	-25	12	-2	Decrease	4	-4	-4	-5
Recovery	56	28	-13	29	14	-2	Recovery	3	-21	-1	2
<u>(1981-82 Recession)</u>											
Price Increase	30	39	-20	23	36	0	Price Increase	-3	-2	1	-1
Decrease	-28	-44	-18	-19	17	-24	Decrease	3	13	2	n.a

* Based on the historical movements of the explanatory variables in Table 12 and the estimated coefficients summarized in Table 10. Simulated change in price is the sum of the contribution made by major factors. The contributions made by major factors are calculated as the product of the change in the variable multiplied by the associated coefficient.

1/ Actual rate of change in production in excess or below the long-term average rate of change in production. For the cycle around the 1975 recession, the periods used for the production figures are: (i) 1972-73 for price increase; (ii) 1975 for price decrease; and (iii) 1976 for recovery. For the cycle around the 1981-82 recession, the periods are: (i) 1979-80 for price increase; and (ii) 1981 for price decrease.

Commodity prices during 1981-82 have experienced the largest cumulative decline (25 percent) and the most protracted length of decline (8 quarters) in the last three decades. Real commodity prices in 1981 reached the lowest level in the postwar period and in 1982 declined by a further 11 percent to a level 16 percent below that reached in the 1975 recession. Compared with the commodity price decline during the 1975 recession, the 1981-82 decline appears to have been caused relatively more by exchange rate movements. Economic activity had a strong influence on commodity prices in both recessions, but somewhat greater in 1975. Interest rates appear to have exerted relatively more influence in the 1981-82 recession.

The sharp decline in commodity prices during 1981-82 is shown to be a culmination of a more unstable pattern that began in the early 1970s. The long-term downward trend in real commodity prices from 1972 to 1982 has been more than twice that from 1957 to 1971. In addition, the degree of instability of primary commodity prices from 1972 to 1982 has been more than three times that of the 1957-71 period, as fluctuations in world economic activity, inflation, exchange rates, and interest rates have also been significantly more pronounced.

Table 1. Sample Commodities

Commodities	Weights Used to Aggregate Prices ^{1/}	
All	<u>100.0</u>	
Food	<u>31.4</u>	100.0
Oils & oilseeds		<u>27.1</u>
Groundnut oil		7.2
Copra		7.1
Groundnut cake		4.7
Fish meal		4.5
Palm oil		2.7
Soybean meal		0.5
Soybeans		0.4
Cereals		<u>25.7</u>
Maize		10.1
Wheat		8.3
Rice		7.3
Sugar		<u>21.1</u>
U.S.		10.1
Free market		7.5
EEC		3.5
Meat		<u>18.5</u>
Beef		14.1
Lamb		4.4
Bananas		<u>7.6</u>
Beverages	<u>18.2</u>	100.0
Coffee		<u>67.1</u>
Robusta		34.8
Other milds		32.3
Cocoa		<u>19.7</u>
Tea		<u>13.2</u>
Agricultural raw materials	<u>22.5</u>	100.0
Cotton		<u>34.2</u>
Medium		23.1
Long		11.1
Wool		<u>28.7</u>
Fine		21.3
Coarse		7.4
Rubber		<u>23.1</u>
Hides		<u>8.0</u>
Jute		<u>4.0</u>
Sisal		<u>2.0</u>
Metals	<u>27.9</u>	100.0
Copper		48.6
Iron ore		20.8
Tin		11.0
Aluminum		10.2
Zinc		3.7
Nickel		3.0
Lead		2.7

^{1/} based on the shares in the value of exports by developing countries in 1968-70.

Table 2. Determinants of Commodity Price Movements ^{1/}
(1958-1982)

Dependent Variables: Changes in Price of	Sample Period	Explanatory Variables: Changes in								R ²	DW	SFE
		Constant	Lagged Price	Economic Activity	WPI	Exchange Rate	Interest Rate Changes	Supply Shocks				
								Food	Beverages			
All commodities												
	1958-82	-0.028** (-4.66)	0.085 (0.90)	1.299** (5.41)	1.730** (5.45)	-0.919** (-2.92)	-0.004 (-1.75)	-0.017 (-0.80)	-0.061* (-2.16)	0.462	1.78	0.038
	1958-71	-0.013* (-2.58)	0.013 (0.10)	0.556* (2.35)	1.488* (2.16)	-0.492 (-0.68)	-0.009 (-1.97)			0.141	1.97	0.023
	1972-82	-0.049** (-3.14)	0.034 (0.23)	1.719** (4.06)	2.325** (3.79)	-1.068* (-2.37)	-0.003 (-1.06)	-0.029 (-0.97)	0.071 (1.81)	0.514	1.67	0.051
Food												
	1958-82	-0.032** (-3.39)	0.075 (0.74)	0.939* (2.46)	2.399** (4.99)	-1.135* (-2.18)	-0.000 (-0.08)	-0.047 (-1.35)		0.293	1.93	0.061
	1958-71	-0.007 (-0.96)	-0.028 (-0.20)	0.511 (1.52)	0.732 (0.78)	0.294 (0.26)	-0.007 (-1.22)			--	1.87	0.035
	1972-82	-0.091** (-3.77)	-0.047 (-0.30)	0.747 (1.09)	4.370** (4.60)	-1.716* (-2.26)	0.003 (0.56)	-0.064 (-1.39)		0.408	1.95	0.080
Beverages												
	1958-82	-0.017 (-1.32)	0.230* (2.15)	0.901 (1.74)	0.939 (1.51)	0.427 (0.65)	-0.004 (-0.86)		-0.135* (-2.00)	0.155	1.84	0.001
	1958-71	0.003 (0.31)	0.172 (1.21)	-0.426 (-0.88)	-0.034 (-0.03)	-0.883 (-0.60)	-0.011 (-1.27)			0.013	1.85	0.007
	1972-82	-0.021 (-1.62)	0.201 (1.19)	1.889 (1.94)	0.983 (0.794)	0.472 (0.492)	-0.005 (-0.739)		-0.138 (1.40)	0.147	1.90	0.118
Agricultural raw materials												
	1958-82	-0.018* (-2.32)	0.307** (3.22)	1.471** (4.55)	0.714 (1.90)	-1.005** (-2.65)	-0.007* (-2.50)			0.412	1.86	0.007
	1958-71	-0.020** (-2.83)	0.210 (1.77)	1.036** (3.11)	1.087 (1.18)	-1.122 (-1.10)	-0.015* (-2.50)			0.218	1.85	0.033
	1972-82	-0.005 (0.23)	0.257 (1.60)	2.142** (3.48)	0.026 (0.04)	-0.293 (-1.95)	-0.007 (-1.99)			0.473	1.89	0.039
Metals												
	1958-82	-0.926* (-2.60)	0.083 (0.84)	1.459** (3.67)	1.585** (3.19)	-1.809** (-3.66)	-0.008* (-2.19)			0.266	1.96	0.003
	1958-71	-0.021 (-1.06)	0.037 (0.27)	0.875 (1.41)	2.983 (1.69)	-0.313 (-0.16)	-0.003 (-0.24)			0.016	1.97	0.062
	1972-82	-0.032 (-1.51)	0.079 (0.51)	1.731** (3.00)	1.666 (2.03)	-1.905** (-3.38)	-0.009* (-2.07)			0.385	1.93	0.008

1/ The level of significance is indicated by one (95 percent) or two (99 percent) asterisks.

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