RICHARD N. COOPER
Yale University
ROBERT Z. LAWRENCE
Brookings Institution and Yale University

The 1972–75 Commodity Boom

AN EXTRAORDINARY increase in commodity prices occurred in 1973–74. Even leaving aside crude oil as a special case, primary commodity prices on one index more than doubled between mid-1972 and mid-1974, while the prices of some individual commodities, such as sugar and urea (nitrogenous fertilizer), rose more than five times. While the timing differed from commodity to commodity, the sharp upward movement was widespread, affecting virtually all commodities. Most rose dramatically to twenty-year highs, and many went to historical highs. (This is not the innocuous statement it would be for manufactures, whose prices have been subject to a slow upward creep; many commodities had lower prices in 1970 than they did in 1953.)

The sharp rise in commodity prices startled most observers, for it came on the heels of apparent oversupply in 1970–71, and it fed recently aroused concerns about long-term commodity shortages, seeming to confirm the gloomy forecasts of the "eco-doomsters." *The Limits to Growth*,[1] which forecast the ultimate collapse of the world system with unrestrained growth, was published with much fanfare in 1972, and together with the subsequent run-up of commodity prices, seemed to herald the arrival of a Ricardian economy in which growing population and output of manufactured goods would press on a limited resource base.

In addition, the commodity boom came at a time of heightened concern about inflation. The general price level in the United States accelerated

1. Donella H. Meadows and others, *The Limits to Growth* (Universe Books, 1972).

from virtual stability before 1966, and consumer prices continued to rise at the higher rates right through the recession of 1970–71. Thus, the boom of 1973–74 in commodity prices perhaps both reflected and reinforced inflationary expectations.

Then, from their peaks in late 1973 or early 1974, commodity prices, oil and some foods excepted, fell almost as dramatically as they had risen, though generally not back to pre-1972 levels.

Interesting tales can be told about many of the individual commodities—the special circumstances that led to the rise in prices and to the subsequent fall. Bad weather reduced harvests of many crops here and there around the world, labor disruptions curtailed mine output, several important materials-producing countries were subject to political unrest, newly rich Arabs were buying disproportionately large amounts, and so on. But the movement in commodity prices was quite general, and while these stories are intriguing and sometimes significant, they do not fill the need for some general explanation—a common cause, or strong linkages among the commodities affected.

The purpose of this paper is to analyze the 1972–75 movements in commodity prices in the light of historical experience, with a view to establishing how much can be explained by conventional economic analysis of the general demand for and supply of industrial raw materials. (Except for some general description, foodstuffs and petroleum will be excluded.) We will then discuss the extent to which the remaining, "unexplained," part of the price movements can be reasonably attributed to "speculative" or inflation-hedging demands for commodities. The last part of the paper briefly addresses the social costs of sharp and erratic movements in commodity prices and considers the pros and cons of policies to limit such movements, with special emphasis on the management of buffer stocks.

The Commodity Boom

Prices for most primary commodities began to rise rapidly in 1972, although a few took off in 1971; they hit their peaks in the summer of 1973 or, in the case of many metals, in the spring of 1974, with some of the agricultural products having a second peak, typically lower than the first, in early 1974. The *Economist* dollar index of twenty-eight commodities, heavily influenced by copper, coffee, sugar, beef, and grains, hit its high in May

1974, 115 percent above the level of two years earlier, and then declined irregularly by 21 percent by June 1975, when it began rising again.[2] Prices of industrial materials, with which we shall be concerned here, rose 127 percent over two years to their peak in April 1974, then declined by 40 percent by June 1975.

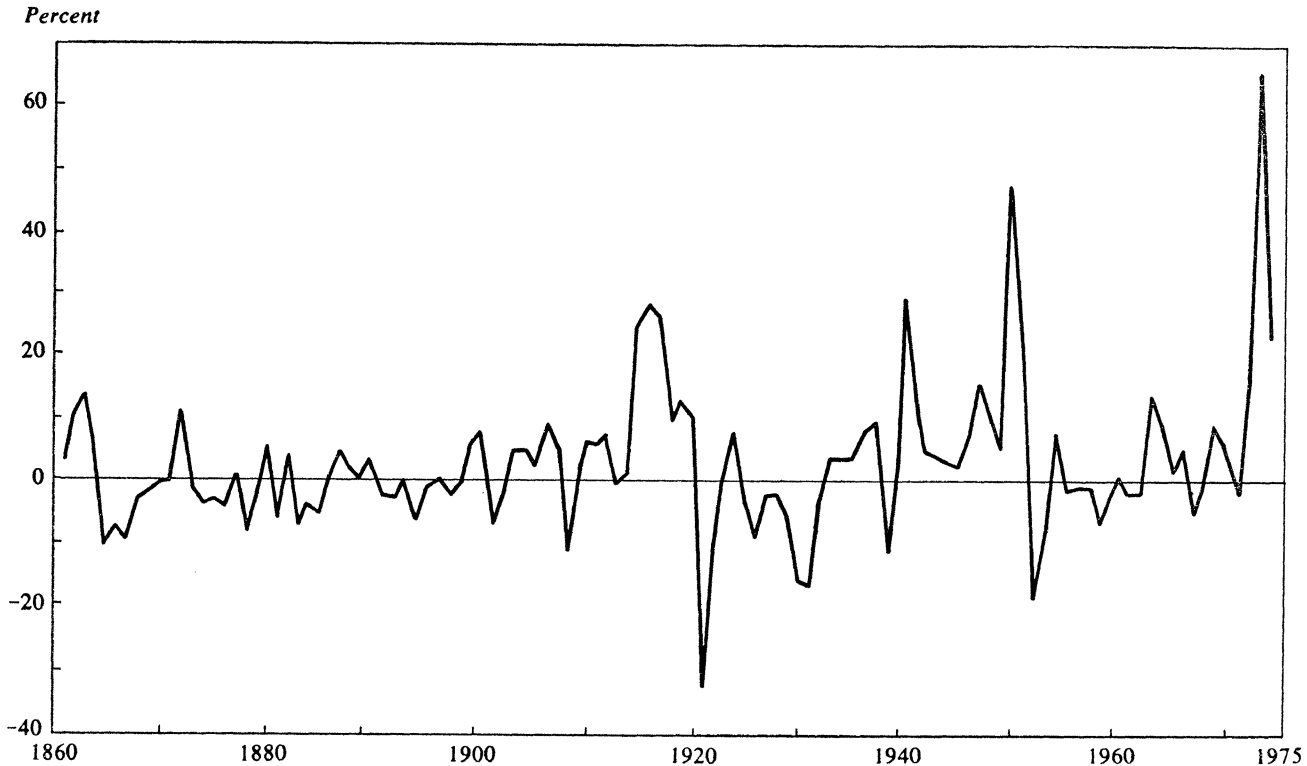
These are extraordinary changes. During the 115 years that the *Economist* index for all commodities (including foodstuffs, but excluding fuels) has been compiled, in no year have commodity prices risen as rapidly (63 percent) as they did from 1972 to 1973 and in no three-year period have they risen as rapidly (159 percent) as in 1971–74. The closest year-to-year change came in 1949–50 (48 percent) and the closest three-year increase in 1914–17 (101 percent). The largest annual decline in the index during the Great Depression was only 17 percent, although a drop of 33 percent occurred between 1920 and 1921. Thus, the recent commodity boom and bust is striking not merely against the relatively stable background of the preceding twenty years, but even across a much longer perspective, encompassing the late-nineteenth-century heyday of price flexibility (see figure 1).

A composite index typically involves offsetting movements among its components, and for a number of commodities the price movements in 1972–75 were reminiscent of, and no larger than, those before the Second World War. But the recent movement, like that of the Korean War boom, was noteworthy for its generality as well as for the magnitude of individual price changes. Not all components moved in perfect parallel. As figure 2 shows, the prices of agricultural raw materials peaked well before the prices of nonferrous metals; and the prices of the main foodstuffs declined months after the metals.

The period under consideration contained several developments that may help to explain the strength of the commodity-price boom. The overall rate of inflation in the United States, already high in the recession-ridden early seventies, accelerated in 1972 and 1973. Similar acceleration occurred in most other countries, stimulated in part by large U.S. balance-of-payments deficits in 1971 and 1972 that flooded the world with international reserves in the form of dollars. These U.S. deficits generated monetary expansion directly in those countries that, by choice or necessity, did not sterilize the monetary impact of the inflows, and removed the balance-of-

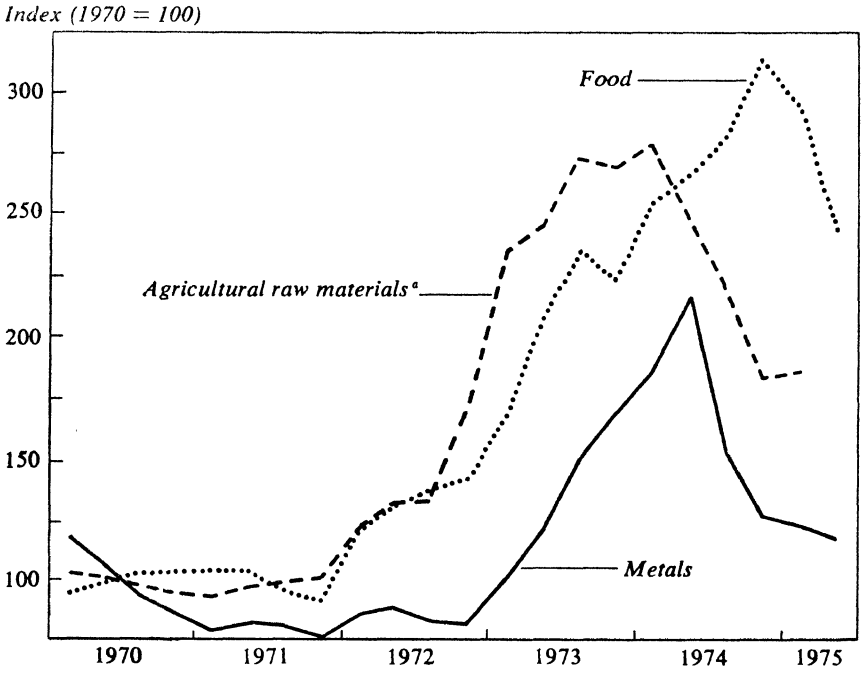
2. The *Economist* commodity price indexes for 1860–1975 used in this section appear in *Economist*, vol. 248 (July 7, 1973), pp. 70–71; vol. 250 (March 2, 1974), pp. 86, 87; and vol. 256 (September 6, 1975), pp. 80–81.

Figure 1. Annual Change in *Economist* Index of Commodity Prices, 1861–1974



Sources: Calculated from indexes (1845–50 = 100) in *Economist*, vol. 250 (March 2, 1974), pp. 86–87, and vol. 256 (September 6, 1975), p. 81.

Figure 2. Major Components of the *Economist* Index of Commodity Prices, Quarterly, 1970–75



Sources: The index for prices of food, metals, and fibers appears in *Economist*, vol. 248 (July 7, 1973), pp. 70–71, and vol. 256 (September 6, 1975), p. 81; and the price indexes for hides and rubber are from United Nations, Statistical Office, unpublished tabulation (October 29, 1975).

a. The index for agricultural raw materials was constructed from the *Economist* index for fibers and from the hides and rubber components of the United Nations index of commodity prices.

payments constraint usually present for many other countries, thereby permitting domestic monetary expansion.

This period also saw the movement to flexible exchange rates, briefly in 1971, then more generally after a second devaluation of the dollar in February 1973. The abandonment of fixed rates of exchange was followed by wide swings in several important exchange rates. For example, while the dollar depreciated against the German mark by 36 percent between January 1973 and June 1975, this general trend was punctuated by an appreciation of the dollar against the mark by 11 percent in the last quarter of 1973. Average daily changes in the dollar-mark rate exceeded 0.8 percent in the third quarter of 1973. The high variability of exchange rates during

this period raises the possibility that much of the demand for commodities in 1973 was designed to hedge against currency uncertainties. We address this issue below.

Analyzing the general movement of commodity prices requires some summary indexes. We have chosen the commodity price indexes published by *The Economist*. As noted above, they have the advantage of maintaining a rough comparability over a long period of time. They are composed of sensitive—that is, flexible—prices, so they exclude the various administered prices such as those for oil or aluminum. And they adopt a global, rather than merely an American, perspective: they take prices from the most important market, wherever it may be. The *Economist* indexes include an overall measure covering twenty-eight commodities, a food index, and an index of industrial materials covering eighteen commodities that in turn is broken down into indexes for metals, fibers, and miscellaneous industrial materials (mainly rubber and hides).[3] These indexes are highly correlated with the corresponding components of the more comprehensive United Nations index of commodity prices,[4] and with the prices of thirteen sensitive raw materials in the U.S. wholesale spot market, compiled by the U.S. Department of Labor. It is less well correlated with the "industrial materials" component of the U.S. wholesale price index because the latter includes many items that are not raw materials and some products that are subject to administered pricing; these factors deprive the index of considerable sensitivity that the *Economist* measures have to changes in business or other factors.[5]

3. The leading commodities of the industrial-materials index (with percentage weights in the most recent version) are as follows: copper (34.5 percent), wool (15.1 percent), cotton (14.5 percent), rubber (7.1 percent), zinc (6.6 percent), tin (5.4 percent), lead (4.2 percent), and hides (3.8 percent). *Economist* (September 6, 1975), p.80.

4. For a comparison between the price indexes compiled by the United Nations and by *The Economist*, see J. B. Dearman, "World Commodity Prices," *Economic Trends*, no. 247 (May 1974) (London: Her Majesty's Stationery Office), pp. vi–x.

5. The correlation matrix between indexes of commodity prices (quarterly observations) for 1954–74 appears at the end of this note.

The matrix is calculated from the all-items commodity index and the industrial-materials index in *Economist* (July 7, 1973), p. 70, and (September 6, 1975), p. 81; the index of commodities on the wholesale spot market in *Survey of Current Business*, various issues; the primary-commodities index, 1954–69, in United Nations, Department of Economic and Social Affairs, *Price Movements of Basic Commodities in International Trade: 1950–1970*, Statistical Papers, series M, no. 29, rev. 1/add. 1 (U.N., 1971), p. 7, and 1970–74, in United Nations, Statistical Office, unpublished tabulation (October 29, 1975).

The presence of general inflation complicates the interpretation of price movements for any subset of goods and services. Absolute movements in commodity prices are pertinent for their impact on prices of finished goods through cost and on inflationary expectations. On the other hand, relative price movements are pertinent to resource allocation, serving as signals to producers and consumers. While this paper deals with both aspects, the bulk of the analysis focuses on relative prices, since we are concerned with only a small sector of the total economy and rely on a standard formulation that explains relative price movements. We therefore deflate our commodity-price series by the United Nations price index for exports of manufactured goods. This index can be interpreted crudely as an indicator of changes in the long-run nominal supply price (at constant real cost) of commodities, especially capital-intensive mineral commodities, on the assumption that the secular change in productivity for materials is similar to that for manufacturing. In other words, we use it as a general index of inflation applicable to internationally traded goods.

Figure 3 illustrates the relative price movements from 1950 to 1975 in the three major components of the *Economist* commodity index.

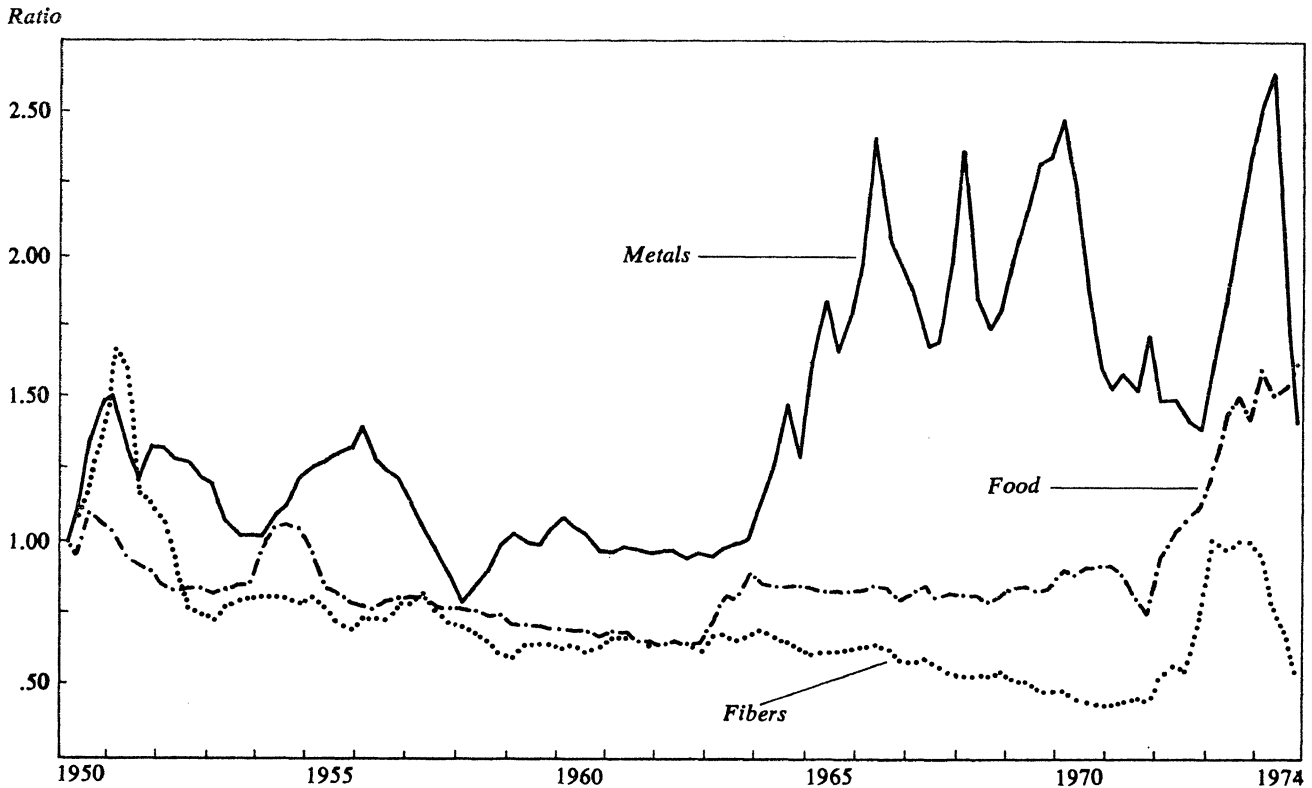
Our indexes measure prices in terms of dollars, a point of consequence only during the recent period of frequent changes in exchange rates. We will comment later on the biases that may arise from using dollars rather than some other currency. But focusing the analysis on a relative price index has the advantage of avoiding the problem of exchange rates in measurement, since both numerator and denominator are in dollars and movements in the dollar exchange rate cancel out in the ratio of primary prices to prices of manufactured goods.

Index	Economist, *all items*	*United Nations, primary commodities*	Economist, *industrial materials*	*U.S. wholesale spot market (13 raw materials)*
Economist, all items	1.00			
United Nations, primary commodities	0.96	1.00		
Economist, industrial materials	0.95	0.87	1.00	
U.S. wholesale spot market (13 raw materials)	0.97	0.96	0.96	1.00

(Values greater than 0.219 are significant at the 95 percent level.)

Figure 3. Relative Prices of Major Components of the *Economist* Commodity Index, Quarterly, 1950–74

Ratio of *Economist* commodities index to U.N. index of exports of manufactured goods



Sources: *Economist* (July 7, 1973), pp. 70–71, and (September 6, 1975), p. 81; United Nations, Department of Economic and Social Affairs, *Monthly Bulletin of Statistics*, various issues.

Commodity Prices and Demand and Supply

The leading explanation for the sharp rise and subsequent fall in commodity prices is that the world economy experienced an unprecedented boom in 1972–73, followed by the recession—the worst since the 1930s—of 1974–75. Figure 4 shows the relationship of commodity prices to OECD industrial production over the period 1954–74. While individual countries on occasion have had economic expansions more rapid than that in 1972–73, that period is unusual in the past three decades in that economic expansion was closely in phase in the three major industrial areas of the United States, Western Europe, and Japan. The conjunction of expansions in the three areas, it was said, put exceptional pressure on raw-materials prices.

For the "base line" needed to test this proposition, we turned to a simple demand-determined model of raw-materials prices to be estimated over the period 1950–74.

One simple model suggests that the relative price of a given commodity or group of commodities, relative to its long-term trend, is a function of the ex ante excess demand for that commodity, $(p - \bar{p})/\bar{p} = h(D^* - S^*)$, where p is the price of the commodity relative to some general level of prices, $\bar{p}$ is the trend relative price of the commodity, D^* is the ex ante demand for the commodity at price $\bar{p}$, and S^* is the ex ante supply of the commodity at price $\bar{p}$. To concentrate on the cyclical aspects of price movements, this relationship can be rewritten with demand and supply also taken as deviations from their respective trends, and normalized around the trends so that scale alone does not influence the percentage deviation of price from its trend:

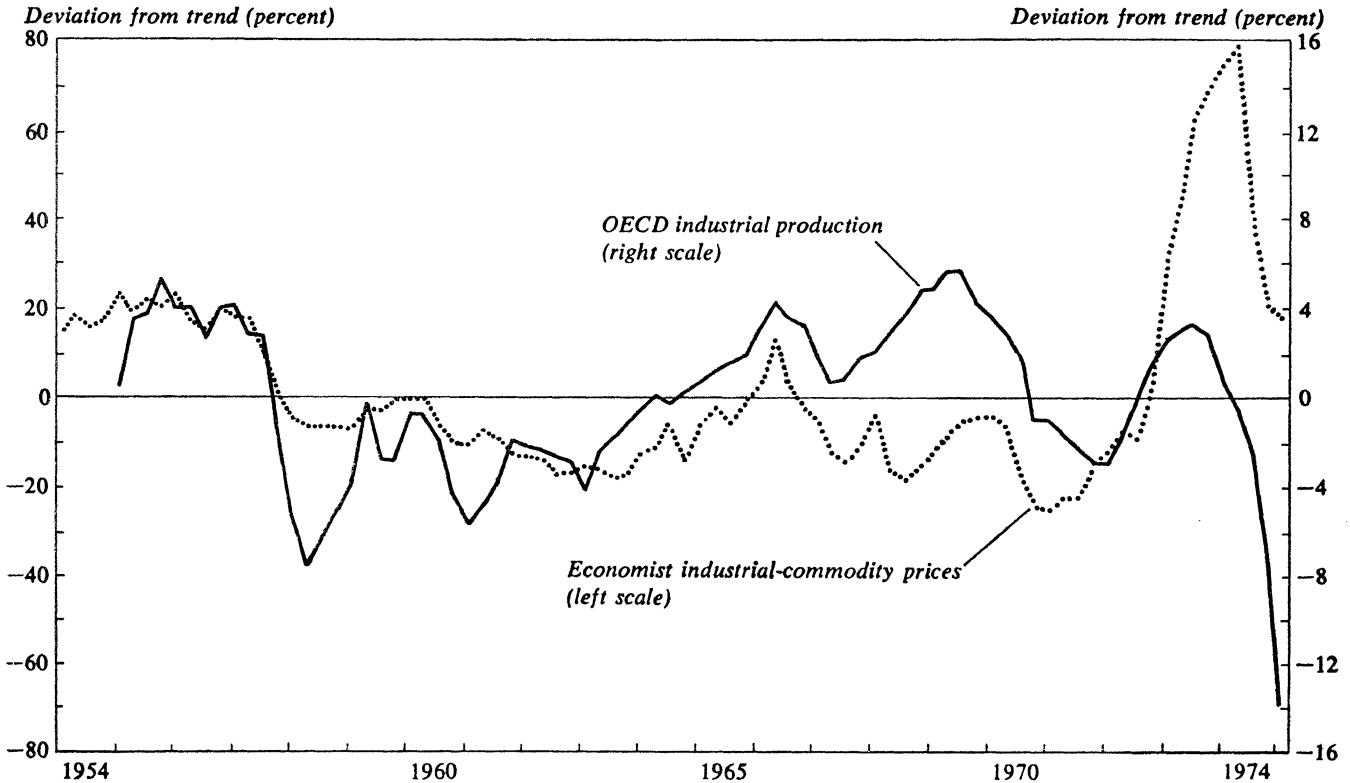
$$\frac{p - \bar{p}}{\bar{p}} = h\left[\left(\frac{D^* - \bar{D}}{\bar{D}}\right) - \left(\frac{S^* - \bar{S}}{\bar{S}}\right)\right]. \tag{1}$$

Since the price variable is taken as a deviation from its trend, the trend values of demand and supply, $\bar{D}$ and $\bar{S}$, respectively, can be assumed equal, assured by the required movement in trend prices. This permits concentration on the cyclical aspects of the problem. Moreover, since we want to focus first on the demand hypothesis, we will suppose not only that $\bar{D} = \bar{S}$ but also that actual supply is equal to trend supply, an assumption that will be relaxed later.

A specific variant of equation 1 is:

$$P = aD + (\text{sign}D)\, bD^2 + c(dD/D), \tag{2}$$

Figure 4. Deviation from Trend of OECD Industrial Production and *Economist* Index of Prices of Primary Industrial Commodities, Quarterly, 1954–75



Sources: Organisation for Economic Co-operation and Development, *Industrial Production, 1955–1971* (Paris: OECD, 1973), p. 220; OECD, *Industrial Production, Quarterly Supplement to Main Economic Indicators, 1975–3*, p. 8; *Economist* (July 7, 1973), p. 70, and (September 6, 1975), p. 81; United Nations, Department of Economic and Social Affairs, *Price Movements of Basic Commodities in International Trade: 1950–1970*, Statistical Papers, series M, no. 29, rev. 1/add. 1 (UN, 1971); and United Nations, Statistical Office, unpublished tabulation (October 29, 1975).

where P and D designate the deviation from trend of relative prices and of ex ante demand, respectively. Equation 2 says that the deviation of price from its trend values depends linearly on the extent of ex ante excess demand; on that variable squared (and adjusted for sign, so a negative deviation enters negatively) to capture a possible nonlinearity in the relationship; and on the percentage change in demand from the preceding period, to capture any acceleration effect—that is, to allow for the possibility that an exceptionally rapid change in demand leads to a larger deviation from trend price than a slow change in demand does.

Any ex ante excess demand must be eliminated either by an unplanned supply response, such as the running down of stocks, or by changes in price to assure equality between ex post supply and demand. The formulation in equation 2 assumes that all the adjustment is made in price—that actual prices move so as to eliminate any ex ante excess demand. We address the question of stocks below, but for the most part they are neglected in the formal analysis.

Equation 2, along with a variant that allows explicitly for supply effects, provides the main basis for our price analysis. We also try an alternative formulation that explains percentage changes in prices rather than deviations of the price level from its trend. Variables similar to those in equation 2 can be invoked in this alternative formulation.

We have no direct measure of ex ante demand. However, in the short run the demand for raw materials may be assumed to respond mainly to the growth in output of finished goods that use the materials, and more particularly to industrial production (a variable that includes construction materials). We therefore use industrial production as our proxy measure for ex ante demand for raw materials. There has been a long-term decline in the ratio of materials inputs into manufacturing output, but that phenomenon is taken care of by defining the demand variable relative to its trend.[6]

The influence of materials prices on total industrial production is likely to be small and protracted, so this possible feedback effect is neglected in our analysis. The change in materials prices is presumed to alter the short-

6. The elasticities at the mean of OECD consumption of the principal nonferrous metals with respect to OECD industrial production over the period 1955–74 are as follows: primary aluminum, 1.6; copper, 0.72; zinc (slab), 0.84; tin. 0.37; lead (refined), 0.64. See Metallgesellschaft Aktiengesellschaft, *Metal Statistics, 1961–1971* (Frankfurt: MAG, 1972), and ibid., *1952–1961* (1962); American Metal Market, *Metal Statistics, 1975* (Fairchild, 1975), and relevant preceding issues.

run input-output relationship enough to eliminate excess or deficient demand for materials.

DEMAND FACTORS

The standard formulation of demand for raw materials in the United States focuses on U.S. industrial production. We add industrial production in Western Europe and Japan (which will be called "other OECD" here) as a separate explanatory variable in order to get a better measure of world demand and to test the independent contribution of production in the rest of the world to raw-materials prices. Other OECD effectively represents the net impact of the rest of the world since the Soviet Union is relatively self-sufficient in materials,[7] and other omitted countries account for only a minor portion of world industrial production. Separating the two components of "world" industrial production may be justified on the grounds that the composition of output and the techniques of production differ somewhat between the United States and other industrial countries, so that a given change in industrial production could call for differing amounts of raw materials.

In fact, U.S. industrial production dominates cyclical movements in the series for total OECD or world industrial production. This is because the United States, which has a large weight in the production totals,[8] has experienced much larger variations in production than has Europe as a whole or Japan.[9] Thus, the simple correlation over the period 1950–74 between deviations of U.S. industrial production (quarterly) from its trend and deviations in "total" industrial production (U.S. plus other OECD as defined here) from its trend was 0.90, indicating a strong parallelism between move-

7. The eastern trading area (USSR, China, Hungary, Poland, North Korea, North Vietnam, Albania, Bulgaria, Czechoslovakia, German Democratic Republic, Romania, Mongolia) has been a modest net exporter of nonferrous metals to the rest of the world, accounting for 1 to 2 percent of the value of world trade in these markets. See General Agreement on Tariffs and Trade, *International Trade, 1974/75* (Geneva: GATT, 1975), appendix table E.

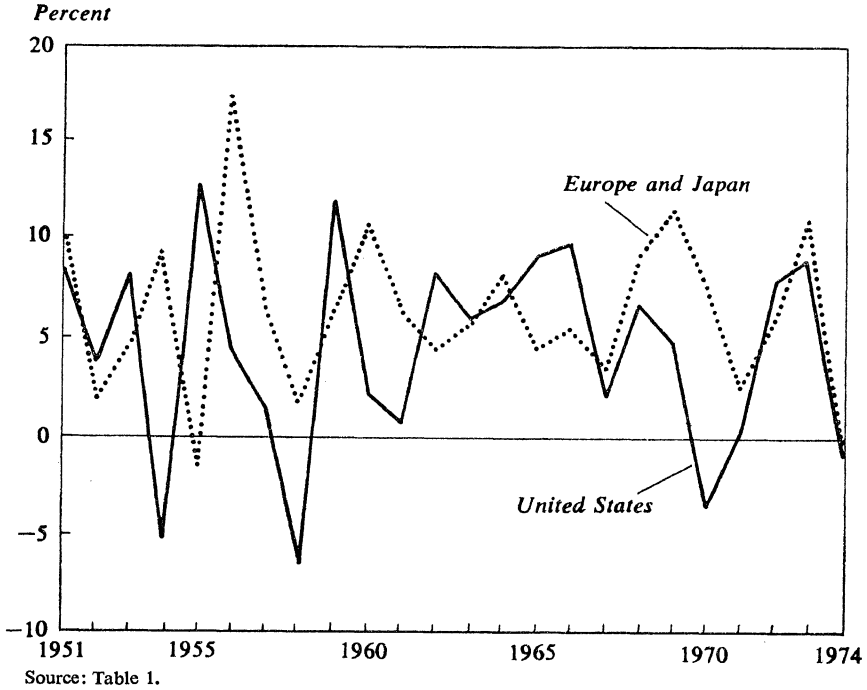
8. The weights in the OECD industrial production index are as follows:

	United States	*Japan*	*Europe*
1960	52.9	5.3	38.3
1970	42.9	11.6	40.4

Source: OECD, *Industrial Production, Third Quarter 1965, Supplement to Main Economic Indicators*, p. 8, and *Industrial Production, 1974-1, Quarterly Supplement to Main Economic Indicators*, p. 8.

9. The standard deviation of deviations of production from trend is 5.38 for the United States and 2.96 for Europe and Japan combined.

Figure 5. Annual Percentage Changes in Industrial Production, United States and OECD European Countries and Japan, 1951–74



Source: Table 1.

ments in the total and in its U.S. component. In contrast, the correlation between the United States and Europe was −0.13 and between the United States and Japan was 0.11. Industrial production in those two areas tended to lag behind that in the United States by two to three quarters, although even with allowance for these lags, the correlations remain small.

As figure 5 shows, industrial production in the two major areas was out of phase in the earlier years, thus helping to relieve the pressure on markets for raw materials during both upswings and downswings of business activity, although, as noted, the compensation was far from complete because U.S. swings tended to be much larger. In the later years, however, there was much greater convergence in business activity; the simple correlation in deviations from trend between the United States and Europe was 0.68 during 1970–74 so that the offsetting effects on raw-materials demand was largely lost.

But, even with this greater synchronization, the question remains: how did the cyclical expansion of 1972–73 compare with that of the preceding two decades?

Table 1. Annual Growth Rate of Industrial Production and Deviation from Trend, by Major Industrial Area, 1950–74

Percent

Year	Growth from preceding year				Deviation from trend	
	United States	*OECD European countries and Japan*[a]	*OECD European countries, Japan, and United States*[a]	*World*	*OECD European countries, Japan, and United States*	*World*
1950	...	...	...	...	0.1	−2.6
1951	8.5	10.2	9.1	11.1	3.7	1.5
1952	3.9	2.0	3.1	6.7	1.5	1.6
1953	8.3	4.9	6.9	6.3	3.0	1.2
1954	−5.3	9.5	0.5	2.9	−1.8	−2.2
1955	12.7	−1.4	6.6	11.4	−0.6	2.2
1956	4.4	17.5	9.6	7.7	3.4	3.2
1957	1.3	6.3	3.4	4.8	1.5	1.4
1958	−6.5	1.6	−2.9	0	−6.5	−4.8
1959	11.9	6.3	9.3	11.4	−3.0	−0.6
1960	2.2	10.7	5.9	6.1	−2.6	−1.0
1961	0.8	6.2	4.1	5.8	−3.7	−1.8
1962	8.2	4.5	6.4	7.3	−2.7	−1.2
1963	6.0	5.7	5.8	6.8	−2.3	−1.0
1964	6.8	8.1	7.4	7.9	−0.4	0.2
1965	9.2	4.5	6.9	7.4	1.1	0.9
1966	9.8	5.4	7.8	8.2	3.4	2.4
1967	2.1	3.6	2.8	3.8	0.9	−0.3
1968	5.7	9.1	7.2	8.5	2.7	1.5
1969	4.7	11.2	7.8	7.9	5.0	2.7
1970	−3.7	7.6	1.7	4.2	1.4	−0.4
1971	0.2	2.5	1.3	4.0	−2.5	−2.1
1972	7.9	5.9	6.9	7.7	−1.1	−1.1
1973	9.0	10.7	9.9	8.9	3.1	1.1
1974	−1.0	−0.2	−0.4	4.1	−2.6	−1.3
Trend growth rate[b]	...	...	...	...	5.2	6.4

Sources: This table is calculated on the basis of data on industrial production from the following sources: *United States—Business Conditions Digest* (March 1975), p. 108, and (November 1975), p. 76; *OECD European countries*—1950–52, OECD, *Industrial Statistics, 1900–1962* (Paris: OECD, 1964), p. 4, and 1953–74, *Business Conditions Digest* (January 1974), p. 108, and (August 1975), p. 104; *Japan*—ibid. (July 1974), p. 106, and (August 1975), p. 104. *World*—United Nations, Department of Economic and Social Affairs, Statistical Office, *Statistical Yearbook*, various issues. United Nations world industrial production index includes centrally planned and market economies.

The weights referred to in note *a* are from OECD, *Industrial Production, Third Quarter 1965, Supplement to Main Economic Indicators*, p. 8; *Industrial Production, 1968–1, Quarterly Supplement to Main Economic Indicators*, p. 8 and ibid., *1974–1*, p. 8.

a. Each area is weighted by its current share in OECD industrial production. The group in the second column is referred to in the text as "other OECD."

b. Exponential growth rates fitted over the period 1950–74.

If the annual percentage increase in industrial production is used as a criterion, 1973 indeed saw a large boom (see table 1). The 9.9 percent increase in the OECD index was the largest since at least 1950 and the 8.9 percent increase in world industrial production was the largest since 1959. On the other hand, industrial production in the OECD area was only 3.1 percent above its 1950–74 trend, and the United Nations measure of industrial production was only 1.1 percent above its 1950–74 trend. These are not large deviations by recent historical standards. Thus, if the expansion of 1972–73 is to be singled out, it would have to be on the basis of the speed with which it developed, rather than on the level of production actually achieved. An alternative inference is that the importance of synchronization, while valid, has been exaggerated.

EMPIRICAL ESTIMATES

Equation 2 and its percentage-change variant were fitted for quarterly data over the period 1950–74. In order to enter the influence of industrial production in the United States and other OECD separately, the term for total production relative to trend in equation 2 was disaggregated into production in each of these two areas relative to the trend in their total. The sum of these two variables thus equals total production relative to trend, but the coefficient for production from each area is estimated separately by the regressions. Table 2 shows the results of regressions for nonferrous metals with most of the insignificant variables deleted. The nonlinear and percentage-change terms in equation 2 proved in all trials to be statistically insignificant.

The adjustment for the trend of inflation, entered either as a separate explanatory variable, as in equation 2.3, or as a deflator to the dependent variable, as in 2.1 and 2.2, is important for explaining prices of raw materials. Correcting for autocorrelation of the residuals in equation 2.2 raises the $\bar{R}^2$ from 0.52 to 0.81 and almost halves the coefficients of the two industrial-production variables.[10]

10. Strong first-order autocorrelation in the residuals of an equation fitted to quarterly data is not surprising. It does not cause bias in the estimated coefficients, but it does lead to underestimation of the variance of the estimators, so standard tests of statistical significance can be misleadingly reassuring when it is present. Despite this weakness, and despite the improvement of fit that correction for autocorrelation generally brings, we use uncorrected equations below because of the substantially greater requirements for information for forecasting more than one period ahead with a corrected equation. For a discussion of autocorrelation in the residuals, see J. Johnston, *Econometric Methods* (2d ed., McGraw-Hill, 1972), chap. 8, especially pp. 246–49.

Table 2. Effect of Industrial Production on Prices of Nonferrous Metals, 1950-74[a]

Equation	Dependent variable	Determinant						Regression statistic			
		Constant	$Q_{US}/\bar{Q}$	q_{US}	$Q_{E+J}/\bar{Q}$	q_{E+J}	mp	Standard error of estimate	Durbin-Watson	ρ[b]	$\bar{R}^2$
2.1	*RPM*	−5.25	5.43	...	5.08	...	...	16.49	0.51	...	0.52
		(9.90)	(10.46)		(8.07)						
2.2	*RPM*	−2.71	2.86	...	2.60	...	...	10.35	1.75	0.82	0.81
		(4.09)	(4.08)		(2.56)						
2.3	*pm*	−2.17	...	1.33	...	0.93	1.06	9.43	1.78	...	0.17
		(1.60)		(3.52)		(1.87)	(2.56)				

Sources: Derived from text equation 2. The basic data are from the relevant sources given for table 1 and figure 3.

a. The symbols used are defined as follows:

Q = industrial production, with the subscripts *US* and $E + J$ signifying the United States, and Europe and Japan, respectively

$\bar{Q}$ = trend industrial production

q = percentage change in Q

mp = percentage change in UN price index for exports of manufactures

RPM = percentage deviation from 1950–74 trend of *Economist* index of prices for nonferrous metals divided by UN index of prices for exports of manufactured goods.

pm = percentage change in *Economist* index of prices for nonferrous metals.

All data are quarterly. The numbers in parentheses are *t*-statistics.

b. Rho is the coefficient on the lagged residual.

The coefficients on the independent variables are not statistically different from each other. Industrial structure is sufficiently similar in the United States and in Europe and Japan so that total production is the important influence on prices. When total production is on trend, prices of nonferrous metals will also be on trend regardless of the situations in the United States, Europe, and Japan taken separately. An equation (not reported) using only deviations in U.S. industrial production from its own trend performed as well as equation 2.1. This indicates that the greater fluctuations in the U.S. economy have been the principal source of fluctuations in prices of nonferrous metals over the period of regression.

Equation 2.3 relates the simple percentage changes in prices of metals to percentage changes in industrial production and prices of manufactured goods. The unitary elasticity of prices of manufactures supports the use of relative prices as the dependent variable in the other equations shown. The prices of raw materials incorporate the inflation rate of other goods, and in addition vary according to the demand generated by industrial production.

The general message of these equations, including those run but not reported, is that deviations of prices from trend are most strongly influenced by deviations of industrial production from trend, and percentage changes in commodity prices are most strongly influenced by percentage changes in industrial production (and not by deviations from trend), implying that a rapid increase in industrial production even from the bottom of a recession will tend to increase metals prices sharply from their recession lows.

Table 3 shows comparable results for agricultural raw materials. In contrast to the metals case, in equation 3.2, changes in industrial production in the other OECD area exert a statistically more significant and a quantitatively larger influence on the prices of agricultural raw materials than do changes in U.S. industrial production. This result corresponds to differences in the industrial structures of the two areas. In 1963, for example, the United States accounted for 41.2 percent of total OECD production of textiles, clothing and leather, whereas Japan and Europe together accounted for 56.3 percent.[11]

11. By 1970, the United States accounted for 35.8 percent of OECD textiles, clothing, and leather products; Europe and Japan produced 59.7 percent of those products. These data are based on international standard industrial classification 32 from OECD, *Industrial Production, 1955–1971* (Paris: OECD, 1973), p. 270, and OECD, *Industrial Production, Quarterly Supplement to Main Economic Indicators, 1975–3*, p. 23.

Table 3. Effect of Industrial Production on Prices of Agricultural Raw Materials, 1950–74[a]

Period and equation	Dependent variable	Determinant			Regression statistic			
		Constant	$Q_{US}/\bar{Q}$	$Q_{E+J}/\bar{Q}$	Standard error of estimate	Durbin-Watson	ρ[b]	$\bar{R}^2$
1950–74								
3.1	*RPF*	−2.75	2.37	3.24	25.22	0.15	...	0.09
		(3.39)	(2.98)	(3.36)				
3.2	*RPF*	−3.13	1.99	4.63	9.53	1.47	0.93	0.87
		(4.94)	(2.85)	(4.23)				
1954–74								
3.3	*RPA*	−2.30	1.68	3.09	6.45	1.46	0.94	0.89
		(4.47)	(2.77)	(3.84)				

Sources: Derived from text equation 2. The basic data are from the relevant sources given for table 1 and for figure 3; United Nations, Department of Economic and Social Affairs, *Price Movements of Basic Commodities in International Trade: 1950–1970*, Statistical Papers, series M, no. 29, rev. 1/add. 1 (UN, 1971); and United Nations, Statistical Office, unpublished tabulation (October 29, 1975).

a. The symbols used are defined as follows and as in table 2, note *a*: *RPF* is the *Economist* index for prices of fibers divided by the UN index for prices of exports of manufactured goods; *RPA* is the index for prices of agricultural raw materials (as defined in note *a* of figure 2) divided by the UN index of prices for exports of manufactured goods. Both are measured as deviations from the 1950–74 trend. All data are quarterly. The numbers in parentheses are *t*-statistics.

b. Rho is the coefficient on the lagged residual.

It might be thought that changes in prices for raw materials would reflect orders for them, which would precede industrial production by at least a quarter. But various attempts to introduce leading or lagging variables generally yielded results no better than those from regressions based on the same period for all variables.

SUPPLY FACTORS

So far the analysis has neglected the supply side entirely. Yet many of the contemporary explanations for the sharp rise in prices in 1973–74 emphasized supply problems. Food was one clear case: poor harvests in the USSR and in southern Asia in 1972, combined with a change in USSR policy regarding the maintenance of cattle stocks in the face of bad harvests, resulted in a world shortage of grains. Another important development in supply was the sharp reduction in the Peruvian anchovy catch. The Peruvian harvest of fish dropped 62 percent between 1970 and 1972 (and a further 50 percent in 1973);[12] this loss of protein-rich animal feed put upward pressure on the market for soybean meal and other animal feeds, in the face of rapidly growing demand for red meat throughout the world. These developments in turn may also have affected the markets in three nonfood agricultural products—cotton, wool, and hides—because of the substitution possibilities or the complementarities between these items and foodstuffs. Large numbers of acres were shifted from cotton to grains in Turkey and Mexico, for instance, after the sharp increase in grain prices in 1972–73, contributing to the shortage of cotton. Australian sheep were slaughtered in response to the steady rise in demand for meat and wheat (and weak demand for wool), with effects on the subsequent supply of wool. Supplies of metals were affected by the strikes and political unrest in Chile, the major exporter of copper; and Zambia halted its copper shipments through Rhodesia. In addition, some have blamed environmentalist pressures and the recession of 1970–71 in the United States for the failure of investment in refining capacity to match the trend in demand and thus for the shortages of a few years later.

The supply of raw materials is difficult to measure satisfactorily. First, we consider the deviation of global output of nonferrous metals from their

12. The decline was from 12.6 million metric tons in 1970 to 2.3 million metric tons in 1973. See Food and Agriculture Organization of the United Nations, *Yearbook of Fishery Statistics: Catches and Landings, 1973*, vol. 36 (Rome: FAO, 1974), p. 9.

trend, on the assumption that the trend is adequate to satisfy the trend growth in demand. Introduction of realized rather than ex ante supply into the equations raises a methodological problem, since actual supply may respond to, as well as affect, the price. This problem did not arise in considering demand, because the level of industrial production for all practical purposes could be assumed to be beyond the influence of commodity prices. Similarly, many changes in supply are due to "exogenous" nonprice factors. But, other things being equal, one would expect prices that were higher than trend to call forth correspondingly higher output of raw materials, and this possibility will bias the estimated coefficients algebraically upward. We assume, however, that shifts in the supply schedule have dominated movements along it. Despite this complication, therefore, we have introduced a percentage deviation from trend output of raw materials into the equations, with the results shown in table 4. The supply variable is statistically significant with a negative sign (without the bias mentioned above the coefficient would be larger). But its contribution to the coefficient of determination is limited, explaining in the case of equation 4.1 only about 3 percent of the unexplained variance in equation 2.1. Introduction of a nonlinear (squared) supply variable did not yield significant results.

The level of producers' stocks is also an important variable on the supply side. Other things equal, when stocks are low, prices might be expected to rise more than when stocks are high because consumers will be less certain of future supply at going prices and will tend to buy more. At the global level, the only material for which data were available to test this proposition was copper.[13] When the level of stocks at the end of the previous quarter (measured as the percentage deviation from trend) is entered, it is significant and the equation is improved (compare equations 4.3 and 4.1).

Data on refinery capacity for nonferrous metals can be calculated annually on a global basis since 1956, and data on smelting capacity in copper are available since 1965. Introduction of this variable did not, in general, produce significant results. Equation 4.5 is an exception: the capacity variable is significant, although smaller than the supply variable.

Our attempts to introduce a supply variable for agricultural raw materials did not meet with much success. For one thing, only annual data are available. The supply variable was significant for wool, but an aggregate supply index for fibers alone, or for all nonfood agricultural commodities,

13. This series includes stocks held by refiners and at the New York Commodity Exchange and the London Metal Exchange (LME).

Table 4. Effect of Industrial Production and Supply Variables on Prices of Nonferrous Metals, *RPM*, 1950–74[a]

Period and equation	Determinant						Regression statistic			
	Constant	$Q_{US}/\bar{Q}$	$Q_{E+J}/\bar{Q}$	*SM*	S_{-1}	*CAP*	Standard error of estimate	Durbin-Watson	ρ[b]	$\bar{R}^2$
1950–74										
4.1	−5.73	5.85	5.65	−0.90	...	...	15.92	0.53	...	0.55
	(10.63)	(11.19)	(8.82)	(2.84)						
4.2	−3.10	3.31	2.94	−0.53	...	...	10.14	1.81	0.82	0.82
	(4.63)	(4.65)	(2.95)	(2.19)						
4.3	−4.19	4.19	4.27	−1.03	−0.45	...	12.98	0.84	...	0.71
	(7.87)	(8.07)	(7.07)	(3.96)	(6.58)					
4.4	−3.09	3.17	3.06	−0.62	−0.20	...	9.89	1.85	0.76	0.83
	(4.48)	(4.45)	(3.30)	(2.60)	(2.67)					
1956–74										
4.5	−4.77	4.15	5.46	−0.76	...	−0.64	10.09	1.97	0.78	0.83
	(5.53)	(4.62)	(4.08)	(2.99)		(2.32)				
1954–70										
4.6	−6.69	6.82	6.56	−1.11	...	...	13.87	0.56	...	0.68
	(12.03)	(10.92)	(9.79)	(3.79)						

Sources: Industrial production, same as table 1; *RPM*, same as figure 3; world stock of copper at refineries, American Metal Market, *Metal Statistics*, various issues; world production of nonferrous metals, UN, *Monthly Bulletin of Statistics*, various issues; world nonferrous metals capacity, *Year Book of the American Bureau of Metal Statistics*, various issues.

a. The dependent variable is *RPM*. The symbols are defined as follows and as in table 2, note *a*: *SM* is the index of world production of nonferrous metals; S_{-1} is the world stock of copper at refineries, the New York Commodity Exchange, and the London Metal Exchange, at the end of the previous quarter; *CAP* is the index of world capacity for nonferrous metals. All data are quarterly. The numbers in parentheses are *t*-statistics.

b. Rho is the coefficient on the lagged residual.

proved to be statistically insignificant or, when significant, to have a positive coefficient. Within a calendar year, supplies of cotton and of rubber respond to price incentives, thereby confounding any effect of supply on prices within the period of observation. In addition, government intervention, especially the U.S. cotton-support program, interfered strongly with the relationship between output and availability until the early 1970s.

Explanation of the Boom

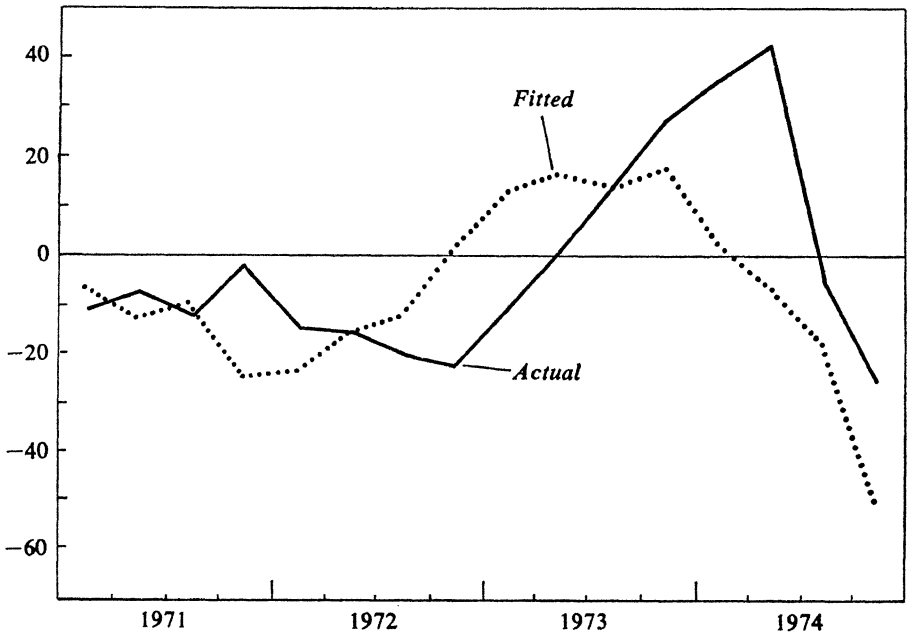
To summarize the results thus far, conventional business-cycle analysis, adapted to the circumstances of industrial raw materials, can go much of the way toward explaining movements of industrial prices. How well can such equations explain the extraordinary increases in commodity prices of 1972–74? For this purpose ex post regressions over the whole sample period are a little like Monday-morning quarterbacking. But how well could the price changes of 1972–74 have been anticipated on the basis of structural information available in 1971, given what happened to demand and supply? Answering this question requires an out-of-sample projection based on regressions fitted over a period earlier than that of special interest, but making use of the realized values of the independent, or "exogenous," variables. We have reestimated equation 4.1 over the period 1954–70, and used the resulting equation to "forecast" changes in nonferrous metals price over the period 1971–74. We start with 1954 in order to be able to "backcast" the Korean War period as well. The estimating equation is shown as 4.6 in table 4. We chose the equation that did not use stocks on the grounds that information on future stocks would not be available for a forecast.

The actual values of relative prices of nonferrous metals (*RPM*) and the fitted values for 1971–74 are shown in figure 6. The mean absolute error over the out-of-sample period is 17.2 compared with 12.0 over the period that was estimated. The residuals fall into an interesting pattern: they are strongly negative in the second half of 1972 and the first quarter of 1973—the most vigorous phase of the boom in the United States—and they are strongly positive (that is, actual prices were well above the fitted prices) in the first two quarters of 1974, reflecting the continued rise of prices for a period after industrial production had reached its peak.

Most attention has been focused on the very high prices that were sustained into 1974, but the unexpectedly low prices in late 1972, given the

Figure 6. Actual and Fitted Deviations from Trend of Relative Prices of Metals, Quarterly, 1971–74

Deviation from trend (percent)



Source: Derived from table 4, equation 4.6.

strength of the boom, are equally puzzling. A possible explanation, derived from perusal of the trade journals of that period, is the widespread belief at the time in substantial *excess* productive capacity in nonferrous metals.[14] This industry had been built up substantially in response to the strong demand of the late 1960s, and when that was followed first by the recession of 1970–71 and then by the winding down of the Vietnam War, capacity appeared adequate for any expected demand for years to come. This attitude was reflected in investment activities in mining, smelting, and refining; already modest plans for expansion were actually trimmed back

14. In the periodic Department of Commerce survey on plant and equipment, conducted as of June 30, 1972, only 25 percent of primary-metals manufacturers believed more plant and equipment were needed, 56 percent that existing capacity was adequate, and 19 percent that it exceeded needs. By March 1974, the figures were 51, 48, and 1, respectively. *Survey of Current Business*, vol. 54 (June 1974), p. 19.

Table 5. Growth of Global Capacity in Selected Nonferrous Metals, Selected Periods, 1955–73[a]

Annual rate of increase, in percent

Period	Copper		Lead	Zinc
	Smelting	*Refining*		
1955–65	3.0	4.1	n.a.	n.a.
1965–70	2.2	5.9	4.1	5.0
1970–73	−1.0	3.4	1.5	0.5

Sources: *Year Book of the American Bureau of Metal Statistics, 1973* (1974), and issues for 1970, 1965, 1955.

a. Calculated from data on annual capacity at year end. Communist countries are omitted owing to absence of accurate data.

n.a. Not available.

in 1971. The Federal Reserve Board series on U.S. capacity in primary metals shows a shortfall from trend of 4 percent by the beginning of 1974; and investment in productive capacity in the nonferrous metals industry in the noncommunist world slowed down substantially in 1970–73. Indeed, in copper smelting, there was an absolute decline (see table 5). Environmental concerns and new requirements to reduce pollution also delayed bringing some planned investment to fruition on their original schedules. The general view that capacity was more than ample in 1972 may have contributed to the delay in price increases in response to rising economic activity, as consumers drew down their inventories in confident expectation that they could replenish them comfortably later. Furthermore, in spite of mounting demand, global refinery stocks of copper were high and rising throughout 1972. Metals prices began to rise rapidly in early 1973, but they remained below trend for several months. Refinery stocks of copper fell precipitously in 1973.[15]

The sharp increase in prices in late 1973 has drawn the most attention. Because it came from a point well below trend, it was all the more dramatic. Underlying economic conditions (as embodied in our estimating equations), particularly the rise in industrial production throughout the world, would have explained an increase in relative prices to 18 percent above trend. Given the sharp increase in prices of manufactured goods (measured in dollars) during this period, plus an upward trend in prices of nonferrous metals of about 5 percent a year in nominal terms,[16] a dollar-price

15. American Metal Market, *Metal Statistics, 1975*, p. 65.

16. Prices of nonferrous metals followed an upward trend of 4.8 percent during the period 1950–74, while prices of agricultural raw materials had a slight downward trend. The price of nonferrous metals relative to manufactured goods had an annual upward

increase in nonferrous metals of nearly 70 percent might have been expected from the third quarter of 1972 to the third quarter of 1973, compared with an actual price increase of 79 percent. But prices continued to rise rapidly thereafter, even in the face of sluggish industrial production, and by the second quarter of 1974 reached a peak nearly 42 percent above the trend of relative prices.

CHANGES IN COMPOSITION OF OUTPUT

We have not tested formally for the impact on nonferrous metals of changes in the composition of output. These metals are used especially heavily in construction, and in production of machinery and transportation equipment. In late 1973 and early 1974, construction and automobile production were already declining, but machinery production continued strong well into 1974, in Europe and Japan as well as in the United States. The U.S. industrial production index with its various components reweighted by their use of nonferrous metals (including aluminum), like the industrial production index, reached a peak in the fourth quarter of 1973 and turned down thereafter. Thus, while the reweighted index experienced larger swings than the official index—it dropped 3 percent between the second and third quarters of 1974 alone—its peak and subsequent decline still occur too early to suggest that changes in the composition of demand can explain the continued rise of prices of nonferrous metals into 1974.[17] Moreover, production of machinery and transportation equipment generally swings more than total industrial production, so that some procycli-

---

trend of 2.7 percent during the period 1950–74 and of 2.9 percent over the period 1950–70.

17. The following table compares the official U.S. industrial production index, taken from various issues of the *Survey of Current Business*, with the index reweighted according to the use its components make of nonferrous metals. The reweighting is based on the 1967 input-output tables reported in the *Survey of Current Business*, vol. 54 (February 1974), table 1.

	1973		*1974*	
Quarter	*Reweighted index*	*Original index*	*Reweighted index*	*Original index*
1	100.0	100.0	102.0	101.5
2	102.4	101.4	103.1	101.9
3	104.3	102.9	99.9	101.9
4	105.7	103.2	96.9	98.5

cal change in the composition of demand for nonferrous metals is built into our estimating equations. This question deserves further analysis, however, both for U.S. experience and for Europe and Japan.

FLUCTUATIONS IN EXCHANGE RATES

As noted above, the fluctuating value of the dollar after March 1973 should not have a consequential effect on our unit of measurement, which is in prices of raw materials relative to prices of manufactures, both measured in dollars. If, however, any depreciation of the dollar were reflected fully and immediately in the prices of raw materials—that is, if their prices were determined wholly outside the U.S. market (an implausible assumption, in view of the influence of U.S. industrial production on materials prices)—and if, in contrast, export prices of manufactured goods from all major countries were fixed in terms of dollars in the short run, then our main price variables, *RPM* and *RPA*, would reflect fully any change in the value of the dollar relative to other currencies. The U.S. dollar was devalued 10 percent[18] in February 1973, and then depreciated against the major European currencies from March, when currencies were allowed to float in the marketplace, until July. When weighted against other currencies by shares in world trade, this depreciation amounted to a further 9 percent. Thus, on extreme assumptions, the depreciation of the dollar in the first half of 1973 could have explained a rise in prices of nonferrous metals relative to manufactures of about 18 percent. From July 1973 until January 1974, however, the value of the dollar returned almost to its pre-February 1973 value; if the implausible assumption on pricing also holds for appreciations, that movement should have accounted for a decline in materials prices relative to manufactured goods. Prices of fibers continued to rise beyond July, reaching their peak in September 1973, and then declined about 1 percent by January 1974; prices of metals, however, continued to rise steadily until April 1974 and only thereafter declined. By that time, the dollar was again depreciating—about 10 percent between January and May, when it began to appreciate again (see table 6).

The evidence suggests that materials prices are strongly influenced by what happens in the U.S. market, so that they are unlikely fully to reflect any change in the value of the dollar relative to other currencies. Move-

18. In terms of the official price of gold or special drawing rights. The effective devaluation against other currencies was lower because several other currencies—for example, the Canadian dollar and the British pound—depreciated against SDRs as well.

Table 6. Values of U.S. Dollar in Terms of Other Currencies, Compared with Prices of Raw Materials, January 1973–August 1975

Percentage deviation from average value in March 1973[a]

Date and point in appreciation-depreciation cycle	*Value of dollar*		*Price of materials (sign reversed)*	
	Relative to ten other currencies[b] (*1*)	*Relative to special drawing rights*[c] (*2*)	*Nonferrous metals* (*3*)	*Fibers* (*4*)
1973				
January 3[d]	9.7	6.1	22	25
March	0.0	0.0	0	0
July 6 (low)	−8.8	−5.9	−31	5
1974				
January 28 (high)	8.5	5.1	−41	−3
May 10 (low)	−2.0	−1.5	−96	12
September 3 (high)	3.5	2.2	−19	27
1975				
March 3 (low)	−9.4	−4.2	−10	33
August 12 (high)	3.1	1.9	− 2	33

Sources: Columns 1 and 2, unpublished data provided by the Board of Governors of the Federal Reserve System; columns 3 and 4, calculated from monthly averages in *Economist* (September 6, 1975), p. 81.

a. In March 1973, fixed exchange rates were abandoned by a number of European countries and their currencies were allowed to float vis-à-vis the U.S. dollar and other currencies.

b. Eight European currencies plus the Canadian dollar and Japanese yen, weighted by 1972 share in global exports plus imports.

c. A weighted average of sixteen currencies; nearly one-third of the weight is accounted for by the U.S. dollar.

d. Within 0.5 percent of Smithsonian "central rates" of December 1971.

ments in the value of the dollar measured in SDRs (the dollar accounts for about one-third of the weight of the "basket" of sixteen currencies that determines the value of the SDR) are less dramatic than those measured in other currencies, and probably give a more accurate—though still exaggerated—picture of the impact of fluctuations in exchange rates on materials prices.

In our judgment, the importance of movements in exchange rates on prices of commodities lies not so much in changes in the unit of measurement as in the psychological effect of fluctuating exchange rates on speculative demand.

The Korean War Experience

The outbreak of hostilities in Korea in June 1950 came when the world economy was recovering from the recession of 1949. Widespread anticipa-

tions of shortages led to heavy purchases by consumers and businessmen, and set off a worldwide boom of considerable proportions. By the time the hoarding reached its height at the end of March 1951 and before prices began to fall, the *Economist* index was 55.7 percent above its level when the Korean War began. Total industrial production had risen at an annual rate of 15 percent and was 5.54 percent above trend (compared with the 1973 peak 3.38 percent above trend). Although food prices rose by 26 percent over this period, the boom was centered in industrial raw materials. The *Economist* fibers index rose by 88 percent and the metals index by 45 percent. These changes stand in sharp contrast with those of the 1972–74 boom, in which food prices had the largest increase among the components (table 7).

After a respite in mid-1951, the expansion resumed until the middle of 1953.[19] During this second phase of the expansion, however, prices of primary commodities fell steadily, and by June 1953, the *Economist* index had returned to its June 1950 level.

When equation 4.6 is backcast over the period 1950–53, it puts the peak for relative prices of nonferrous metals in the first quarter of 1951, at 36 percent above trend. In fact, metals prices did peak in that quarter, but at 49.7 percent above trend. Because the equation also underestimates these prices in the two quarters prior to the invasion in June 1950, only part of the underestimation can be attributed to wartime commodity speculation. The equation then overestimates metals prices in the boom year of 1953, when evidently the large inventory accumulation of the early fifties, combined with the resolution of the Korean conflict, served to depress prices below what they otherwise would have been.[20]

In retrospect, it seems fortunate that the world was near the trough of a cyclical recession when the Korean War broke out. The speculative boom that the war set off provided the cushion of inventories and the stimulus to the expansion of primary-goods capacity that facilitated the remarkable noninflationary expansion of 1952–53, generated by the war-induced in-

19. For a fuller discussion of the Korean War business cycle in the United States, see Bert G. Hickman, *Growth and Stability of the Postwar Economy* (Brookings Institution, 1960), chap. 5.

20. The mean absolute error over the period 1950–53 is 18 percent as compared with the within-sample mean absolute error of 12 percent. For a discussion of the behavior of commodity prices during this period, see Gertrud Lovasy, "Prices of Raw Materials in the 1953–54 U.S. Recession," *International Monetary Fund Staff Papers*, vol. 5 (February 1956), pp. 47–73.

Table 7. Troughs and Peaks, and Changes, Price Indexes of Selected Commodities, 1949–53 and 1971–75 Cycles

Monthly averages

Commodity and cycle	Date and index (1963 = 100 for 1949–53; 1970 = 100 for 1971–75)			Change (percent)	
	Trough (1)	Peak (2)	Trough[a] (3)	Trough to peak[b] (4)	Peak to trough[c] (5)
ALL ITEMS					
1949–53 cycle					
Date	*6/49*	*3/51*	*6/53*		
Index	65.1	155.7	98.6	82.1	−44.9
1971–75 cycle					
Date	*11/71*	*5/74*	*6/75*		
Index	87.3	253.8	201.0	97.6	−23.2
FIBERS					
1949–53 cycle					
Date	*7/49*	*3/51*	*2/53*		
Index	85.9	232.6	98.8	92.1	−80.7
1971–75 cycle					
Date	*3/71*	*1/74*	*1/75*		
Index	94.7	310.3	195.6	106.5	−45.3
FOOD					
1949–53 cycle					
Date	*6/49*	*6/51*	*6/53*		
Index	58.0	113.7	92.7	64.9	−20.3
1971–75 cycle					
Date	*11/71*	*11/74*	*7/75*		
Index	88.9	329.4	235.7	115.0	−33.2
METALS					
1949–53 cycle					
Date	*6/49*	*2/51*	*9/53*		
Index	56.2	134.7	90.2	82.3	−39.6
1971–75 cycle					
Date	*11/71*	*4/74*	*6/75*		
Index	75.3	230.6	111.1	101.5	−69.9

a. For the 1971–75 cycle, the figure in this column is the lowest observation over the period January 1974–August 1975.

b. The calculation is made with the appropriate data in columns 1, 2, and 3, as follows: (col. 2 − col. 1)/[(col. 1 + col. 2)/2].

c. Calculated as (col. 3 − col. 2)/[(col. 2 + col. 3)/2].

Sources: *Economist* (July 7, 1973), pp. 70–71, and relevant succeeding issues.

crease in military expenditure.[21] It was equally fortunate that this expansion was accompanied by good crops and falling food prices. In contrast, the speculation in 1973–74, aggravated in part by the Yom Kippur War in October 1973, occurred when recession was close at hand. The resulting buildup in industrial inventories exacerbated the recession, and a poor crop year in 1974 combined with depleted international grain reserves to make food prices a major problem in the stemming of inflation.

Speculation

During 1973–74 much talk centered on commodity speculation. Was the large jump in prices above the predicted level the result of a scramble for commodities for speculative purposes? Were large amounts purchased for holding rather than for further fabrication? This is a simple question that should have a straightforward answer.

NONFERROUS METALS

Unfortunately, the data on stocks of commodities other than those in the hands of producers are generally unavailable. Industrial production in the OECD countries was over 9 percent higher in 1973 than in 1972, and world demand for nonferrous metals probably grew in rough proportion, or perhaps slightly faster, given the heavy production of automobiles in 1973. World smelter production of lead and zinc and of refined copper rose about 3 percent and about 5 percent, respectively, and world production of tin fell modestly,[22] for a price-weighted average increase of about 4½ percent. So the growth in supply did not satisfy the growth in demand during that year. But the implied price elasticity of demand for nonferrous metals —that is, the percentage discrepancy in imputed demand over new supply, divided by the observed increase in prices—should have been less than 0.06 to explain fully the price increases that were observed by late 1973 and early 1974. This figure contrasts with estimated short-run price elasticities

21. From 1951 to 1953, the U.S. economy averaged a 2.7 percent unemployment rate combined with a 4.1 percent decline in the wholesale price index and a 3.0 percent increase in the consumer price index. For a fuller exploration of the reasons for price stability, see John P. Lewis, "The Lull That Came to Stay," *Journal of Political Economy*, vol. 63 (February 1955), pp. 1–19.

22. *Mining Annual Review, 1974* (London: Mining Journal, 1975), and ibid., *1973*.

of demand of −0.21 percent for copper in the United States, −0.09 percent for copper in Europe, and −0.55 percent for U.S. tin.[23] Allowance for stockpile sales of lead, tin, and zinc by the United States—equivalent to around 5 percent of world production—would reduce the implied elasticity even further. We infer, therefore, considerable speculative demand for the metals in late 1973 and especially in 1974. For example, the Japanese were exceptionally heavy buyers of nonferrous metals in 1973; their imports increased by 40 percent, much more than did their industrial production (17 percent). (These purchases were perhaps stimulated in part by the soybean embargo imposed by the United States in June, which might have been feared as a precedent.)

The rapid growth in consumption was satisfied by drawing down stocks of metal at refineries throughout the world, as well as by substantial sales of lead, tin, and zinc from the U.S. strategic stockpile (a topic to which we return below). Except for zinc, net imports into the United States declined in 1973, so in effect U.S. stockpile sales reduced U.S. reliance on the world market and eased supplies elsewhere.

How much of the reduction in recorded stocks went into consumer holdings is difficult to know. Japanese firms became large sellers of metals, especially copper, in late 1974, indicating substantial excess inventories there.

AGRICULTURAL RAW MATERIALS

Prices peaked earlier for agricultural raw materials than for metals, generally in late 1973. But these products, too, were subject to a combination of cyclically high demand, speculative pressures, and some supply deficiencies. While the pressures on agricultural raw materials were quite general, four commodities—wool, cotton, rubber, and hides—account for the bulk

23. The calculation here is based on the *Economist* index for nonferrous metals, in which copper has about two-thirds of the weight. The examples of estimated elasticities used here are from Franklin M. Fisher and Paul Cootner, in association with Martin N. Baily, "An Econometric Model of the World Copper Industry," *Bell Journal of Economics and Management Science*, vol. 3 (Autumn 1972), pp. 568–609, and F. E. Banks, "An Econometric Model of the World Tin Economy: A Comment," *Econometrica*, vol. 40 (July 1972), pp. 749–52.

The fact that U.S. producers sold below the free-market price would, however, tend to raise that price disproportionately in times of heavy demand, so the elasticity calculation must be applied with caution. The United States accounts for about one-fifth of world production of the metals considered here.

of this category that moves in international trade (and for 82 percent of the weight in the *Economist* index). Vegetable oils are somewhat less important, because their use is mainly in edibles.

These four products have diverse backgrounds. Use of wool for fabrics is on a strong downtrend, while world demand for cotton is rising. As a result, wool prices were deeply depressed in 1970–71, and herders cut back their flocks, responding in part to the strong demand for meat and wheat and setting the stage for an apparent wool shortage in 1972–73.

Cotton has been strongly influenced by U.S. agricultural policies, since this country accounts for about one-fifth of world exports. For years, the Commodity Credit Corporation stabilized the price. As with grains, policy shifted away from direct support, and government stocks, which in the mid-sixties had amounted to over one-quarter of world production, were virtually exhausted by mid-1971. World production grew sharply in 1972 and substantially in 1973, but world demand—especially from developing countries—also rose substantially.[24]

Production of hides, a by-product of the slaughter of beef for meat, fell modestly below its 1970 levels in 1971 and 1972 as beef herds were being built up. In addition, Argentina, the second largest cattlehide exporter, drastically lowered its export quotas on cattlehides in 1971 (to protect a domestic leather industry), so that its exports fell from 7.5 million hides in 1970 to 3.4 million in 1971.

FUTURES TRADING

A further indicator of the "speculative" behavior in 1973 and 1974 was the tremendous expansion of trading in futures in a wide range of commodities. Futures transactions between the early 1970s and the first half of 1974 went up over 50 percent in lead and tin, doubled in zinc and copper, and rose nearly threefold in rubber (see table 8). It is possible neither empirically nor conceptually to differentiate between pure speculation and hedging by users, but demand for long forward positions in commodities grew substantially, accompanied by sharp increases in both prices and volume. Anxiety about supplies in the face of continuing strong demand

24. World consumption of cotton increased 1.6 million bales for the year ending June 1973, compared with annual increases ranging from 400,000 to 1.2 million bales during the preceding four years. *U.S. Actions Needed to Cope with Commodity Shortages*, Report to the Congress by the Comptroller General of the United States (1974), p. 214.

Table 8. Annual Volume of Turnover on Commodity Futures Markets in London and New York, Selected Commodities, 1970–74

Thousands of long tons; except cotton, millions of bales

Commodity	*Market-place*	*1970–72*	*1973*	*1974*[a]
Copper	London[b]	2,303	4,222	3,068
	New York[c]	2,470	6,301	6,887
Cotton[d]	New York	25	45	40
Lead	London	801	1,341	1,251
Rubber	London	148	599	590
Tin	London	154	169	248
Zinc	London	612	1,325	1,276

Sources: W. C. Labys, *Speculation and Price Instability on International Commodity Futures Markets*, United Nations Conference on Trade and Development, TD/B/C.1/171 (UN, 1974), p. 4; tabulation provided by New York Cotton Exchange.

a. January-June, annually adjusted.
b. London Metal Exchange, wirebars only.
c. Commodity Exchange, Inc., only.
d. No, 2 contract traded on New York Cotton Exchange.

for finished goods, combined with general uncertainty concerning international monetary developments, may have been sufficient to stimulate hedging purchases by users of raw materials. But when such purchases run way ahead of normal demand, their motive is hardly distinguishable from that for speculation—the expectation of reselling (in this case, in fabricated form) at a profit.

CAUSES OF SPECULATION

A number of reasons can be invoked for the commodity speculation in 1973 and 1974.

Shortages. At the level of general public discourse, considerable attention had been given to *The Limits of Growth*, which strongly underlined (among other things) the finiteness of the earth's resources and drew public attention to their possible exhaustion within a foreseeable future. This psychology of shortage was reinforced when production of several commodities actually fell despite rising demand and rising prices; a notable example was the world fish catch. In the face of a vigorous boom, many manufacturers may have feared for their supplies of raw materials and engaged in anticipatory buying. The oil embargo of October 1973 no doubt lent credence to these fears, while at the same time threatening a business recession in the affected countries.

Inflationary expectations. Speculative behavior might have been intensified by the rapid rise in inflationary expectations in 1973 and especially in early 1974, following the quadrupling of oil prices posted by the Organization of Petroleum Exporting Countries. Led by food, U.S. consumer prices rose by 6 percent during 1973, twice the rise of the preceding year, and by year end prices were rising even more rapidly. Most other countries saw even greater increases in consumer prices. The acceleration in inflation may have created an environment in which businessmen felt justified in purchasing above-normal amounts of raw materials, in the expectation that even the historically high prices that they were paying could be recouped through higher prices of finished goods.[25]

Exchange-rate uncertainty. The period 1973–74 was also fraught with considerable uncertainty regarding exchange rates. The postwar international monetary system broke down in the spring of 1973 when countries abandoned their commitment to fixed exchange rates and major currencies were allowed to float against one another in the exchange markets. The U.S. dollar promptly fell against other leading currencies by nearly 10 percent, from March until July 1973, and this movement, taken with the devaluations of December 1971 and February 1973, left most observers with the strong impression that the dollar was undervalued. But few were willing to bet heavily on it, so the dollar remained depressed; in fact, to some it appeared likely to slide for some time, until the Yom Kippur War and the oil embargo exposed Europe's basic economic vulnerability and resulted in an appreciation of the dollar. A good deal of currency speculation, both spot and forward, took place during this period—as shown by foreign-exchange losses later reported by some of the world's major banks. It is quite likely that uncertainty regarding currency values also stimulated commodity speculation—especially where exchange controls limited transactions between currencies. Indeed, for a country such as Japan, going long on internationally traded commodities needed for future production was a way to reduce large dollar holdings of uncertain value.

Flexible exchange rates introduced a new and unfamiliar uncertainty into short-run calculations of cost and profitability, and risk-averse businesses

25. In contrast to 1950–51, there is little evidence of hoarding by households during the recent period; on the contrary, personal saving rates in the United States jumped from 6.6 percent of personal disposable income in 1972 to 8.2 percent in 1973 and to 8.9 percent in the first quarter of 1974, despite (or because of?) substantial increases in prices.

may have preferred the more familiar uncertainty of buying raw materials needed for future production, thereby assuring themselves of supplies at a known cost, or of buying futures. A sharp increase in hedging demand for futures, by driving futures prices up, may then have stimulated commodity speculation on both spot and futures markets, thereby driving prices up still further.

One indication of deepened financial uncertainty is the change in the price of gold, a commodity that displays a secular increase in industrial demand but whose price in the short run is typically dominated by speculative purchases (including changes in "hoarding" demand by the traditional repositories of nonmonetary gold, Asia and the Middle East). After monetary authorities ceased to intervene in the London gold market in March 1968, the price gradually rose from $35 an ounce to between $60 and $70 an ounce. With the second devaluation of the dollar in February 1973 and the general move to flexible exchange rates, the price of gold rose sharply, reaching a peak of nearly $130 in July 1973 (during this period the dollar was also depreciating against continental European currencies, though not so rapidly). The price then receded to below $100 by November, when announcement of the Arab oil embargo and the subsequent quadrupling of oil prices sent the price up dramatically to about $180 in early April 1974. The price then moved erratically throughout the rest of the year, reaching a peak of nearly $200 in January 1975 (associated with international disagreement on the future shape of the monetary system, and on the role of gold in it). During 1975 the price retreated, to under $140, with the announcement that the International Monetary Fund would sell off one-sixth of its substantial gold holdings for the benefit of less developed countries.

The sharp increases in gold prices in the spring of 1973 and again in the spring of 1974 can be taken as a rough indicator of the prevailing uncertainty about the functioning of the international economic system in the face of substantial changes such as the adoption of floating exchange rates or a marked increase in oil prices. (It is also true, however, that South Africa, the major producer of new gold, reduced its sales substantially in 1974, pushing the price up; and there were periodic rumors that European nations would resume official purchases of gold at a high price.) Prices of art objects, antiques, real estate, wine, and other hedges against an uncertain value of money also rose sharply during this period. Thus, the continued climb of prices of nonferrous metals in early 1974, despite sharp

declines in industrial demand, may reflect this same uncertainty with regard to the financial system.

Price controls. Finally, but not least, some speculation within the United States may have been stimulated by the price controls on commodities during the second half of 1973. Commodities had been subject to the price freeze of August 1971, then decontrolled between November 1971, when Phase II started, and June 1973. In that month, producer prices of nonferrous metals, among others, were subjected to a ceiling by Presidential order. Price ceilings initially also applied to domestic sales of scrap metal, and world demand at that time was so high that scrap was immediately diverted into the uncontrolled export markets (leading to appeals for export controls on metal scrap, such as had been imposed on soybeans in June). Copper scrap prices were decontrolled in August, with a consequent rise in domestic scrap prices and decline in exports; but the refined metals were not decontrolled until December, whereupon producer prices rose.

The impact of U.S. price controls on the relatively free prices of the metals that are included in the *Economist* index is complex. In a period of high demand, price controls on one important segment of the market, U.S. smelters and refiners, should lead to higher prices in uncontrolled sectors, to which purchasers shift for their marginal supplies. So a sharp rise in London prices in the summer and fall of 1973 might have been expected, although it should have been associated with some increase in net imports into the United States; in fact, net imports of copper, lead, and tin fell in 1973. American fabricators were evidently competing with surging demand elsewhere in the world.

But once American prices were decontrolled (or, as in the case of copper, the ceiling was raised), the opposite effect should have been observed: a decline in the London prices, ceteris paribus. Zinc prices did indeed decline briefly, but lead and copper showed no such response, and zinc soon resumed its upward movement into 1974. So the impact of U.S. price controls on London prices, if any, must have come in early 1974 through speculative demand stimulated by the prospect of a resumption of price controls, and hence restricted supplies, at some later time.

Whatever the origins of commodity speculation in 1973–74, they were quite different from those in 1950–51. During the earlier period, most of the speculation was motivated by concern about physical shortages to civilian users during a major war, and much of the speculative purchasing—

of foods and of finished goods—was done by households, presumably for future use.

The Desirability of Limiting Price Movements

The sharp increase in commodity prices in 1973 was cause for widespread anxiety and even alarm. It was for many a new and unusual development that seemed to support a number of fears that were current concerning the exhaustion of resources and the acceleration of inflation. The movement of economic variables such as prices into new and unexpected values generates uncertainty and induces both protective and speculative actions, often indistinguishable from one another. Were the sharp increases in prices going to continue into even more implausible values? Were they going to level off at the new highs? Or could they be expected to recede to the more "normal" levels within the realm of earlier experience? When demand is exceptionally high, a rapid increase in prices acts as a useful rationing device, inducing some buyers to drop out of the competition. On the other hand, rapid price increases can also act as a destabilizing signal, inviting purchases with the objective of riding the price up to its crest and then selling, whether in unfabricated or in fabricated form (for users of the material can be speculators as well). In the end the boom burst and those who bought near the peak lost money—a salutary, chastening experience for those who speculated; but forestalling even a temporary boom may have been socially preferable.

The direct impact of raw-materials prices on the consumer price index is relatively low if fuels are excluded, but it is not negligible. On direct pass-through, it takes an increase of 14½ percent in the prices of nonfood, nonfuel raw materials to increase the consumer price index by 1 percent.[26] On this basis, a doubling of these commodity prices would increase consumer prices by 7 percent. Moreover, a scare psychology of any kind may be contagious, and strong increases in raw-materials prices that led to speculative purchases could spread into markets for more highly fabricated goods, with broad effect. This phenomenon did not seem to arise during 1973–74 (as it had in the first wave of the Korean boom of 1950), although apparently there was some contagion from one commodity market to another, for

26. Joel Popkin, "Commodity Prices and the U.S. Price Level," *BPEA, 1:1974*, p. 256.

the underlying supply-demand situation cannot explain even moderate price increases for some commodities.

While the direct impact of materials prices on the consumer price index is relatively small, there is potential indirect impact. Sharp increases in the prices of materials offer manufacturers justification both to themselves and to the public to raise their prices—very much as increases in the cost of living provide moral justification to most people for increases in wages; and manufacturers may take the occasion of such price increases also to widen their margins, when demand for their goods is strong, and thus produce a multiple effect rather than simply a pass-through of materials prices. Convention or fear of public opprobrium may not inhibit price increases that seem "cost justified," even when demand for finished goods is weak. Firms following a long-run pricing strategy and worried about their own unwillingness (for whatever reason) to change prices freely may well find it expedient to widen markups when demand is stagnant whenever higher costs of materials or labor can at least superficially help them justify their actions. Under these circumstances, extraordinary increases in materials prices provide a dense enough cloud of informational noise to permit price increases well beyond the direct impact on costs.[27] Increases in commodity prices would then in effect play the role of price leader in an oligopolistic industry, signaling all participants to raise their prices. The effect would not be fully symmetrical, since such industries would not be fully exploiting their collective market power. Even though specific illustrations abound, this point must remain conjectural: since commodity prices and markups both tend to rise and fall with business activity, the independent influence of commodity prices is difficult to sort out.

A further cost of large increases in materials prices hinges on the policy targets of the government, and in particular of central banks. Under a regime in which changes in the price level are a target of policy, in the sense that price increases evoke both concern and restrictive action, and in an economy in which prices of manufactures and services fall only sluggishly in response even to strong excess supply, increases in materials prices, of whatever origin, will depress production in the higher-stage processing sec-

27. A similar phenomenon is frequently observed in less developed countries following a currency devaluation. Devaluation jars public expectations enough and stirs enough general confusion to permit economically unrelated price increases to proceed without public disapproval. See Richard N. Cooper, *Currency Devaluation in Developing Countries*, Essays in International Finance 86 (Princeton University, International Finance Section, 1971).

tors. Supply shortages due to bad harvests will in the short run raise not only the relative prices of the goods in short supply but also the general price level. Restrictive action to combat "inflation" will then generate a recession—a paradoxical response to a shortage of supply.[28] Large increases in commodity prices thus may result in real costs to the economy operating via the policy response to them. Moreover, since price reductions are likely to be especially welcome to the monetary authorities in a modern economy with secular inflation, the policy response is not likely to be fully symmetrical: price declines in themselves are less likely to generate expansionary measures than price increases are to generate contractionary measures.

By creating uncertainty, price fluctuations for a given product may also hold investment below what it otherwise would have been in that product.

Finally, large price fluctuations in final products probably stir consumer anxiety, itself undesirable if it can be avoided at low cost.

The Possibilities for Limiting Price Movements

If large price increases, even when only temporary, impose costs on the economy, what are the possibilities for limiting them? As usual, one approach deals directly with prices, the other indirectly by manipulating quantities.

PRICE CONTROLS

Presenting problems in the best of circumstances, price controls are particularly difficult for raw materials. The reason is partly that raw materials are more frequently traded in highly competitive markets than are many products, and partly that raw materials enter more freely into international trade than do many other products. The first condition makes price controls much more difficult to establish and to enforce than they are in less competitive sectors of the economy; and the second makes them impossible to enforce without restrictions on exports and (for a commodity that is imported) subsidies to imports if the country wishes to maintain domestic use of those commodities.

28. For a discussion of this problem in the context of a simple two-sector model, see Robert J. Gordon, "Alternative Responses of Policy to External Supply Shocks," *BPEA, 1:1975*, pp. 183–204.

During the Korean War, imported commodities and most domestically produced agricultural commodities were exempt from the price controls, which were introduced in January 1951. In any case, the controls were imposed when commodity prices, though not the prices of many fabricated products, had reached their peak. Thus, the "control" system on most covered commodities (for example, scrap and refined metals) consisted largely of deciding how rapidly to lower the price ceilings on products whose market prices were falling almost continuously during the two-year duration of the controls. If the controls had any effect at all on commodity prices, it was probably to increase them during the several months before January 1951 during which controls were anticipated; effective controls on fabricated products during 1951 may, however, have damped producer demand for high-priced raw materials and thus contributed to the decline in prices during 1951.[29]

As noted earlier, the price ceilings imposed on a number of commodities in June 1973 quickly encountered problems. Exports of soybeans were embargoed, with heavily adverse reaction abroad (not surprising in view of the long-time efforts of the U.S. government and farm community to encourage dependence on the United States as a supplier of agricultural products). Prices abroad continued to rise, and drew supplies of a number of products from the U.S. market. The price ceilings on copper scrap had to be abandoned in August, for instance, in order to permit effective domestic competition with foreign purchasers of U.S. scrap.

It is not impossible to maintain a system of price controls in the presence of relatively free foreign trade, only very difficult. Indeed, the nonferrous metals industry itself maintains a reasonably effective system of "controls" in that the prices charged by U.S. producers of copper, lead, zinc, and a number of less important metals often differ—sometimes by substantial amounts—from those prevailing on the London Metal Exchange. Why, during periods like late 1973 and early 1974, do U.S. producers maintain prices far below those prevailing in the international markets, and continue to supply their customers at the lower prices rather than divert output into higher-priced foreign sales?[30] And why, in a period like 1975, when

29. For a detailed account and assessment of price controls during the Korean War, see Gardner Ackley, "Selected Problems of Price Control Strategy, 1950–52" (August 1953; processed) (available on microfilm from the National Archives of the United States).

30. Price ceilings on U.S. producers might seem to offer the explanation during the second half of 1973; but this pattern of behavior has a long history.

LME prices were below U.S. prices, do buyers continue to deal with U.S. refiners rather than import from abroad? These are intriguing questions for detailed exploration. But the answer lies, we think, in implicit long-term futures contracts designed to reduce uncertainty both for buyers and for sellers, so that both parties forgo short-run maximizing behavior for the sake of long-run security.[31]

Whatever the reason, it is obviously possible under some circumstances to maintain a dual market for long periods of time even without formal import or export restrictions, without arbitrage undermining it. During periods of high LME prices, the U.S. producers must in some way ration sales to their traditional customers, including their foreign customers. This behavior incidentally makes it possible to impose controls on prices of U.S. producers, as was done from June to December 1973, and it also means that prices of a major part of sales of nonferrous metals in the United States move only sluggishly in response to sharp changes in market conditions; the producers themselves damp down both increases and reductions in price.

BUFFER STOCKS

Buffer stocks, which manipulate quantity rather than price, may be a more effective, although less direct, way to influence price movements. Actual sales from buffer stocks can satisfy demand that temporarily runs ahead of production, and prospective sales from buffer stocks may be sufficient to nip any speculative boom in the bud, or even to inhibit the bud from forming.

Introducing buffer stocks raises three questions: How large should they be? How much do they cost relative to the alleged benefits? When should the manager of the stock buy or sell? We will not address the last question here, except to say that it is no more necessary to operate the buffer stock on the basis of fixed buying or selling prices than it is for policymakers to intervene in the Treasury bill market or the foreign-exchange market on that basis. In particular, the rate of change of price should generally figure in decisions of the manager to buy or sell.

The regression equations we relied on for assessing the nature of the

31. For an interesting exploration of a related line of thought in connection with the costs of inflation, see Arthur M. Okun, "Inflation: Its Mechanics and Welfare Costs," *BPEA, 2:1975*, pp. 351–90.

recent price changes can also be used in reverse to get a crude estimate of the stocks that might be required to hold price changes within some specified range, based on "normal" demand. Suppose, for example, we want to keep nonferrous metals prices (as measured by the relatively volatile *Economist* index) within a range of 30 percent around its trend relative to the prices of manufactured goods—that is, within a 15 percent deviation from trend. Equation 4.6 offers a reasonable explanation of relative price movements in terms of underlying demand and supply variables. During the second and fourth quarters of 1973 the estimated price exceeded its trend by more than 15 percent, for a total excess deviation in the two quarters of 4 percentage points (see figure 6). If we assume that changes in ex ante demand for nonferrous metals are proportionate to changes in industrial production, then it would have required additional sales equivalent to about 0.6 percent of annual U.S. consumption of nonferrous metals to hold prices within 15 percent above trend (world supply was about four times U.S. consumption in 1972). A similar, alternative calculation, based on the estimated coefficient for deviations of supply from trend rather than on industrial production, suggests that sales of roughly six times that size would have been required (the estimated coefficient on OECD industrial production is about six times the coefficient for supply). But the supply coefficient has a downward bias, so we would judge that required sales might vary between 1 and 2 percent of U.S. consumption.

These are not enormous amounts, even if buffer stocks were designed to cover two booms of the magnitude of 1973's. However, the residuals of the fitted equation show that demand in late 1973 and early 1974 was not adequately explained by the movements in industrial production and in the supply of nonferrous metals. To make matters worse, even sales in 1973 from the U.S. strategic stockpile of lead and zinc of around one-fifth of U.S. consumption, and sales of tin of around one-third of consumption, did not prevent the sharp increase in prices (see table 9). The "speculative" demand thus absorbed the stockpile sales and still drove up prices.

The same regression equation can be used to estimate the stocks required to satisfy the total speculative demand for nonferrous metals at a price increase no greater than 15 percent above trend. The actual prices were more than 15 percent above trend during the fourth quarter of 1973 and the first half of 1974, for a cumulative total of 59 percentage points in excess of 15 percent over the three quarters (see figure 6). The quantities required to have prevented prices from rising above 15 percent over trend would have

Table 9. U.S. Stockpile Sales, Stocks, and Consumption, Selected Strategic Materials, 1971–74

Thousands of short tons

Activity, and year and half	*Copper*	*Lead*	*Rubber*	*Tin*	*Zinc*
Stockpile sales					
1971: First	0	3	0	1	0
Second	0	7	40	1	2
1972: First	0	18	28	*	78
Second	0	32	28	*	134
1973: First	0	70	37	2	108
Second	0	179	67	20	158
1974: First	231	143	36	25	175
Second	20	86	1	2	92
Stocks, December 1973					
Excess over strategic needs	252	764	182	213	437
Consumption, 1972					
United States	2,236	1,120	717*p*	62	1,417
World	8,718	4,592	3,493	258	6,086

Sources: General Services Administration, Office of Preparedness, *Stockpile Report to the Congress, July–December 1974* (GSA, 1975), and relevant preceding issues; Commodity Research Bureau, *Commodity Year Book, 1975* (1975), pp. 291, 294; American Metal Market, *Metal Statistics, 1975* (Fairchild, 1975), pp. 95, 149, 251, 281.

* Less than 500 short tons.

p Preliminary.

amounted to about 9 percent of annual U.S. consumption of nonferrous metals on the basis of the regression coefficient applicable to OECD industrial production, and about six times that on the basis of the regression coefficient applicable to world supply (the latter figure is biased for the reason given earlier).[32] To these figures would have to be added that portion (roughly 30 percent in the case of lead and zinc) of the stockpile sales to users of the metals—that is, the portion that did not go through U.S. producers.

Speculation by definition involves an attempt to profit from future shortages (or from future excess supply), and if the stockpiles had been large enough to satisfy the speculative demand that in fact developed, speculation would probably have been less intense than it actually was. This view has been expressed with respect to foodstuffs: depletion of the Commodity Credit Corporation's stocks of grains and other products has been seen

32. By the same management rule, a buffer stock would have had to *purchase* nonferrous metals during 1972 and in the fourth quarter of 1974 to keep relative prices from falling more than 15 percent below trend.

as a major factor in the sharp price increases of 1973.[33] But it must reckon with the large stocks of certain commodities in December 1973. The U.S. strategic stockpile held, in excess of so-called strategic requirements, amounts of tin equivalent to 77 percent of world consumption in 1973; for lead and zinc, the corresponding figures were 16 percent and almost 7 percent. Yet the prices of these products increased sharply with other commodity prices. The reason these large stocks did not prevent prices from rising may lie, however, in the General Services Administration's lack of authority to sell more than a small portion of these stocks. In view of the major political effort required to get congressional approval of GSA sales of any product produced in the United States, the "market" perhaps correctly discounted the possibility of large sales from the strategic stockpile. New authority did become available in late December 1973, but even that limited sales to only a small portion of excess holdings. Thus, the full GSA holdings were not available to the market. A further limitation on GSA sales was that some of its holdings had already been committed for sale under long-term contracts.

Perhaps if GSA had had full authority to dispose of its total surplus holdings of nonferrous metals and other commodities, the price developments of 1973–74 would have been very different. But at this stage that must remain a conjecture.

The International Tin Council does manage a buffer stock in an effort to keep world prices within a 20 percent range, and the council sold tin steadily during the first three quarters of 1973. But its holdings were small, amounting at the beginning of 1973 to only about 5 percent of world consumption. Sales of three-quarters of that amount were evidently inadequate to stem the combined real and speculative boom of that year.[34]

If properly managed buffer stocks hold out at least the possibility of stabilizing prices, what about the costs? These can be separated into three components: the capital costs (the forgone earnings) of carrying the stocks, the storage and maintenance costs, and the terms-of-trade costs of acquisi-

33. See Fred H. Sanderson, "The Great Food Fumble," *Science*, vol. 188 (May 9, 1975), pp. 503–09.

34. Of course, as the experience of the U.S. Treasury with respect to silver in the early sixties demonstrates, even an enormous "buffer" stock cannot prevent speculative purchases of a commodity if the trend of demand of the commodity for use is running ahead of prospective new production. Conversion of silver coins to copper and nickel held down silver prices for four years, until mid-1967; but then prices shot up.

tion. The last may actually be regarded as a benefit if the stocks are acquired during a period of weak demand and large downward price deviations are also thought to be undesirable.[35]

Carrying costs for metals are negligible: 0.03 percent of market value for the major nonferrous metals in the strategic stockpile during fiscal year 1974, for instance, or an average of under 25 cents a ton. On this basis, it would cost only about $225,000 a year to carry stocks of copper, lead, tin, and zinc equivalent to about 20 percent of annual U.S. consumption. Storage costs for agricultural raw materials are higher: GSA storage costs for natural rubber amounted to $3.96 a ton in fiscal 1974, for instance, or about 0.5 percent of average market value during the year.[36]

The major cost in carrying a buffer stock is the capital cost.[37] At 1971 prices, it would have cost $660 million to acquire stocks of copper, lead, tin, and zinc equivalent to 20 percent of U.S. consumption of those metals in 1972. Judgments vary on the true opportunity cost of government funds, but in real terms it probably lies between 5 and 10 percent; if so, the *annual* costs of carrying such buffer stocks of these nonferrous metals would be between $33 million and $66 million.

A calculation such as this must be taken with a grain of salt. But it probably points to the right magnitude of the costs to be weighed against the important, if less tangible, benefits that would flow from the stocks. Furthermore, price fluctuations themselves could be greatly reduced if management of aggregate demand could be improved to the point at which coordinated booms of the magnitude experienced in 1972–73, which set the stage for speculative purchases, and the subsequent coordinated slump, could be avoided.

35. If the commodity is primarily imported and the policy perspective is a national rather than a global one, however, this terms-of-trade effect must be reckoned a cost, although possibly a low one if the acquisitions are spread over a long period.

36. Data on carrying costs were provided by the U.S. General Services Administration.

37. The money a buffer stock makes by buying low and selling high may help to finance the operation, but it does not reduce the social costs of acquiring and carrying physical stocks. Those are real and must be set against any benefits that flow from price stabilization. Intervention in future markets need not require physical stocks, but substantial physical stocks would surely be necessary for preventing a sharp increase in speculative sentiment and for inhibiting the formation of supply-restricting cartels.

Comments and Discussion

Barry Bosworth: In this paper, Cooper and Lawrence have tried to trace the origins of the rise in prices of nonfood nonfuel commodities in 1972–74. The competing hypotheses that they examine are (1) an abnormally rapid growth in demand for consumption uses, (2) unusual shortfalls in supply, and (3) speculative activity. The study does examine nonfood agricultural raw materials, but the empirical work focuses upon nonferrous metals—a category in which copper accounts for two-thirds of the index that they use. They deflate this metals index by the index of world prices for traded manufactured commodities. Both the narrow range of the metals index and the choice of the deflator may affect some of their conclusions. As their figure 3 shows, in the deflated form they use, the rise of metals prices in 1973–74 is not abnormal compared with that in 1964–66. But this comparability of the two periods really is a story for copper since prices of most other basic commodities did not rise nearly as sharply in the earlier period. Also, their relative price deflator rose by 52 percent in the 1971–74 period compared with 32 percent for more general indexes such as the OECD deflator. Thus, it minimizes the rise in relative prices of metals in the latter period.

When the authors introduce a supply variable in their equations in table 4, I do not believe that primary refinery production is the appropriate choice. The measured negative effect is likely to represent an average of a negative and a positive association of quantities with price. First, changes in capacity, or disruptions due to strikes, will be inversely related to price. But, in addition, a reduction in price will lower production for a given capacity. The negative coefficient tells me that in industries with high fixed costs, the first effect dominates; but it is an underestimate of the influence

of supply disruptions on prices because of the inadequate distinction between shifts in the supply curve and movements along it. In a short-run model, refinery capacity would be a more relevant variable. Finally, there is no room in the model for the very large sales out of government stockpiles in some periods, and the view that production trends represent the equilibrium market condition requires some heroic assumptions.

The latter portions of the paper concentrate upon speculation, which I think must play a primary role in any interpretation of the 1973–74 period. It is unfortunate that conclusions about the role of speculation must be inferred from the residuals rather than more direct evidence. Moreover, the authors can only guess about the driving force behind the speculation. Was it an implication of basic market pressures? Since not all markets would have the same degree of capacity pressure, this explanation would suggest wide variation in relative price changes—which does not seem to have been the case. Did the uncertainties of the international financial system spur the speculation across a broad range of commodities? Or did it reflect an inflation-induced flight from money? But all of these explanations must also be applicable to the subsequent collapse of commodity prices.

A correct interpretation of the 1973–74 period is crucial to the final portion of the paper, which is concerned with stabilization schemes. For example, buffer-stock requirements vary substantially depending upon whether the problem is speculation, or disruptions in demand or supply. A speculative interpretation also would, in some cases, reduce expectations of a recurrence, since 1973–74 was an unusually turbulent period. Furthermore, the question is not one of adopting a system of buffer stocks against a history of no attempt to stabilize these markets. Indeed, the government had engaged in extensive stockpile activity. While everyone is aware of the previous existence of U.S. food reserves, GSA was also quite active in the metals markets. As table 9 indicates, in fiscal year 1974, stockpile sales represented about 10 percent of U.S. copper consumption, 30 percent for lead, 75 percent for tin, about 25 percent for zinc, and 15 percent for rubber. Not included in the table are aluminum sales equal to about 15 percent of primary production.

Finally, I would emphasize, more than the authors do, the importance of raw-materials prices for the general price level. Although a 14½ percent price increase in these products is required to raise the U.S. consumer price index by 1 percent, when one realizes that the metals price index doubled

and agricultural raw materials items rose even more than that, the impact does not seem so small. A combination of market structure, controls, and GSA sales held down increases in producer prices in the United States, but price increases in steel, aluminum, other metals, fibers, lumber, and paper have been serious cause for concern in previous inflations. If one believes that such sudden relative price increases initiate strong inflationary forces within the domestic economy because of institutional arrangements (a rachet process), they become even more significant.

Hendrik S. Houthakker: I read this paper with mixed feelings. The idea of investigating the overall behavior of commodity prices is a good one and in some ways the authors have added considerably to our knowledge. However, two self-imposed limitations—the neglect of food commodities and the neglect of energy commodities—compromise the usefulness of the paper as an analysis of commodity prices.

As Barry Bosworth noted, the story here is basically a copper story. This is not the authors' purpose, but the metals index they use happens to give a very heavy weight to copper. Unfortunately, as a copper story, it is not a very good one, because much more could be said about copper than this paper reflects. Rather than go through the paper in detail, I can associate myself with most of the comments and questions that Bosworth raised. Therefore, let me first put forward an alternative hypothesis concerning the development of commodity prices during the great inflation of 1972 to early 1975 and then comment on a few specific points.

My hypothesis is that commodity markets are inherently more sensitive to supply and demand changes than are any other markets in the economy. In fact, institutional factors such as information facilities and contract forms are conducive to price sensitivity. So, it is very easy for such markets to register both large and small differences in supply and demand. What I think we are observing in these markets is the intensification of inflationary pressure that began in 1972. I would attribute this increase in general to the breakdown of the Bretton Woods system and in particular to the large accumulation of international reserves between 1969 and 1972. Such an accumulation created a tremendous amount of excess purchasing power. And, while in most markets, excess demand generally takes a long time to show up in prices, it showed up quite rapidly in the sensitive commodity markets.

The full impact of the very strong inflationary pressures that culminated

during 1972 was concentrated on commodity markets as the inflationary pressures raised the demand for inventories of raw materials by users. This extraordinary rise in raw-materials demand is not captured by the normal relation between raw materials and the demand for final goods, represented by industrial production, that the authors rely on. Then, as inflationary pressures were alleviated by general price increases, there was a corresponding negative reaction in commodity prices—the necessary sequel to what went before. I do not think that the Cooper-Lawrence effort to relate these price movements primarily to changes in industrial production has been fruitless; but while they can offer some insights into the price increases in this way, they certainly cannot explain everything.

I would like to offer several specific comments on the particular model and methods used by the authors. First, I do not agree with the use of relative prices and deviations from trends as variables in the regressions. If my hypothesis is correct and commodity prices were the first to rise, deflating commodity prices by industrial prices creates quite an obscure model. I feel it would have been more illuminating if Cooper and Lawrence had tried to explain changes in commodity prices without deflation and without deviations from trend as well as with these adjustments. Perhaps this would have provided a clearer picture of how their approach contributes to the explanation of price increases. Second, Cooper and Lawrence consider industrial production only in the OECD area. However, USSR and Chinese purchases often have a major impact on these markets; for instance, China has been a factor of some importance in the copper market. I suggest that imports of these countries should be considered in an analysis of world commodity prices.

Third, I feel that the term "speculation" is used too loosely in this paper. Is it speculation if a shoe manufacturer buys more hides than he usually does—or is this anticipatory hedging? It is misleading to call all the many different activities in these markets "speculation." Furthermore, considering that the major emphasis in the paper is speculation, the data used seem inadequate, since they were from a secondary source. It would have been useful to examine the notion that speculation was a major factor in the price movements by examining data on open interest by type of position (large hedgers, large speculators, and small traders), which are available for some American markets.

Finally, I would like to raise a question about the treatment of buffer stocks. Cooper and Lawrence referred to the social costs of acquiring and

carrying such stocks. If the stocks are acquired to stabilize prices and are successful in doing this, there would be a profit, so what would the social cost consist of?

General Discussion

The panel actively discussed the importance Cooper and Lawrence gave to speculation as an explanation of the recent commodity-price boom. Robert Solomon criticized the authors for attributing to speculation all of the price movement that their equation could not explain, and found their evidence for this interpretation unconvincing. He expressed particular surprise at the importance they attributed to movements in exchange rates in explaining commodity speculation, and wanted the authors to expand their explanation of how fluctuating exchange rates affect commodity prices. Furthermore, Solomon questioned the relationship between the price of gold and of other commodities in 1973–74. In response, Cooper stated that there were two links between currency fluctuations and the purchase of commodities. First, he recalled, dollars had been considered "as good as gold" and then were twice devalued and allowed to float. Countries that were long in dollars might have found it politically acceptable to convert dollars into commodities (or to encourage the private sector to do so). Japan, for instance, bought commodities well in excess of her needs, and may actually have been trying to unload dollars. Second, manufacturers might have wanted to purchase commodities in the face of floating exchange rates because they were risk averters. They preferred to purchase commodities ahead of actual need in order to get them at a known price.

Arthur Okun agreed with Cooper, explaining that the introduction of exchange-rate risk will make currencies as a group less attractive. Thus, the decrease in dollar holdings will not be fully offset by an increase in holdings of other types of currency. James Tobin noted that this phenomenon depended on the covariance matrix relating the risks in different assets. Cooper agreed, but suggested a strong presumption in favor of Okun's view. Consider a fabricator who relies on world markets for inputs and who is suddenly confronted with a movement in exchange rates. His knowledge about currencies is so much less than his knowledge about the commodity that it makes more sense for him to go into the commodity whose market he knows than to go from dollars into marks.

Gardner Ackley argued that a speculative interpretation of the recent boom was necessary, as it was in the 1950–51 experience. However, he noted an interesting difference between the two booms. In the fifties, the boom in industrial production continued for several years after the end of the commodity-price speculation, with the U.S. unemployment rate declining to around 3 percent. In connection with this difference, Ackley thought that the paper did not pay enough attention to the impact of price controls on the commodity-price boom of 1950–51, which he felt probably played a major role in ending the speculative boom. Also on this subject of controls, Fred Bergsten questioned the view that price controls were not possible without export controls. In World War II and the first few years afterward, price controls were not coupled with export controls but were applied to exports as well as to domestic sales. Bergsten felt that this experience should be studied before one concluded that price controls and export controls must coincide.

Lawrence Krause found it useful to distinguish two types of speculation; speculative buying for fear of unavailability and speculative buying in anticipation of price rises. The distinction is important because the two different types can be modified in different ways. Buffer stocks can reduce the speculative buying that arises from the questionable availability of a commodity, while action in the forward market can defuse speculation over prices that is not grounded in the supply-demand balance. Krause noted that it would be useful to find a way to measure the "supply constraint" speculation. Cooper and William Nordhaus agreed with Krause's perception of the problem, and Cooper went on to remark that this distinction is also one of the major differences between the commodity-price boom of the early fifties, which reflected fears about availability, and that of the early seventies. Frank Schiff felt that concern over availability could be connected with fear of controls as well, and that such concern probably did play an important role in the recent commodity-price boom.

The panel focused on stocks and stockpile management as one way of averting price increases due to speculation. Ackley noted how important stocks were in determining the current prices of commodities. The metals studied by Cooper and Lawrence, he observed, are commodities with large stocks relative to current production flows. As a result, the rate of release and accumulation of stocks is an important factor in the determination of commodity prices, and conversely, expectations about price changes are an important influence on the rate of stock accumulation and hence on actual

prices. Lawrence Klein noted that a good deal of valuable information on stocks could be gathered from trade associations and might measurably improve the equations. He also pointed out that the disposal of stocks by GSA is often influenced by diplomatic and other considerations that should be taken into account in explaining price-stabilization activity.

Nordhaus saw no reason why buffer stocks had to be positive. He felt that physical holdings were not necessary because one could play the forward market. If a short position were desirable, the answer was to take a short position in the forward market. He noted that if buffer stocks were operated in such a fashion, the capital costs of keeping them would fluctuate around zero in the long run. Cooper answered that Nordhaus was correct with respect to speculation due to concern over price, but when speculation rose from the fears of inadequate supply, physical stocks were necessary.

Robert Solow and Klein offered suggestions on the form of the equations and variables used. Solow pointed out an inconsistency in form between the table 2 and table 4 equations. The regressions in table 2 could be considered as a reduced form from a demand-and-supply analysis, with the U.S. and other OECD production relative to trend acting as a measure of demand shifts. To carry through this reduced form in table 4 requires a measure of supply shifts, which the supply (production) of materials does not provide. Cooper and Lawrence agreed, but noted that their attempts to cite explicit measures of capacity were not very successful and worked only in an equation that also included supply. Solow also noted that a model with a nonlinear supply curve that became very inelastic at high levels of output would have been plausible a priori and would have had a better chance of explaining the large increases in prices in 1973–74. Cooper replied that a squared supply term was tried in the regressions but was insignificant.

Klein offered several suggestions for improving the variables used by the authors. He agreed that raw-materials prices should be deflated, as the authors had done, but questioned the particular price index they had used. A more appropriate deflator would have consisted of the prices of the capital goods and consumer goods that countries that produce raw materials were buying. Klein also argued that pressure on capacity should have been measured more directly as the appropriate variable for explaining prices. He believed that capacity pressure in raw-materials industries was very high in 1972–73, in contrast to the measure of production relative to trend, and

felt that capturing this fact would have improved the equations and their predictions of the recent period.

Klein also urged the importance of more disaggregation and attention to specific market conditions in analyzing raw-materials markets. For instance, on the supply side, in recent years the political and social situation in the Congo and Chile were important in the case of copper. Similarly, on the demand side, developments in the steel industry are directly relevant to explaining the situation in iron ore. Klein reported that good price relations could be obtained by proceeding in that fashion for thirty or so commodities. Cooper accepted Klein's point, but argued that the commodity boom was a very general phenomenon and that much might have been missed by concentrating on individual commodities.