Commodity prices in the 1970s

This article, which has been prepared by C A Enoch and M Panić of the Bank's Economics Division, examines the behaviour of certain commodity prices during the 1970s, and compares this with the experience of the two previous decades. The increases in commodity prices during the 1972–74 boom were unprecedently large; and whereas when prices had previously risen sharply they had soon fallen back, by the end of the 1970s commodity prices were generally higher than they had been in 1972–74. In the 1970s commodity prices seem to have responded more quickly and sharply than before to changes in economic activity; econometric evidence for this is provided in the appendix to the article.

Introduction

The enormous increases in the price of oil over the past decade have tended to eclipse the large and often spectacular increases in the prices of other primary products which took place over the same period. Many of these prices began to rise sharply before the quadrupling of oil prices in 1973–74; and, having risen to very high levels in the early 1970s, most of them have tended to remain there. Moreover, commodity prices appear to have been much more sensitive to changes in world economic activity and demand over this period than they were during the two decades following the Korean War boom. Given the potential impact of commodity prices on world inflation, these developments deserve closer attention than they often receive. Moreover, as commodity prices influence other prices and are, in turn, influenced by them, it is important to analyse movements in both nominal and 'real' prices.

The aim of this article is to describe briefly movements in prices of commodities other than fuels and precious metals during the 1970s and to compare them with experience during the preceding two decades; to assess the response of commodity prices to some of the more important factors that influence them; and to suggest reasons for the changes in behaviour that have been observed during the past decade.

There are always considerable problems in analysing commodity prices. The variety of primary products is such that the aggregate price indices may often be arbitrary. Moreover, many commodities tend also to be produced and traded under widely different conditions, so that it is difficult to obtain representative price quotes. Overall, therefore, the results reported later in the paper and some of the conclusions are, unavoidably, tentative.

Commodity prices in the 1970s

One of the difficulties in analysing commodity prices is that different indices can give a conflicting picture both of trends over a particular period and of fluctuations around the trends.[1] The aggregate indices often differ in the type of prices (e.g. spot or contract) which they incorporate, the number of commodities which they cover, and the weights assigned to each commodity.

As a precaution against the distortions that might arise from relying entirely on one particular index, two of the most widely employed indices of commodity prices have been used in this article, those compiled by the United Nations (UN) and by *The Economist*.[2]

Both indices reflect changes in prices expressed in US dollars. But they differ in two important respects. First, the UN indices include a greater number of commodities than the *Economist* indices, so that the changes which they record are less dependent on the price movements of one or two commodities with large weights. Second, the UN indices—based on specific price quotations in countries which are major traders in a particular commodity—are intended to show, so far as this is possible, actual changes in prices of commodities traded internationally.[3] The *Economist* indices, on the other hand, are confined to those commodities which are traded on markets in the United Kingdom and the United States and exclude commodities such as aluminium, nickel and woodpulp, which are traded predominantly at producers' prices.[4]

Despite these differences, the two sets of indices show a broadly similar pattern of changes in commodity prices, both in the short run and in the long run. For instance, Charts A and B show a slight but steady decline in commodity prices, measured in dollars, between the Korean War boom and the early 1960s. This was followed by a modest recovery in nominal prices until the beginning of the 1970s; but real prices (i.e. commodity prices relative to those of manufactured goods) continued to decline, though less sharply than during the 1950s. In fact, given the

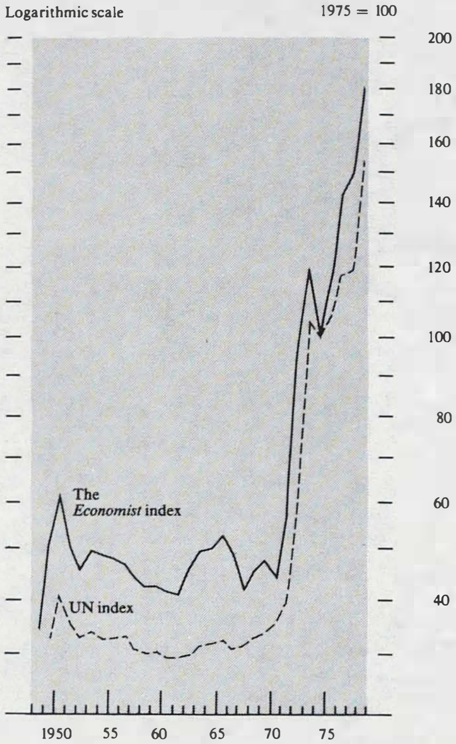
(1) This is shown clearly in a recent study of long-term trends in real terms of trade of primary commodities. See J Spraos, 'The statistical debate on the net barter terms of trade between primary commodities and manufactures', *The Economic Journal*, vol. 90, no. 357, March 1980.

(2) Used with permission.

(3) *Methods used in compiling the United Nations price indexes for basic commodities in international trade*, United Nations Statistical Papers (series M, no. 29 rev. 2) 1979.

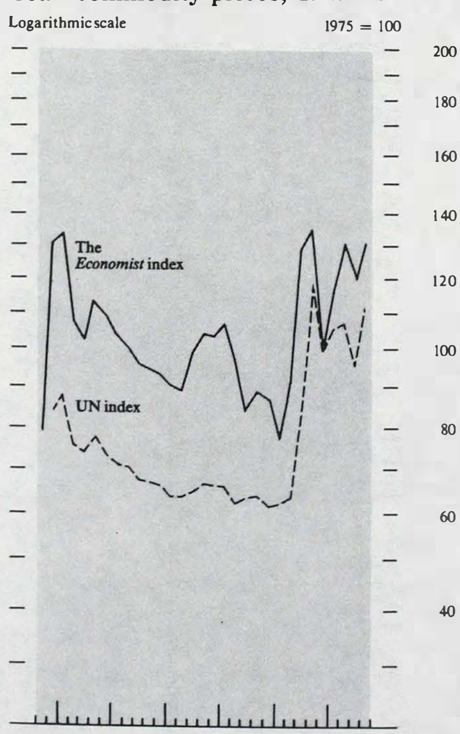
(4) 'The Economist commodity indicator updated', *The Economist*, 5 January 1974.

Chart A
The *Economist* and UN indices of 'nominal' commodity prices, 1949–79[(a)]



(a) All price indices are defined in dollars.

Chart B
The *Economist* and UN indices of 'real' commodity prices, 1949–79



acceleration in the growth of world industrial production (from an annual average of 4½% in 1952–61 to 6¾% in 1961–71) the annual increases in nominal terms during the 1960s were extremely modest—about 0.7% according to the *Economist* all-items index and 1.8% according to the overall UN index.

In the early 1970s, however, there was a sudden change, with both indices showing one of the biggest increases in commodity prices on record. Differences in the composition of the two indices produce a slight variation in the timing of the upsurge in prices. The *Economist* index shows 1972 and 1973 as the years when the biggest increases took place, while according to the UN index these happened in 1973 and 1974. But both indices agree that there was a decline in commodity prices during the 1975 recession, and that the upturn in world economic activity in 1976 brought a recovery in prices. At the end of the 1970s commodity prices were higher in nominal terms than in 1974, and even in real terms they almost recovered to 1974 levels, despite a substantial reduction—from 6¾% in 1961–71 to 3½% in 1971–79—in the annual rate of growth of world industrial production. Moreover, the increases in the 1970s were not confined to any single group of primary products. Prices of foodstuffs, agricultural raw materials and metals all increased sharply in 1972–74, fell in 1975, and then went up again strongly in 1976–77 and in 1978–79 (Charts C–E).

The frequency and scale of these changes in commodity prices appear to be rather different from their behaviour during the previous two decades. For instance, Chart C shows only two increases of any note in food prices between the Korean War and the early 1970s—in 1954 and 1963. (The two increases are pronounced in the *Economist* food index because they mainly reflect changes in the price of coffee, which has by far the greatest weight in that index.) In the 1970s, on the other hand, prices of a number of important foodstuffs, such as wheat, maize and soyabeans, showed a degree of short-term variability very similar to that of metals.

Prices of agricultural raw materials were generally quite stable during the 1950s and the 1960s (see Chart D). This does not seem to be the result of the weighted average smoothing much greater variations in its components. The prices of individual commodities which comprise these particular indices, such as cotton, forestry products, natural rubber, wool and tobacco were all fairly stable over most of the period. Since the early 1970s, on the other hand, many of the prices have fluctuated a good deal.[(1)]

Metal prices, as Chart E shows, tend to vary considerably over the cycle, both in nominal and real terms. Unlike the other two commodity groups, they increased very substantially in the first half of the 1960s. Most of this can probably be attributed to a sharp rise in the price of copper, which has a large weight in both the UN and the *Economist* indices, though prices of zinc, lead and tin also increased

(1) See International Bank for Reconstruction and Development, *Commodity trade and price trends* (John Hopkins University Press: Baltimore and London, 1980).

Chart C
Food prices and world industrial production, 1950–79

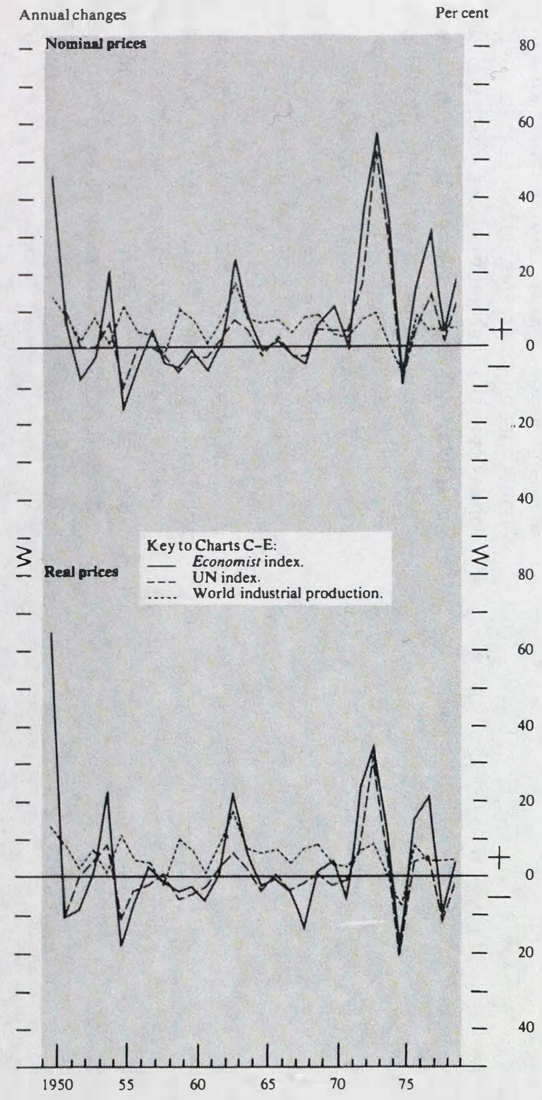


Chart D
Agricultural raw materials and world industrial production, 1950–79

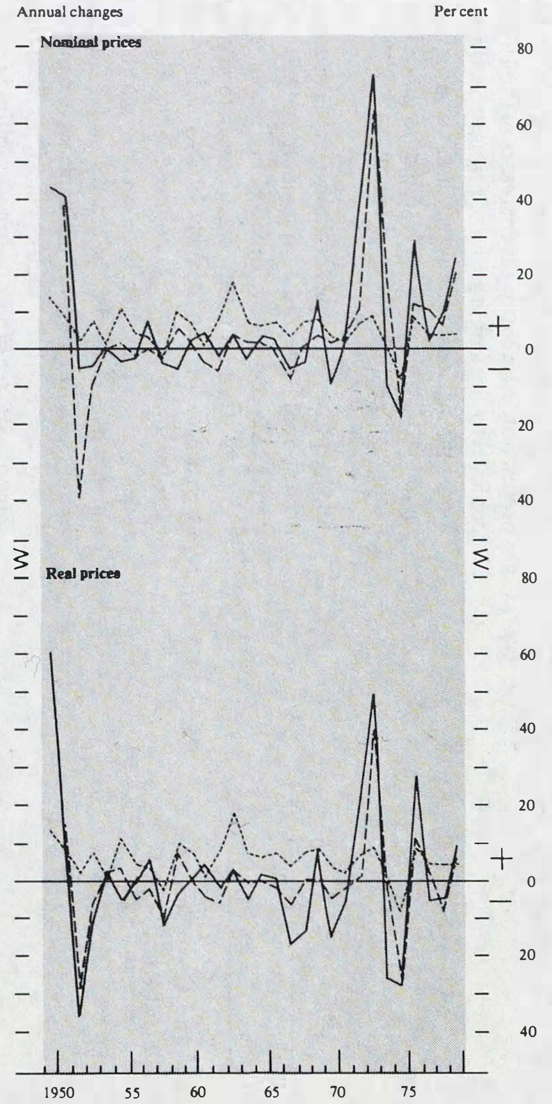
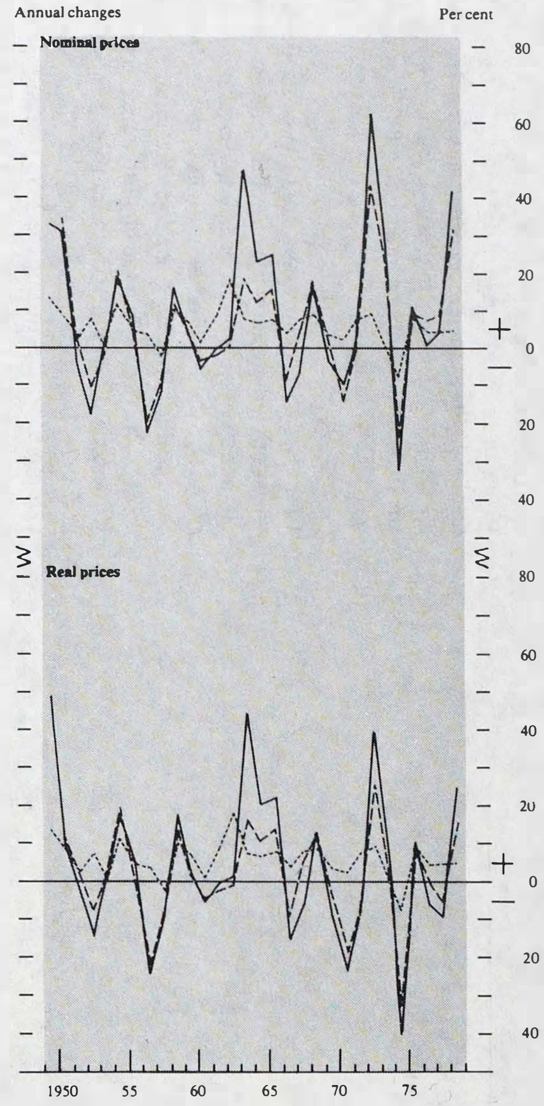


Chart E
Metal prices and world industrial production, 1950–79



during the 1964 boom. More recently, the prices of all these metals, as well as of aluminium and nickel, rose sharply in 1972–74, then fell in 1975, before rising again, in some cases quite steeply, in 1976–77 and 1979.

An analysis of quarterly changes in world commodity prices shows high and statistically significant correlations between a number of important prices during the 1970s, especially over 1968–74.(1) For example, quarterly changes in prices of copper, zinc, tin and lead are highly correlated with one another. At the same time, these prices tend to be highly and significantly correlated with quarterly movements in prices of agricultural raw materials, particularly natural rubber, cotton and forestry products—and also, as already pointed out, with prices of certain foodstuffs such as wheat, maize and soyabeans. All these commodities have fairly large weights in the UN and *Economist* indices, reflecting the fact that they account for a high proportion of world trade in primary products. Hence, the recent behaviour of the two sets of indices seems to indicate some widespread underlying developments rather than changes in prices of a few dominant commodities.

There have been three developments in world commodity prices since 1970 which appear to be distinctly new:(2)

- Increases in commodity prices during the 1972–74 boom were unprecedentedly large: no comparable rises seem to have occurred before in peace time, at least over the last 120 years covered by the *Economist* index.(3)
- On each of the previous occasions when there was a significant increase in world commodity prices—the American Civil War, the two World Wars and the Korean War—the high levels were not maintained for long. They were usually soon followed, first by a sharp fall in prices, and then by a prolonged period of small, but steady decline. In contrast, commodity prices at the end of the 1970s were higher in nominal terms than in 1972–74, and many almost recovered even in real terms to the levels reached during the 1973 boom.
- Charts C–E suggest that commodity prices may have responded more quickly and sharply to changes in world economic activity in the 1970s than they did during the previous two decades.

Determinants of commodity prices

Although the commodities boom of 1972–74 was unique in peace time, a number of the factors which influenced primary product prices then, especially those of industrial materials, appear also to have been present during the rest of the decade, though on a more modest scale. They include: synchronisation of the business cycle in major industrial countries; inadequate stocks at the beginning of cyclical upswings; increases in production costs; speculative demand for commodities brought about by the instability of major currencies; and inadequate expansion of productive capacity during the previous cycle. In addition, there were a number of crop failures in the early 1970s, as well as later in the decade.

Cyclical factors

As metals and agricultural raw materials are essential inputs in industrial processes, it is to be expected that short-run fluctuations in world industrial activity should be one of the major determinants of commodity prices in the short run. But the extent to which changes in the level of activity influence the short-run behaviour of primary product prices will depend on at least two factors. First, it will depend on the short-run stability of industrial output. The greater the instability, the greater will be shifts in world demand for raw materials and, other factors remaining similar, in their prices. There is little doubt that in the 1970s there was not only a significant slowing down in the rate of growth of world industrial output, but also, compared with the 1950s and the 1960s, an appreciable increase in its fluctuations over the cycle. This may have been at least partly due to the increased synchronisation of the business cycle across countries.(4) In any event, the change has almost certainly produced more pronounced cyclical variations in demand for industrial materials.

World industrial production

	1952–61	1961–71	1971–79
Average annual rate of growth	4.5%	6.7%	3.5%
Standard deviation	4.0	4.3	4.9
Coefficient of variation	88.9%	64.2%	140.0%

Second, the short-run impact of changes in industrial activity on commodity prices will depend also on the stocks of these commodities held by consumers and producers at the turning points of the cycle. If, for instance, producers or consumers (or both) start to hold lower stocks at the start of a cyclical upswing—for reasons other than a major technical change in the production process—commodity prices will tend to become more sensitive to increases in demand. Moreover, at least some producers may be unwilling to run their stocks down rapidly when demand picks up if the increase in demand leads, or is expected to lead, to a significant increase in prices. Unfortunately, data on stocks of raw materials are either inadequate or, in most cases, not available. There is, however, evidence that consumers have tended to hold lower stocks of primary products since the early 1970s than during the previous two decades. There are a number of reasons for this: greater uncertainty about the strength and length of economic recoveries; the high cost of holding stocks; and the ease with which, once demand picks up, higher costs can often be passed on, in an inflationary environment, in higher prices.

(1) This conclusion is based on the work reported in an unpublished Bank of England paper by Mrs J L Hedges, *Inter-relationships between commodity prices*.

(2) See, for instance, R N Cooper and R Z Lawrence, 'The 1972–75 commodity boom', *Brookings Papers on Economic Activity*, no. 3, 1975; and G F Ray, "The 'real' price of primary products", *NIESR Economic Review*, no. 81, August 1977.

(3) See, for instance, Ray, "The 'real' price of primary products".

(4) 'The degree of economic interdependence seems to have been, if anything, greater since 1973 than before, particularly among European countries . . .' J R Artus and J H Young, 'Fixed and flexible exchange rates: a renewal of the debate', *IMF Staff Papers*, vol. 26, no. 4, December 1979, page 668. See also OECD, *Economic outlook*, July 1980, page 18.

Apart from changes in industrial activity, a number of other factors appear to have had an increasingly important influence on the short-term behaviour of commodity prices.

Energy costs are an important component of total costs in the production of many primary commodities, both directly (e.g. in the case of aluminium) and indirectly (e.g. in agricultural production through the use of fertilisers). Moreover, synthetics derived from oil are often the most important substitutes for agricultural raw materials. Energy costs are also an important part of transportation costs. As a result of large increases in the prices of oil and other fuels in the 1970s, these costs and prices have risen significantly.

The extent of speculative activity is never easy to establish with certainty. Nevertheless, in the periods of highly unstable exchange rates and accelerating inflation—e.g. in 1972–74, in the first half of 1977 and in the second half of 1979—there were signs of a switch from currencies into 'real' assets such as certain primary commodities. These periods were also those of recoveries in economic activity. Hence, cyclical upswings in the 1970s seem to have been associated with speculative as well as 'trade' demand for primary commodities.(1)

Finally, good arable land, which seems to be increasingly in limited supply, can be switched from food to industrial crops such as cotton, and vice versa, according to changes in the relative prices. Responses of this kind to short-term price fluctuations may well explain at least some of the observed increase in sensitivity over the past decade of prices of agricultural raw materials, and even of certain foodstuffs, to changes in world industrial activity. In the case of foodstuffs, the high income elasticity of demand for certain products in developing countries is probably an even more important reason for the surprising sensitivity of their prices to changes in industrial activity in the 1970s. In other words, changes in industrial activity influence the prices of raw materials and, in this way, the incomes of primary producers. Variations in primary producers' incomes are then reflected in significant short-run changes in demand for certain foodstuffs and thus in their prices.

Longer-term influences

The impact of the changes which have influenced the short-run behaviour of commodity prices since the early 1970s has probably been intensified by a number of medium to longer-term developments, which seem to have adversely affected investment, and thus the productive capacity of many primary products. In periods of rapid increases in demand, commodity prices are also likely to reflect investments and disinvestments made in the years preceding the upturn.

Generalisations are always dangerous in the case of primary commodities, as developments can vary considerably even within a broadly similar group, such as metals. There was, for instance, a significant increase in the productive capacity of zinc—but not of aluminium and copper—in the second half of the 1970s, even though for all of them there were major increases in prices in the early part of the decade. Nevertheless, it seems that increases in productive capacity in response to higher prices were not as great in the 1970s as before.(2)

There are a number of reasons for this. The experience during the two decades following the Korean War—when excess capacity depressed prices despite exceptionally rapid growth in world industrial production—has probably made many primary producers rather cautious. After 1973, the increasingly uncertain prospects for world economic growth provided further justification for a more careful approach to expanding productive capacity. Furthermore, most primary production is now controlled by governments and large corporations, which are likely to pay much more attention to long-term demand prospects before expanding capacity, rather than act precipitately in response to a temporary increase in prices, as small producers might be tempted to do.

Much of the world's natural resources are located in the developing countries. Most of these countries gained independence in the 1950s and the early 1960s, and investment in many of them has been regarded as involving some political risk. Whether justified or not, these views have almost certainly led since the mid-1960s to reduced investment in the primary producing sectors of such countries. Given that developing countries have limited capacity to develop their own resources, this has probably reduced the availability of certain raw materials.

There has also been a significant increase over the past two decades in the size and capital intensity of mining projects. In the economic environment that has prevailed since the early 1970s, this can create a number of problems, all of which may delay or even discourage new investment. Capital intensive projects are generally also energy intensive, and energy costs have soared since 1973. Moreover, the more capital intensive the method of production the higher will be the cost of keeping productive capacity idle, which increases the likelihood of losses in a stagnant and uncertain economic environment. Furthermore, the scale and long lead times (often of up to ten years) of new mining projects are also likely to create financing problems in a world of slow growth, low profitability, and the high cost of raising capital externally.

At the same time, the productive capacity of certain commodities has been deliberately reduced. In some cases (e.g. coffee bushes in Brazil before the frosts of the mid-1970s) this was prompted by a desire to avoid overproduction and depressed prices. In others (e.g. zinc smelting in the later 1960s and early 1970s), increases in

(1) See also Cooper and Lawrence, 'The 1972–75 commodity boom' and E C Hwa, 'Price determination in several international primary commodity markets: a structural analysis', *IMF Staff Papers*, vol. 26, no. 1, March 1979.

(2) The 'McCracken Report' warned a few years ago that, '. . . present information on investment intentions suggests that in the early 1980s productive capacity for some industrial raw materials might become insufficient'. *Towards full employment and price stability*, (OECD: Paris 1977, page 16). See also R F Mikesell, *New patterns of world mineral development* (British-North American Committee, 1979).

costs—in many cases caused by more vigorous environmental requirements—made some of the old plants unprofitable.

Together, these factors have probably been responsible for most of the upward shift in world commodity prices during the 1970s. On the other hand, reductions in the levels of stocks normally held by consumers, higher energy prices and speculative demand for commodities probably account for a significant proportion of the observed short-run fluctuations in primary product prices.

Some econometric evidence

Most of the preceding analysis is difficult to quantify, either because the data are not available or because of the diversity of products which comprise the aggregate indices of commodity prices. It is, however, possible to test the simpler observation that commodity prices seem to have become more sensitive over the past decade to changes in world industrial production and oil prices—two of the determinants which are easily quantifiable. The results of such a test are described briefly in this section and in more detail in the appendix. The appendix also contains some of the relevant tables and a brief description of the basic model.

The analysis covers a period of slightly over twenty years, from 1957 (when all the relevant data became available on a quarterly basis) until 1979; and two sub-periods: 1957 Q2 (and later quarters when the equation includes lags) to 1969 Q4, and 1970 Q1 to 1979 Q3. The division is inevitably rough and somewhat arbitrary. In many instances the change would have taken place over a number of years rather than abruptly during a particular cycle. But the division makes it possible to test the extent to which behaviour in the 1970s was significantly different from the earlier period.

As can be seen from the appendix, the same model was used in all cases to estimate the effect of changes in world industrial activity,(1) oil prices and prices of manufactured goods on the commodity prices shown in Charts A–E. A Chow test was performed for each of the aggregate indices to see if there was evidence of a structural break in the equation. The results support the observation that in the case of the major aggregates the two sub-periods are in fact different. The exception is the *Economist* index for foodstuffs, where only the 'real' equation showed significant evidence of a break.(2)

The elasticities of responses in world commodity prices to changes in industrial activity and oil prices—both of which indicate in some cases appreciable changes in behaviour—are summarised in the table below. Changes are particularly apparent in the short-run 'activity' elasticities, i.e. the short-run responses of commodity prices to changes in world industrial activity. The equations used included world export prices of manufactured goods and were generally (virtually) homogeneous.

For instance, the short-run activity elasticities for the *Economist* all-items index increased from 2.0 for the whole period (small and statistically insignificant in 1957–69) to 3.1 in the 1970s. In other words, other things remaining equal, an increase in world industrial output of, say, 7% would lead, in the short run, to an increase in world commodity prices of 22%. Judged by the experience of recent years, 7% may seem unrealistically high; but between 1959 and 1970 an annual increase in world industrial production of at least 7% or more occurred in seven of the eleven years. As already pointed out, this produced very small increases in nominal commodity prices and a steady decline in real prices. The elasticity of 3.1 for the 1970s, on the other hand, indicates that under the rather different conditions of that decade annual increases in

Industrial activity and energy elasticities in commodity price equations(a)

	Elasticity of commodity prices in response to changes in world industrial production						Short-run elasticity of commodity prices in response to changes in world oil prices		
	Short run			Long run					
	1957–79	1957–69	1970–79	1957–79	1957–69	1970–79	1957–79	1957–69	1970–79
Metals									
Economist	1.53	0.87	3.87	3.18	3.22	3.15	0.27	0.01	0.43
UN	1.03	0.55	2.60	1.56	0.83	1.76	0.23	−0.17	0.33
Agricultural raw materials									
Economist(b)	1.46	0.72	3.48	—	—	—	0.03	0.19	0.01
UN	0.37	0.26	3.32	1.62	0.87	1.91	0.18	−0.01	0.20
Foodstuffs									
Economist	2.39	0.43	2.60	2.30	2.49	3.71	0.11	0.09	0.02
UN	0.80	0.07	2.49	—	—	—	0.23	0.11	0.25
All prices									
Economist	2.00	0.39	3.08	2.33	2.18	4.34	—	—	—

(a) All the equations were estimated with nominal commodity prices as the dependent variable and without imposing any 'constraints'. They also included world prices of manufactured goods and were generally (virtually) homogeneous.

(b) Fibres only.

(1) The effect of changes in activity on the short-run behaviour of world commodity prices will depend to a great extent, as pointed out in the previous section, on the level of stocks held by producers and consumers of primary products. Unfortunately, these data are not available.

(2) It might be suspected that the results were obtained only because of the large changes in commodity prices in 1972–74. Equations were therefore run to test for this possibility. In general, they did not affect the conclusions reported in this section. (See the appendix for further details.)

world output of apparently quite feasible magnitudes would lead to very substantial rises in world prices of primary products.

It is also clear from the table that changes in the short-run elasticities are not confined to any one group of commodities, although the changes appear to be particularly large in the UN indices (especially for agricultural raw materials and foodstuffs), which cover a much wider range of commodities than the *Economist* indices. But the elasticities which the two give for the 1970s are very similar, except in the case of metals. They show that, other things remaining equal, an increase of 10% in world industrial production would lead to short-run rises in commodity prices ranging from 25% (foodstuffs) to 39% (non-ferrous metals covered by the *Economist* index).

The evidence for changes in the long-run price responses to changes in industrial activity is much more mixed—though the long-run properties of the equations were often not determined as well as the short-run properties. The *Economist* all-items index, for example, indicates a far from negligible increase in the long-run 'activity' elasticity, from 2.2 in 1957–69 to 4.3 in 1970–79. At the more disaggregated level, however, the increase is confined, rather surprisingly, to the behaviour of the the *Economist* prices of foodstuffs, and is not evident in those for metals. The UN indices show some increases for metals and agricultural raw materials, though these are much smaller than the changes in the short-run elasticities.

There is also evidence in the 1970s of a significant effect of changes in the price of oil on the short-run price of metals. For instance, the *Economist* metals index gives an elasticity of slightly above 0.4, while the UN index indicates a slightly lower elasticity of 0.3. In other words, other things being equal, an increase in the price of oil of 10% will raise the world price of metals by 3%–4%. But, given that oil price increases have in recent years also tended to follow increases in world economic activity, the effect of an expansion in world industrial output on primary product prices may now be very considerable.

Finally, the estimates shown in the appendix indicate that the response of commodity prices to changes in industrial activity and oil prices tends to be very rapid: most of it seems to occur within one to two quarters.

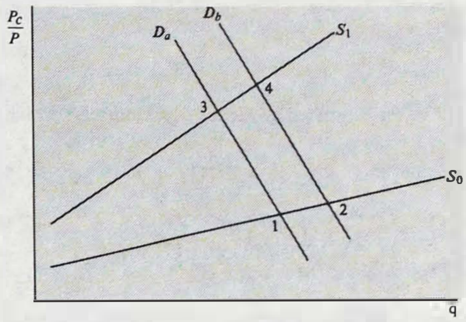
Conclusions

Since the early 1970s world commodity prices appear to have become much more sensitive to short-run changes in world industrial activity than they were during the two preceding decades. To the extent that slow growth of output and investment, exchange rate instability and growing uncertainty about world economic prospects continue into the 1980s, the phenomenon of sharply rising commodity prices in cyclical upturns is likely to do so also.

This is certain to increase the problem of lowering the world rate of inflation, at least during the 1980s. Slow growth of output can depress commodity prices for some time, but by reducing investment and increasing disinvestment in primary production, this would only tend to exacerbate the difficulties in the long run.

Appendix

Some of the developments discussed in the article can be clarified with the help of the simple supply-demand diagram shown below. The diagram abstracts from any long-run trends. S_0 represents the pre-1970 supply curve, S_1 the supply curve of the 1970s: the curve has tilted and/or moved to the left, for reasons explained in the main text. The two schedules D_a and D_b indicate the demand for commodities at cyclical troughs and peaks, respectively.



Thus in the 1960s, commodity markets moved along the S_0 schedule between points 1 and 2. The shift in the supply schedule, roughly contemporaneous with the cyclical peak of 1972–73, led to a move from point 1 to point 4. The subsequent downturn merely led prices to fall back along the S_1 schedule to point 3. Prices therefore remained higher at the end of the 1970s than they had done in earlier recessions because the tight supply conditions underlying the S_1 schedule continued to hold. The main reasons for this shift were probably the inadequate capacity following years of low real prices, the inadequate level of stocks, and higher energy prices.

Further commodity price 'explosions' could arise if the supply curve were to shift further to the left: this could happen if, for example, oil prices increased substantially, or if sluggish growth in industrial output were to lead to further reductions in capacity. (On the other hand, high real prices might stimulate investment and cause a rightward shift of the curve.) In the absence of further shifts in the supply schedule the apparent ratchet effect of the 1970s may not operate again. It is worth noting that, once on a given supply curve, price decreases in downturns should also be greater, although the price level at the end of the downturn would be higher than on the previous supply curve.

These factors are presented more formally in the model described below.

The basic model

Equation 1 below shows a typical function for the quantity demanded of a primary commodity (all prices are in dollars):

$$Q_D \quad = f(WIP, P_c, P_{oc}, PXWM, REUE, Z_1) \qquad (1)$$

where,

Q_D = quantity of commodity demanded;
WIP = index of world industrial production;
P_c = price of the commodity;
P_{oc} = price of other commodities;
$PXWM$ = world price of exports of manufactures;
$REUE$ = euro-dollar interest rate;
Z_1 = 'all other factors'.

The expected sign on the activity variable, *WIP*, is clearly positive. The coefficient on the own-price, P_c, is expected to be negative, and on substitute commodities positive. The expected sign on the coefficient on *PXWM* is positive. The expected sign on the interest-rate variable is negative: higher interest rates imply higher costs of holding and higher returns on alternative forms of asset-holding, and therefore should depress demand for the commodity.

Equation 2 shows a function for the quantity supplied of a primary commodity:

$$Q_S \quad = f(PFO\$, P_c, P_{oc}, REUE, Z_2) \qquad (2)$$

where,

Q_s = quantity of commodity supplied;
$PFO\$$ = price of oil;
Z_2 = 'all other factors'.

P_c, P_{oc} and *REUE* are the same variables as in equation 1. Oil is a major input into the production of commodities, so the expected sign on the coefficient is negative. The expected sign on the own-price is positive and on the price of substitute commodities negative. Higher interest rates are likely to depress commodity supplies, so the expected sign is negative. The variable Z_2 includes unquantifiable factors such as the weather, political problems, technological changes, and so on. Equations 1 and 2 can be expressed in linear form. If it is assumed that the commodity market is always in equilibrium, so that supply equals demand, a reduced-form equation can be derived. The price of substitute commodities is omitted and the only aspect of Z_2 that is included is technological change, which is assumed to be proxied by a time trend. Thus the expected sign on a time trend in equation 2 is positive. The resulting equations are as follows:

$$Q_D = \alpha_0 + \overset{+}{\alpha_1} WIP + \overset{+}{\alpha_2} PXWM + \overset{-}{\alpha_3} P_c + \overset{-}{\alpha_4} REUE \quad (3)$$

$$Q_S = \beta_0 + \overset{-}{\beta_1} PFO\$ + \overset{-}{\beta_2} REUE + \overset{+}{\beta_3} P_c + \overset{+}{\beta_4} t \quad (4)$$

so:

$$P_c = \frac{\alpha_0\beta_0}{\beta_3-\alpha_3} + \overset{+}{\frac{\alpha_1}{\beta_3-\alpha_3}} WIP + \overset{+}{\frac{\alpha_2}{\beta_3-\alpha_3}} PXWM + \overset{+}{\frac{\beta_1}{\beta_3-\alpha_3}} PFO\$ + \overset{?}{\frac{\alpha_4-\beta_2}{\beta_3-\alpha_3}} REUE + \overset{-}{\frac{\beta_4}{\beta_3-\alpha_3}} t \quad (5)$$

The expected signs are shown above the coefficients.

The equation can also be defined in logarithms, respecified and re-estimated in 'Hendry-type' form,(1) which makes the rate of change of prices depend in part on their levels in relation to long-run equilibrium values.

$$\Delta ln P_c = b_0 + b_1 \Delta ln\, WIP + b_2 \Delta ln\, PXWM + b_3 \Delta ln\, PFO\$ + b_4 \Delta ln(1+REUE) + b_5 ln\, WIP_{-1} + b_6 ln\, PXWM_{-1} + b_7 ln\, PFO\$_{-1} + b_8 ln(1+REUE)_{-1} - b_9 ln(P_c)_{-1} + b_{10} t \quad (6)$$

One unresolved issue is whether the model above should be specified in real terms. In this case all the price variables in the equation are divided by a general 'world price' variable, which is taken to be the world price of exports of manufactures (*PXWM*). This approach has generally been adopted in recent academic work.(2) In effect, this merely implies imposing homogeneity on to the equation, so that if all prices doubled this would leave all non-price variables unchanged. Moreover, specifications such as that of equation 6 lead to simultaneous equation bias since the world price of manufactures will itself be influenced by commodity prices. Simultaneous equation bias can be reduced if equations 1 and 2 are both specified in real terms, giving rise to the following reduced-form Hendry-type equation:

$$\Delta\, ln\left(\frac{P_c}{PXWM}\right) = c_0 + c_1 \Delta WIP + c_2\, ln\, \Delta \left(\frac{PFO\$}{PXWM}\right) + c_3 \Delta ln(1 + REUE - \Delta_4 PXWM) + c_4 ln\, WIP_{-1} + c_5\, ln\left(\frac{PFO\$}{PXWM}\right)_{-1} - c_6\, ln\left(\frac{P_c}{PXWM}\right)_{-1} \quad (7)$$

The counter-argument to this approach is that agents react to nominal, not real, prices, and that there is no *a priori* reason why changes in manufactured prices should lead to one-for-one changes in commodity prices. One synthesis is to assume that the homogeneity constraint operates only in the long run. This implies constraining coefficients b_6 and b_9 to be equal when estimating equation 6. In fact, there is probably no choice of specification which is unambiguously superior.

In order to avoid the possibility that the results of this exercise might be determined by choice of specification, all three specifications discussed above (equations 6 and 7 and the synthesis outlined in the previous paragraph) were estimated. Given that seven aggregates are examined, this implies estimating, at most, twenty-one separate equations. For two of the aggregates, however, no sensible long-run properties could be obtained on the 'nominal' equations, with or without the long-run homogeneity constraint, so that the alternative specifications became indistinguishable. This therefore left a total of nineteen preferred equations.

The three-month euro-dollar rate was chosen as the interest-rate variable, but in initial runs it was never significant (possibly because of the offsetting influences discussed above, or because of the inadequacy of the choice of variable), and so it was dropped for the rest of the exercise. Prices of manufactured goods, oil prices, and industrial activity were all tested with lags of up to four quarters, and lags were sequentially excluded when they were statistically insignificant or had wrong signs.(3) In only very few cases was more than one lag included in the preferred equation. The (negative) time trend was significant and therefore retained in some, but not all, of the equations.

The preferred equations for the UN indices are shown in the attached tables.(4) In general, they appear reasonably adequate. The objective here is not necessarily to estimate equations that can be claimed *per se* to explain commodity prices, but to include explanatory variables whose influence on the determination of commodity prices may have shifted over time.

The preferred equations were estimated first for the whole period and then for each of the two sub-periods. As reported in the main text, Chow tests were then performed for each set of equations. In the great majority of cases a highly significant structural break was found. These results are shown in Table D.(5)

It was suggested that results for the 1970s period were due exclusively to the abnormal behaviour of the 1972–74 boom. The equations described above were therefore run again, but excluding 1972–73 from the runs involving the *Economist* indices and 1973–74 from those with the UN indices (these being the years

(1) See, J E H Davidson, D F Hendry, F Srba and S Yeo "Econometric modelling of the aggregate time-series relationship between consumers' expenditure and income in the United Kingdom", *The Economic Journal*, vol. 88, no. 352, December 1978. It should be noted that the system is over-identified so that it is not possible to derive the original structural model.

(2) See, for instance, Hwa, 'Price determination in several international primary commodity markets: a structural analysis'.

(3) The only exception to this was where a 'wrong-signed' coefficient partially offset a larger 'correct-signed' coefficient with a shorter lag. This occurred (with one exception) only for oil prices where oil prices with one lag were negative but smaller than the (positive) coefficient on current oil prices. This result is consistent with the general finding that oil prices have a short-run but not a long-run effect.

(4) The equations using the *Economist* indices are available from the Bank at the address given on the reverse of the contents page.

(5) It has been suggested that because of the low explanatory power of many of the equations for the earlier period no significant relationship was established for this period and that therefore the Chow test was not valid. But even if this criticism is valid, it can be levelled against only a minority of the runs, since for three of the indices at least one of the runs was significant at the 95% level for the earlier period and for another three indices at least one was significant at the 90% level.

which the indices suggested to be the peak of the boom). Chow tests were again performed, and the results are also shown in Table D. Some of the equations where a structural break had previously been found now showed no significant evidence for a break, but for many of the equations a significant break still remained. This demonstrates that even when the 1972–74 boom is excluded[1] behaviour in many commodity markets was different in the 1970s from the earlier period.

Analysis of individual equations

In all cases, the comparisons that follow are confined to the equations run over the entire period and those run just over the 1970s, since the equations covering only the period 1957–69 are in general not well determined.

***Economist* All-Item Index (ECOA)**
All three ECOA equations show a highly significant structural break. In each, the short-run elasticity on activity rose in the 1970s to around 3 from 2 in the equations run over the entire period. The long-run coefficient in the nominal equation almost doubled, from 2.3 to 4.4. (The 'real' equation had a simple first-difference form and, surprisingly, no long-run activity effect could be found in the equation with the long-run homogeneity constraint.) Coefficients on oil prices did not in general rise in the equations where they were significant. There was, however, severe divergence from homogeneity in the nominal equation. In the equation with long-run homogeneity imposed the short-run coefficient on manufacturers' prices rose from 1.4 to about 2.

***Economist* Food Index (ECOF)**
Of the three sets of ECOF equations only the 'real' equation showed a significant structural break. In the unconstrained equation the short-run activity elasticity remained stable at around 3 between the complete-period and the 1970s equation; the long-run elasticity, however, rose from 2.5 to 3.7. In the 'real' equations, the short-run activity elasticity was raised from 1.5 to 2.5 but the long-run elasticity remained stable at about unity. In the third set of equations the short-run activity elasticity rose from about 2 to 3, and the long-run elasticity from about 2 to about 5. Only in this equation was there an increase in the long-run elasticity on oil; in the other equations the long-run coefficient was insignificant, and the short-run elasticity was generally stable.

***Economist* Metals Index (ECOM)**
Of the three sets of preferred ECOM equations only the 'real' equation failed to show a significant structural break. The two other equations were among the most satisfactory in the whole exercise, with the $\bar{R}^2$ for the 1970s being about 0.5. In the unconstrained equations the short-run activity elasticity rose from 1.5 in the complete-period equation to almost 4 in the equation for the 1970s; the long-run coefficient, however, remained stable at around 3. In the 'real' equations the activity elasticity remained stable both in the short and long-run. In the equations with the long-run homogeneity constraints, the short-run activity elasticity remained stable at around 3. The short-run oil price elasticity rose from 0.27 to 0.43. Wherever prices of manufactures were unconstrained their elasticity became higher. In all three sets of equations the coefficient on the lagged (level of the) dependent variable was substantially raised, implying a faster speed of adjustment towards the long-run equilibrium values.

***Economist* Fibres Index (ECNF)**
The two preferred equations for the complete-period ECNF are very weak, although those for the 1970s are substantially better and suggest that there was a significant structural break. Both are in simple first-difference form: the activity elasticity in both is raised from 1.4 to over 3 between the complete-period equation and the 1970s equation (although in the latter equation the lags had a "porcupine's back" shape in the nominal equation that would have made it unacceptable). The coefficient on oil prices remained small and insignificant.

UN Foodstuffs Index (UNFO)
The two preferred UNFO equations also show a highly significant structural break. In both sets of equations the activity elasticity rose from about unity in the complete-period equation to 2.5 in the equation run over the 1970s. The elasticity on prices of manufactured goods was always small and insignificant in the nominal equation. The oil price elasticity in both equations remained stable at about one quarter.

UN Non-Ferrous Metals Index (UNME)
Two of the three preferred UNME equations provided evidence for a significant structural break. Again, the equations run over the 1970s were among the best estimated in this exercise. In the unconstrained equations, and where homogeneity was imposed only in the long run, the short-run activity elasticity rose from about unity in the complete-period equation to over 2.5 in the 1970s equation. In both cases the long-run elasticity was fairly stable at around 2. In the 'real' equation both the short and long-run activity elasticity remained stable. The short-run elasticity with respect to manufacturers' prices rose from about unity to 1.6 in the two equations where it was unconstrained. There was a similar increase in the long-run elasticity, from unity to 1.8, in the equation where it was not constrained. The short-run oil price elasticity rose from about 0.23 to 0.33 in all three equations. In all equations, the long-run coefficients suggested a substantial increase in the speed of adjustment to long-run equilibrium.

UN Agricultural Raw Materials Index (UNNF)
Although the UNNF equations were not as successful as the metals equations, this is a notoriously difficult area to model and in this light the performance was quite satisfactory. Some of the runs over the 1970s had a $\bar{R}^2$ not far below 0.45, even with the insignificant variables, whose inclusion was derived from the complete-period equations. In all three equations there was strong evidence for a significant structural break and the short-run activity elasticity rose from under 2 in the complete-period equations to over 3 in the 1970s equations. In the nominal equation the long-run elasticity rose slightly, from 1.6 to 1.9. (The 'real' equations were specified in simple first differences, and in the third set of equations no long-run activity elasticity could be determined.) Where unconstrained, the short-run coefficient on manufacturers' prices rose slightly from 1.7 to about unity and the long-run coefficients from 2 to 2.4. The short-run oil price elasticity remained roughly stable. Once again, in all equations, a faster adjustment to long-run equilibrium was indicated.

Exclusion of 1972–74
As reported above, the equations were rerun excluding 1972–73 from the regressions involving the *Economist* indices and 1973–74 from those with the UN indices, to examine whether the structural shift was confined solely to the 1972–74 cycle. As was to be expected, the activity elasticities were generally somewhat lower when these years were excluded than in the complete runs. Nevertheless, the post-1970 elasticities often remained substantially higher than the elasticities in the complete period run. For instance, for the *Economist* metals index the short-run activity elasticity for the 1957–79 period, with 1972–73 omitted, was 1.41; for 1970–79 with 1972–73 omitted it was 3.43. Long-run elasticities, as before, were not much changed between the complete period and the shorter period.

(1) This is quite a strong test, since it is by no means certain that one would wish to exclude the 1972–74 period from the analysis of the paper.

Table A
UN Foodstuffs Index

ΔUNFO	ΔWIP	ΔWIP_{-1}	ΔPXWM	ΔPFOS	$\Delta PFOS_{-3}$	$\bar{R}^2$	SE	RSS	F	DW
1957–79	0.2727	0.5310	0.2450	0.1371	0.0949	0.21	0.0426	0.1521	6.698	1.79
	(1.51)	(3.00)	(1.18)	(2.56)	(1.62)					
1957–69	−0.0217	0.0874	0.6552	0.0543	0.0521	−0.01	0.0270	0.0328	0.799	2.60
	(0.17)	(0.69)	(1.45)	(0.53)	(0.52)					
1970–79	0.2189	2.2706	0.0117	0.1018	0.1516	0.46	0.0458	0.0713	7.495	1.89
	(0.32)	(3.63)	(0.05)	(1.63)	(1.96)					

ΔUNFO/PXWM	ΔWIP	ΔWIP_{-1}	$\Delta \frac{PFOS}{PXWM}$	$\Delta\left(\frac{PFOS}{PXWM}\right)_{-1}$	WIP_{-1}	$\left(\frac{UNFO}{PXWM}\right)_{-1}$	$\bar{R}^2$	SE	RSS	F	DW
1957–79	0.3974	0.6175	0.1980	−0.1538	−0.0172	0.0151	0.22	0.0419	0.1455	5.867	2.07
	(2.09)	(3.25)	(3.28)	(2.62)	(1.34)	(1.11)					
1957–69	0.0113	0.1169	0.0656	0.0067	0.00946	0.0093	−0.07	0.0272	0.0325	0.317	2.68
	(0.08)	(0.77)	(0.65)	(0.07)	(0.65)	(1.01)					
1970–79	0.1503	2.1861	1.975	−0.1911	−0.0074	0.00354	0.46	0.0480	0.0767	9.202	2.09
	(0.23)	(3.55)	(2.65)	(2.37)	(0.08)	(0.4)					

t statistics are in parentheses.

Table B
UN Non-Ferrous Metals Index

ΔUNME	Constant	Time	ΔWIP	ΔPXWM	ΔPFOS	WIP_{-1}	$PXWM_{-1}$	$UNME_{-1}$	$\bar{R}^2$	SE	RSS	F	DW
1957–79	−0.2790	−0.0050	1.0322	0.9365	0.2302	0.4138	0.2158	−0.2658	0.29	0.0624	0.2300	7.328	1.52
	(0.48)	(1.33)	(3.16)	(2.64)	(2.77)	(1.91)	(2.05)	(3.92)					
1957–69	0.4468	−0.0005	0.5482	−0.3237	−0.1653	0.1874	0.3497	−0.2256	0.13	0.0549	0.1295	2.054	1.55
	(0.36)	(0.12)	(1.65)	(0.28)	(0.76)	(0.77)	(0.57)	(2.10)					
1970–79	−0.0133	−0.0158	2.5959	1.6177	0.3273	0.6590	0.6654	−0.3742	0.52	0.0628	0.1224	6.970	1.96
	(0.01)	(1.49)	(3.05)	(3.24)	(3.24)	(1.41)	(1.87)	(3.34)					

$\Delta\left(\frac{UNME}{PXWM}\right)$	Time	ΔWIP	ΔWIP_{-1}	$\Delta \frac{PFOS}{PXWM}$	WIP_{-1}	$\left(\frac{UNME}{PXWM}\right)_{-1}$	$\bar{R}^2$	SE	RSS	F	DW
1957–79	−0.00359	1.0321	0.5514	0.2245	0.2700	−0.2059	0.27	0.0616	0.3149	6.195	1.59
	(3.19)	(3.67)	(1.95)	(2.81)	(3.25)	(3.32)					
1957–69	−0.0023	0.6381	0.1735	−0.0623	0.2739	−0.2153	0.12	0.0554	0.1349	2.384	1.60
	(1.64)	(2.09)	(0.55)	(0.30)	(2.17)	(2.21)					
1970–79	−0.0055	1.3184	0.4442	0.3190	0.4179	−0.3195	0.41	0.0655	0.1417	6.220	1.92
	(2.20)	(1.54)	(0.53)	(3.33)	(2.82)	(3.05)					

ΔUNME	Constant	Time	ΔWIP	ΔPXWM	ΔPFOS	WIP_{-1}	$\left(\frac{UNME}{PXWM}\right)_{-1}$	$\bar{R}^2$	SE	RSS	F	DW
1957–79	−0.5480	−0.0067	1.1195	0.9143	0.2200	0.5002	−0.2620	0.30	0.0622	0.3213	7.212	1.54
	(1.57)	(3.24)	(3.87)	(2.60)	(2.72)	(3.23)	(3.45)					
1957–69	0.2317	0.0006	0.5466	−0.4129	−0.1518	0.2066	−0.2180	0.15	0.0542	0.1296	2.441	1.55
	(0.30)	(0.16)	(1.67)	(0.39)	(0.73)	(0.91)	(2.27)					
1970–79	−0.0894	−0.0059	2.0551	1.4379	0.3292	0.4495	−0.3289	0.52	0.0628	0.1263	7.975	1.95
	(0.06)	(1.52)	(3.13)	(3.09)	(3.26)	(1.07)	(3.21)					

t statistics are in parentheses.

Table C
UN Agricultural Raw Materials Index

ΔUNNF	Time	ΔWIP	ΔWIP_{-1}	ΔWIP_{-2}	ΔPXWM	ΔPFO$	WIP_{-1}	$PXWM_{-1}$	$UNNF_{-1}$	$\bar{R}^2$	SE	RSS	F	DW
1957–79	−0.0067	0.7237	−0.7096	0.3575	0.6836	0.1776	0.3171	−0.3881	−0.1962	0.36	0.0396	0.1241	6.990	1.59
	(2.50)	(3.52)	(3.84)	(1.83)	(2.75)	(3.18)	(3.68)	(2.71)	(2.79)					
1957–69	−0.0044	0.1740	0.1013	−0.0151	0.5901	−0.0147	0.2860	−0.4031	−0.3297	0.26	0.0230	0.0211	3.096	1.89
	(1.98)	(1.18)	(0.60)	(0.10)	(1.29)	(1.16)	(2.54)	(1.94)	(3.20)					
1970–79	−0.0150	1.7316	0.8716	0.7220	0.8933	0.2000	0.5681	0.7211	−0.2978	0.42	0.0486	0.0709	4.308	1.72
	(1.75)	(2.26)	(1.01)	(0.99)	(2.33)	(2.47)	(2.23)	(2.07)	(2.32)					

ΔUNNF/PXWM	Constant	ΔWIP	ΔWIP_{-1}	$\Delta \frac{PFO\$}{PXWM}$	$\bar{R}^2$	SE	RSS	F	DW
1957–79	−0.0195	0.6712	0.7299	0.1236	0.24	0.0419	0.1490	10.410	1.77
	(3.50)	(3.53)	(3.84)	(2.34)					
1957–69	0.0144	0.2256	0.3735	0.0148	0.11	0.0249	0.0285	2.997	2.02
	(2.99)	(1.67)	(2.75)	(0.30)					
1970–79	−0.0227	1.882	0.8525	0.1108	0.43	0.0500	0.0876	10.686	2.06
	(2.43)	(2.96)	(1.34)	(1.59)					

ΔUNNF	Constant	Time	ΔWIP	ΔWIP_{-1}	ΔWIP_{-2}	ΔPXWM	ΔPFO$	$\Delta PFO\$_{-1}$	$\left(\frac{UNNF}{PXWM}\right)_{-1}$	$\bar{R}^2$	SE	RSS	F	DW
1957–79	0.3099	0.0003	0.6047	0.6888	0.2515	0.7329	0.1927	−0.1253	−0.0726	0.33	0.0396	0.1242	6.978	1.76
	(1.12)	(1.00)	(2.42)	(3.78)	(1.29)	(2.83)	(3.26)	(1.93)	(1.26)					
1957–69	1.1353	−0.0010	0.1886	0.3911	0.1887	0.8192	−0.0246	−0.0621	−0.2359	0.17	0.0243	0.0236	2.265	1.83
	(2.26)	(1.80)	(1.30)	(2.74)	(1.30)	(1.58)	(0.25)	(0.64)	(2.29)					
1970–79	−0.1800	−0.0004	2.2123	0.4147	0.1585	1.0003	0.1879	−0.2503	−0.0410	0.45	0.0477	0.0684	4.818	2.20
	(0.38)	(0.51)	(2.79)	(0.48)	(0.22)	(2.57)	(2.27)	(2.41)	(0.40)					

t statistics are in parentheses.

Table D
Chow test for structural break

	Complete period equations			Complete period equations excluding 1972–73 for *Economist* indices and 1973–74 for UN indices		
	F test distributed as	F statistics	Significance (a)	F test distributed as	F statistics	Significance (a)
ECOA						
No constraint	5,79	4.67	***	5,71	1.66	
Homogeneity constraint	9,70	2.66	**	9,62	2.87	***
Long-run constraint	10,68	2.47	**	10,60	1.66	
ECOF						
No constraint	6,78	2.00		6,70	1.32	
Homogeneity constraint	6,77	2.36	*	6,69	0.92	
Long-run constraint	7,76	1.17		7,68	1.86	
ECOM						
No constraint	8,74	2.78	***	8,66	2.19	*
Homogeneity constraint	6,77	1.94		6,69	2.13	
Long-run constraint	7,76	2.61	**	7,68	2.30	*
ECNF						
No constraint	4,81	7.77	***	4,73	3.37	**
Homogeneity constraint	7,74	4.75	***	7,66	4.34	***
UNFO						
No constraint	5,79	7.28	***	5,71	5.77	***
Homogeneity constraint	6,77	4.34	***	6,69	7.92	***
UNME						
No constraint	7,76	2.62	**	7,68	1.68	
Homogeneity constraint	8,74	2.50	**	8,66	1.50	
Long-run constraint	7,76	1.78		7,69	1.72	
UNNF						
No constraint	4,81	5.74	***	4,73	2.52	*
Homogeneity constraint	9,70	2.71	***	9,62	5.42	***
Long-run constraint	9,70	2.72	***	9,62	2.40	**

(a) * = significant at 95% level;
** = significant at 97½% level;
*** = significant at 99% level.