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**Commodity Price Fluctuations and
Macro-economic Adjustments in
the Developed Countries**

**Walter C. Labys and
Alfred Maizels**

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ADJUSTMENTS IN THE DEVELOPED COUNTRIES**

By

Walter C. Labys* and Alfred Maizels**

November 1990

* Professor of Resource Economics, Department of Mineral and Energy Resource Economics, West Virginia University, Morgantown, WV.

** Senior Fellow, World Institute for Development Economics Research - United Nations University, Helsinki.

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Introduction

Commodity price fluctuations have been troublesome in their destabilising effects on the foreign exchange earnings of developing countries. Recently, however, attention has been drawn to their role in transmitting inflation and in inducing macroeconomic and financial adjustments in the developed countries. These adjustments range from changes in employment and output (including the business cycle) to changes in money supply, interest rates and exchange rates. While questions of the direction of causality arise in this context, there is no doubt of the importance of assessing the impact of commodity price fluctuations on the economies of the developed countries.

Of the different research issues raised, past studies have often suffered in two respects. First, the various linkages suggested have not been evaluated using common theoretical and econometric approaches. Second, the empirical tests employed have dealt for the most part with only one country and feature short, non-overlapping, time periods. The purpose of this paper is to report on results which stem from attempts to overcome these problems by employing a common theoretical approach and by examining the experience of six major developed countries over the period 1957 to 1986. The method of analysis followed involves Granger-causality tests based on Hsiao optimal lag selection.

I. Setting of the Issue

International problems caused by commodity price instability have not lessened in recent decades. They reoccur each time major price swings take place and their macroeconomic impacts now appear to extend to the developed countries, a linkage which may become amplified because of the increased harmonisation of economic policies in the major developed countries. In addition, fundamental changes

have occurred in the structure of the international economy which necessitate a new analysis of the role played by the commodity sector. While this sector is still responsible for the booms and slumps affecting the growth process of developing countries, it also influences the mechanism whereby recession and inflation in the central industrial countries have been transmitted to the developing countries. According to Maizels (1987), the free working of the commodity markets gives rise to the possibility that a given cyclical disturbance in economic activity in the industrial countries will be significantly enhanced in amplitude as it is passed on to developing countries. These amplified fluctuations typically have an adverse "feedback" on the industrial countries in a recessionary period; this effect can be short-term as a result of a contraction in these countries' exports to developing countries, and can be medium-term as a result of the adverse effects on productive capacity of low commodity prices which, in turn, can precipitate a supply shortage (and a consequential commodity price boom) during a subsequent recovery period.

Thus, the commodity sector has come increasingly to operate not only as a mechanism for the transmission of recession from the developed or industrial countries to peripheral economies, but it has also become a major source of instability in the world economy as a whole. If petroleum is also considered as a primary commodity, then undoubtedly the unprecedentedly large swings in oil prices beginning in 1973 have injected severe and largely unexpected shocks into the international economic system, with dramatically adverse effects on world trade, economic growth and the debt problems of developed countries.

Over the past decade, there have been, of course, additional areas of global economic instability. These include fluctuations in exchange rates among the major currencies, changes in interest rates and in the flows of financial resources, including speculative funds from the commercial capital markets. Instability in these areas has interacted with and reinforced the fluctuations in primary commodity markets.

Though most developed countries have come to acknowledge the need to reduce interest rates from the historically high levels of the early 1980s, and to achieve cooperative action concerning exchange rates so as more closely to reflect the relative purchasing power of different currencies, no consensus on the need for corresponding action has yet emerged in regard to commodity prices.

Some notion of the extent of the instability experienced can be obtained from Table 1, which provides a comparison of changes in relative price instability during a series of subperiods, beginning in 1953 and ending in 1987. The subperiods shown have been selected to reflect the major phases of commodity price fluctuations. There are two aspects of the reported instability which are important to observe. First, the degree of price instability has tended to vary over these subperiods. While the period ranging from 1953 until 1972 has been the most stable, the period between 1973 and 1980 has been the least stable, the percentage price fluctuations in the latter period being at least double those in all other periods. The post-inflationary period of 1981 to 1987, while more stable than the period of 1973 to 1980, was in general less stable than the earlier period of 1953 to 1972.

Second, the amplitude of the price instability found varies according to the functional grouping of the commodities examined. Based on the average variation over the total period 1953-1987, petroleum prices indeed were the most unstable, almost three times as unstable as any other price index. Food commodity prices display less instability than minerals prices, with the agricultural raw material index being intermediate in severity. Also of importance is that primary commodity prices reflect greater instability than that of the price index of the unit value of manufactured exports from the industrialised countries. This confirms the findings of numerous previous studies that the commodity exports of developing countries and their related foreign exchange earnings are more susceptible to instability than are the manufactured exports of industrialised countries.

Table 1
 INSTABILITY IN THE WORLD ECONOMY, 1953-1987
 (Percent deviation from mean^a)

Global Economic Variables	1953-1962	1963-1972	1973-1980	1981-1987
Commodity Prices (\$)				
IMF Total Index	5.06	4.44	12.58	7.40
IMF Food Index	2.24	4.51	11.94	12.35
IMF Agricultural Raw Materials Index	3.38	3.40	21.28	5.31
IMF Oil Prices	11.27	11.06	38.22	19.42
IMF Minerals Index	3.42	6.39	14.64	7.47
IMF Manufactured Goods Export Unit Value Index	3.54	8.26	20.14	7.43
Gross Domestic Product				
Industrial countries	7.96	10.42	5.88	5.74
Developing countries	8.35	14.24	10.01	2.96
GDP Deflator (Wholesale prices)				
Industrial countries	3.65	6.64	15.78	3.68
Developing countries	18.65	21.52	44.77	57.19
World Trade (Export Value)				
Industrial countries	12.62	29.09	30.14	10.90
Developing countries	11.77	21.70	32.28	6.51
Terms of Trade				
Industrial countries	3.40	1.11	3.48	5.26
Developing countries	5.64	2.03	8.77	7.33
Exchange Rates (spot)				
\$-Deutschmark	1.77	7.22	15.69	17.66
\$-Yen	0.24	5.24	13.46	21.17
\$-Pound	3.98	7.08	9.44	13.22
Short-Term Interest Rates				
New York	11.67	14.49	17.92	10.55
London	18.28	19.91	27.04	26.16
Industrial Share Prices				
New York	23.00	21.33	25.46	30.74
London	5.10	10.97	9.03	20.97

^a Based on annual data, $PDM = \frac{1}{n} \sum (Y - \bar{Y})/\bar{Y} \times 100$

Source: International Monetary Fund, various publications, Washington, DC; and Organisation for Economic Co-operation and Development, various publications, Paris.

Table 1 also includes instability measures for a sample of global macroeconomic, trade and financial variables, including separate results for the developing and the industrialised countries. While the transmission, if not covariation, effect between commodity prices and the latter variables appears to be less strong regarding changes in income or gross domestic product during the period 1973 to 1980, it appears to be much stronger concerning changes in domestic inflation. Wholesale price variability in the industrialised countries has changed over the selected subperiods, and has tended to coincide with the instability found in the financial and macroeconomic variables. Devaluation as well as the major currency float from 1972 proved to be highly unstable, as did interest rates and industrial share prices.

There is no doubt that commodity price instability induced changes in world trade, influencing swings in export revenues and contributing to balance of payments crisis. Table 1 shows that even the industrial countries suffered severe export earnings fluctuations between 1963 and 1980. The impact of the balance of payments crises also is reflected in the variability of country terms of trade, which also led to import fluctuations. Not only did the terms of trade for the industrial and developing countries fluctuate during 1973-80, these fluctuations increased in amplitude for the former in the 1981-87 period. The index of the unit value of manufactured goods exported by the industrialised countries displayed a sharp increase in instability between 1973 and 1980.

Of particular interest here is just how this instability has affected macroeconomic adjustment in particular countries, notably the major OECD countries including France, Germany (Federal Republic), Italy, Japan, the United Kingdom and the United States.

II. **Nature of Commodity Price Impacts**

Mention has been made of a number of ways in which commodity price fluctuations affect macroeconomic adjustments in the developed economies. These impacts are now considered in terms of the various theories suggested and several related hypothesis are proposed as suitable for testing: the direct price hypothesis, the indirect price hypothesis, and the Kaldor-effect hypothesis. Also evaluated are issues of symmetry versus asymmetry and price differentiation.

The Direct Price Hypothesis

Several theories have been advanced to support the view that commodity price developments influence and also predate movements in general price levels. Many commodity prices are determined in auction markets which respond quickly to changes in supply and demand, in contrast to prices in consumer markets for manufactured goods. This distinction is emphasised, for example, by Bosworth and Lawrence (1982) and by Beckerman and Jenkinson (1986). Provided conditions in commodity markets reflect aggregate supply and demand in the whole economy, an increase in aggregate demand, which might eventually translate into higher price inflation, might be expected to show up much earlier in commodity prices.

Another argument which might suggest that commodity prices may lead general price movements is their forward-looking element, arising from the storability of commodities, including the existence of unextracted reserves in the case of minerals. Hence commodity stocks, and claims on them which are traded in future markets, are similar to financial assets in the sensitivity of their prices to expectations of future economic conditions. Provided that such markets are efficient, for example, an increase in expectations of inflation should immediately be reflected in higher commodity prices. If these expectations are rational, such price movements could

provide information about future prices which would be useful to policymakers. Finally, a more traditional argument for relying on commodity prices in predicting general price developments is that they enter, usually with a lag, as costs in output prices or in unit manufacturing costs. Thus, current commodity price movements have a direct cost effect on future movements of general price indices.

Commodity prices, however, also have potential weaknesses as indicators of general price developments. Supply conditions in commodity markets can deviate significantly from aggregate supply in an individual economy or the world economy due to specific factors such as changes in climate or weather. In addition, movements in non-commodity costs, particularly wage costs, can dominate the impact of past commodity prices on current prices, while market inefficiency or expectational aberrations can reduce their forward-looking value.

A distinction should also be made between the hypothesis that commodity price levels serve as leading indicators of general price levels, and the hypothesis that commodity price inflation leads general price inflation. The suggestion that the trend in commodity prices could serve as a leading indicator for general prices appears to require a relationship between the levels of the two price series. This in turn implies that the long-run terms of trade are fixed, and thus independent of economic factors, such as differential productivity growth. This is a very restrictive assumption, but one which could strengthen the possible usefulness of commodity prices as indicators of general price developments, in so far as observed deviations from a long-run level relationship tend to be lessened in the future.

Among other studies which have paid attention to direct commodity price impacts, Bosworth and Lawrence (1982) have employed a disaggregated input-output approach to determine the impact of commodity prices on domestic price levels and inflation. They calculated the contribution of primary product inflation to the price

inflation of final output rather than that of value-added, starting from price data on domestic primary output and imports of primary commodities, and using input-output tables to give the primary content of final output. Popkin (1974), using a similar stage-of-process model, concluded that of the 8.2 percent increase in U.S. consumer prices from 1973 to 1974, 3.7 percentage points were due to increases in commodity prices over and above their trend rates of growth. Nordhaus and Shoven (1977), using an input-output model, further concluded that about one-half of the 25.0 percent increase in the net output-weighted wholesale price index over the period of July 1972 to July 1974 could be accounted for by increases in prices of primary commodities and imports.

Among recent attempts to link domestic prices to international commodity price movements, the study of Durand and Blöndal (1986) was performed in response to a request to explore commodity prices as advance indicators of inflation. This request was made by U.S. Treasury Secretary Baker and U.K. Chancellor of the Exchequer Lawson at the September 1987 annual meeting of the International Monetary Fund and the World Bank. Baker suggested that one could use commodity prices, including gold, in assessing the inflation outlook for countries. Lawson proposed the use of a commodity price index as a global indicator or early warning signal of the risks of inflation and disinflation for major industrial countries as a group. The response to their combined suggestion was to find a way to gauge the appropriate overall balance of macroeconomic policies between stimulus and restraint in the context of coordinated efforts to reduce and contain imbalances among the major economies and to promote greater stability of exchange rates.

Several other proposals have been made to create a system of advance price warnings concerning inflationary or deflationary bias from jointly-followed macroeconomic policies. For example, McKinnon (1984) advocated targeting the world money supply to anchor nominal world prices; but abandoned this proposal in

favour of targeting the average price of traded goods directly (McKinnon, 1987), thus allowing for velocity shifts. To the same end, Williamson and Miller (1987) suggested a nominal expenditure target to help stabilise exchange rates.

Durand and Blöndal, *op. cit.* did find empirical evidence to support the possibility of using commodity prices as a leading indicator of inflation. A more thorough set of tests was performed by Boughton and Branson (1988) for the six major countries considered here, plus Canada. They found that there is a tendency for changes in commodity prices to lead those of consumer prices, at least when the data are denominated in a broad index of major country currencies. While such leads were found at turning points, no equivalent relationships appeared between the level of commodity prices and the level of consumer prices.

The Indirect Price Hypothesis

Above it has been suggested that commodity prices influence domestic price developments by entering, generally with a lag, as costs in output prices. Kaldor (1976) has hypothesized that any substantial increase in commodity prices will have a powerful inflationary effect on industrial costs and prices. The rise in the prices of basic materials and fuels will be passed through the various stages of production into unit labour costs and final product prices with an exaggerated effect; it gets amplified on the way by a succession of percentage additions to prime costs which mean, in effect, an increase in cash margins at each stage. This causes (initially) a rise in the share of profits in the value-added of manufacturing, which in itself causes strong pressure for wage increases. Added to this is a possible price-induced rise in wages caused by what Hicks called "real wage resistance", that is, a reluctance on the part of workers to accept a cut in their standard of living.

The Kaldor Effect Hypothesis

Kaldor (1976) also argued that any large change in commodity prices will have a dampening effect on industrial activity, in addition to indirect price and wage effects. For example, commodity price inflation itself can have a deflationary effect on the effective demand for industrial goods (in real terms), partly because the rise in the profits of producers in the primary sector may not be matched by a rise in their expenditure (a feature particularly noticed through the vast accumulation of financial assets by oil producers following the sharp rise in oil prices of the 1970s), and partly because the governments of most developed countries are likely to react to their domestic inflation by fiscal and monetary measures which reduce consumer demand and put a brake on industrial investment. Thus, a rise in commodity prices can result in a wage and price spiral-type of inflation in the industrial sector which, in turn, can cause industrial activity to be restricted. A good example of this can be seen in the inflation which occurred in the United States during 1972 and 1973, which was said to be cost-induced and not wage-induced. The inflation which resulted from the rise in commodity prices (with wage rises trailing behind the rise in living costs) led to strongly restrictionist monetary policies, and these in turn brought about a considerable economic recession. (Somewhat later, similar restrictionist policies were adopted by governments of other leading countries, such as Germany and Japan.)

Kaldor thus hypothesized that if commodity prices rise above a certain level, this will normally lead governments of developed commodity-importing countries to apply restrictive monetary and/or fiscal policies in order to limit the resulting inflationary pressure, and to safeguard the balance of payments position, i.e., the "Kaldor" effect. Such restrictive policies, however, can induce adverse economic conditions, thus contracting output and employment in the industrial countries. Bosworth and Lawrence (1982) have claimed that these adverse effects are intensified when policymakers focus only on the trade-off between inflation and unemployment,

to the neglect of other intervening causal factors. Thus, a demand management policy that refuses to accommodate an impact on the general price level of higher commodity prices may cause some loss of output and an increase in unemployment. At the same time, there are reasons for believing that this inflation-employment trade-off is not a simple linear relationship; that is, an incremental reduction in unemployment will have a greater effect on inflation at lower than at higher levels of unemployment. A larger unemployment change, therefore, will require maintaining a constant inflation rate in responding to positive exogenous commodity price shocks compared to responding to deflationary shocks.

This concern as to the linkage between inflation and unemployment may also mean that a commodity-induced inflationary price shock can be accommodated to some extent by the monetary authorities through an expansion of the money supply. Yet the same confluence of pressures will not occur under a deflationary price shock. Those who argue for an unvarying monetary policy will hold to the same position on both the upside and downside. But it is unlikely that those concerned with unemployment will pursue the argument for accommodation with the same vigour when it would involve an offsetting reduction of the monetary growth rate in response to a deflationary price shock. They are more likely to see such a shock as an opportunity to pursue a more expansionary employment policy.

Bosworth and Lawrence, *op. cit.* argued that there is a macroeconomic impact associated with variations in the inflation rate and departures of the actual rate from that which participants in the economy had expected. The sluggish response of industrial wages and prices to variations in demand and supply implies that demand management policies cannot offset the effect of these price shocks on the aggregate price level without the cost of lower output and higher unemployment. This argument does not rest on the so-called "ratchet" effect; rather, it depends on the extent to which

the economy is dominated by flexible price or by fixed price markets and on the importance of price inflation in determining wages.

Some Recent Experience

When comparing the above hypotheses to recent experience, one finds that primary commodity price fluctuations indeed have played a major role in the worsening of inflation during the 1970s. The 1950s and 1960s were marked by rapid technological progress in the agriculture, energy and extractive industries which contributed to strong downward pressure on relative prices in the corresponding markets. These pressures were important sources of restraint on the general inflation of that period, while opposite forces worked on these markets to produce sharper price increases in the 1970s.

So far, there have been very few published studies of empirical research investigating these hypotheses. Beginning in the period before the 1950s, Lewis (1949), had already discovered and explained the impact of falling commodity prices on the economic crises which occurred during the Great Depression of the 1930s. This explanation of the interaction between commodity prices and international economic cycles received little attention in subsequent years, except for the research carried out on economic and financial cycles by the U.S. National Bureau of Economic Research. Post-war studies of relevance range from that of Morgenstern (1959) to more recent work by Hultgren (1965), Fels and Henshaw (1968), Gordon (1986) and Klein (1986).

Although commodity prices continued to fluctuate during the 1960s, the fluctuations were not of such a drastic nature as to attract major attention. As just mentioned, however, prices fluctuated violently in the 1970s and 1980s, and this has

fostered attempts to analyse the relationship between commodity prices, import prices and inflation.

Symmetry Versus Asymmetry

During the recessionary phase of the business cycle, a fall in commodity prices may not result in deflationary pressures in the industrialised countries; according to Kaldor (1976), declines in the cost of raw materials used in manufacturing industry in these countries tend to be offset, by and large, by wage increases. Thus, there is a "ratchet effect", with commodity price increases accentuating inflation and reducing real output (as a result of defensive government policies), while commodity price declines would tend to have no significant effect in the reverse direction. Underlying this hypothesis is the view that commodity price increases are passed through into final product prices, but no symmetric deflationary response occurs when prices decline. Thus, it is proposed that fluctuations in primary commodity prices are a source of an ever-rising general inflation rate. This is a particularly common argument in comparing agricultural prices at the farm and retail level. Whether such asymmetries exist has become a major debating point between proponents and opponents of commodity stabilisation programmes.

Not much empirical research has been conducted to confirm the ratchet effect at the international level. Two well-known studies often quoted in this context (Goldstein, 1977; Finger and De Rosa, 1978) have not been considered highly relevant to Kaldor's main argument described above. In addition, Brown (1985) and Beckerman and Jenkinson (1986) have considered this impact in a wider context and have devoted particular attention to the kinds of counter-adjustments that were made in national monetary policies. Because of the inherent difficulties of conducting asymmetry analysis (Neftci, 1984), this research issue is being dealt with separately.

Price Differentiation

One major aspect of analysing the above hypotheses is realising that different price impacts might occur, depending on the production source or physical nature of the commodities traded. International commodity price behaviour is normally disaggregated into four commodity groups, as shown in Table 1: agricultural food commodities, agricultural raw materials, minerals and metals, and energy. Ample evidence exists for the belief that the prices of these commodity groups have somewhat different influences on macro-economic adjustments.

In the case of agricultural food prices, they influence consumer prices and hence the value of consumer budgets. Related cost of living increases may thus lead to pressure for higher wages and, where generated, these in turn reduce the profitability of enterprises, and induce national cost-push inflation. When rising consumer prices lead to more restrictive anti-inflation policies, the result could be reduced output and employment. The same consequences can follow from rising agricultural raw materials prices or minerals and metals prices. This latter effect also depends on the extent to which the commodities produced or imported affect industrial costs, directly or indirectly.

In the case of energy prices, the impacts of the oil price shocks of 1973-74 and 1978-79 were particularly severe on macroeconomic performance. Among researchers who have addressed these issues, Bruno (1982), Bruno and Sachs (1981), and Harkness (1982) take a supply-side approach in showing how oil-price shocks lead to increases in wages and prices and to decreases in real output. Research directed more specifically to oil price effects has been performed by Darby (1982) and Pindyck (1980). Some of the suggested theories were later tested empirically by Burbridge and Harrison (1984). A more expanded approach has been taken by Considine (1988), who analyses oil price fluctuations in the context of a

macroeconomic model of the U.S. economy. A detailed examination of oil price effects is beyond the scope of this study and thus is also considered separately.

III. Testing Procedure

Several formal econometric procedures are available for determining the extent of the influence or dependency of one economic variable upon another. Among these, the Granger-causality test has proved most reliable for measuring the nature of causality between variables in economic relationships. Confirmation of the effectiveness of this method appears, among others, in Guilkey and Salemi (1982) and in Nelson and Schwert (1982). Causality tests have also proved reliable in other similar studies employing commodity price and related international economic and financial variables. Examples include Boughton and Branson (1988), Durand and Blöndal (1986), Drobny and Gausden (1988), Gandolfi and Lothian (1983), Geary and Kennan (1982), Hall (1986), Pagano (1985), Pikkarainen and Viren (1988), Stock and Watson (1989), and Surrey (1989). In the present case, we attempt to confirm the existence of and the direction of causality from commodity prices leading to the other price, economic and financial variables.

Causality Tests

The Granger test - from Granger's (1969) definition of causality - is an experiment in which a dependent variable Y is lagged on past values of itself, then regressed on lagged or past values of X . The process is then reversed. One then uses some measure of the residual sum of squares after explanation of the dependent variable to determine whether or not the inclusion of an additional lag of Y or X helps to explain Y . In the model, X is said to cause Y if the current value of Y is better predicted from past values of X and Y , than by past values of Y alone.

The methodology employed here represents an extension of the Granger test to include optimal lag selection and derives from the work of Hsiao (1981), Caines, Keng and Sethi (1981), and McMillan, Douglas and Fockler (1984). In particular, Hsiao (1981) suggests the use of the Akaike (1969a, b) decision procedure, which examines the order of the required univariate stationary autoregressive process and/or the inclusion or exclusion of a variable in the model based on the minimum final prediction error (FPE) criterion. The method is appealing because it balances the risk due to the bias when a lower order is selected and the risk due to the increase of variance when a higher order is selected. By combining this FPE criterion and Granger's (1969) definition of causality, one can reach a practical method for the identification of a system of equations. This requires allowing a variable to depend upon a subset of the variables under consideration and permits each variable to enter the equation with a different number of lags. This means not only that there is a reduction in the number of parameters to be estimated, but at the same time the influence of each variable may be evaluated at different time lags.

The actual procedure employed is as follows:

- (1) All variables were first converted into the first difference of logarithms and regressed against time and a constant. If the coefficient on time was insignificant the variable was considered stationary and could be used in our tests. If time was significant, a second difference specification was constructed and the variable again tested against time. With the exception of the price index which required second differencing, time was insignificant for all other variables after a single differencing.
- (2) After converting all variables to stationary series, the dependent variable Y was regressed against lags of itself to find the optimum Y lag length, this length being determined by the minimum FPE criterion. The FPE criterion for a total of n lags in the independent and lagged dependent variable is defined as:

$$FPE(n) = [(T+n+1), (T-n-1)] \{SSR/T\}$$

where T is the number of observations and SSR is the sum of squared residuals. If $FPE(n+1) > FPE(n)$, then the $n+1$ lag is dropped from the model.

- (3) A series of bivariate models were then estimated for each candidate X-variable. In each of these bivariate models, Y was regressed against the optimum lags of Y determined from step 2 plus lags of the candidate X-variable. The optimum lag length of each X-variable was again determined by the minimum FPE. If the minimum FPE of the bivariate model was less than the FPE of the model containing only lags of Y, then the X-variable in the bivariate model was a candidate for inclusion in the final model.
- (4) The multivariate model was then formed. First, the X-variable found to Granger-cause Y in the bivariate models of step 3 were ranked according to their FPE values. Second, the variable with the lowest FPE was added to the model with the lag length that produced the minimum FPE in the bivariate model. Third, the remaining X-variables were then introduced in ascending order of their minimum FPE values from step 2. For each X-variable, the FPE at each lag of X was calculated. If the minimum FPE, including lags of this variable, was smaller than the minimum FPE with this variable excluded, it was concluded that the added X-variable also Granger-causes Y. The process was continued until all relevant X-variables were tested.
- (5) Steps 1-4 produce sets of equations in which causality in the first equation is reversed in the second. The final step was to treat these two equations as a system and re-estimate them using Zellner's technique. The system was treated as a maintained hypothesis and additional diagnostics were performed.
- (6) The results were summarised in Tables 3 and 5 according to three states of statistical confirmation: (Y) the causality of X on Y is clearly confirmed, using both forward and reverse FPE comparisons; (Y*) the causality of X on Y is confirmed but only weakly, since feedback is present; and (N) no causality can be confirmed.

The tests were performed using the Statistical Analysis System (SAS), both mainframe and personal computer versions. Since five different commodity price variables were required, together with some thirteen impact variables across six countries, a minimum of 1600 lag optimisation runs were made, including four forward-backward configurations for each bivariate pair. Further information on the theory and methods employed can be found in Labys (1989).

IV. The Data

Tests of the above hypotheses have taken place over the longest recent period for which quarterly data describing underlying variables were available, approximately 1957 through 1986. Table 2 gives a summary of the major variables

and the descriptive data employed for the tests. (Also see the data description in the Appendix). The commodity price data are drawn from International Monetary Fund (IMF) publications for the period 1957-1986. For non-oil commodity prices, the IMF all-commodities index was used. This covers 64 commodities (excluding oil). For the evaluation of commodity price impacts for individual commodity groups, IMF indexes were used for food, agricultural raw materials, and mineral prices. For energy

Table 2
DEFINITION OF VARIABLES
(1957.1 - 1986.4)

Commodity Price Variables^a

PIMF	=	Total Commodity Price Index (1980=100)
PIFQ	=	Agricultural Food Price Index (1980=100)
PIAMQ	=	Agricultural Raw Materials Price Index (1980=100)
PIMQ	=	Mineral Price Index (1980=100)
POIL	=	Saudi Arabia and OPEC Market Oil Price Index (1980=100)
IIXUYQ	=	International Price Deflator Based on Prices of Manufactured Exports of Developed Countries (1980=100)

Country Macroeconomic Variables^b

(France, Germany, Italy, Japan, United Kingdom, United States)

IP	=	Industrial Production Index, Seasonally Adjusted (1980=100)
GDP	=	Gross Domestic Product
E	=	Employment in Manufacturing
U	=	Registered Unemployment
W	=	Hourly Earnings in Manufacturing (1980=100)
OS	=	Commodity/Product Output
CP	=	Consumer Prices, all items (1980=100)
WP	=	Wholesale Prices, Total (1980=100)
LC	=	Unit Labour Costs
SP	=	Industrial Share Prices (1980=100)
DC	=	Demand for Credit
I	=	Interest Rates, 3 months or short term rate
M	=	Money Supply, M1
ER	=	Dollar Exchange Rate, spot, end of period
AM	=	Unit (average) Import Value
BOP	=	Balance of Payments
MM	=	Import Value

^a IMF indices

^b OECD data

prices the IMF oil price index of oil-producing countries' export unit values was used (IMF Financial Statistics Yearbook, UN Statistical Yearbook; successive issues).

The economic, price and financial data employed for the domestic price and macro-economic variables were taken from OECD publications for the period 1955-1986, supplemented in certain cases by data from the OECD secretariat (this related chiefly to finding a uniform c.i.f. versus f.o.b. import series). Other variables, because of the late appearances of recorded data, resulted in a shorter time period being employed for the necessary econometric tests (for example, oil prices did not vary significantly until after 1971; SDRs did not become flexible until 1972; and gold prices were fixed until 1971).

V. Empirical Results

The results of applying the above causality tests to the dependent macroeconomic and the independent commodity price variables are summarised in Tables 3 and 5. The evaluation of the results follows according to the three major hypotheses presented earlier.

Direct Price Effects

Several theories have been examined which reflect the view that commodity price swings cause and predate movements in the general price level. Some indication has also been given as to which domestic price variables are most affected by the commodity price swings. The direct price effects are stated in terms of average prices of traded (imported) goods, wholesale prices and consumer prices. The intervention of physical processing operations as well as time lags, however, suggests that

manufacturing unit labour cost impacts might more usefully be interpreted as indirect price effects.

The results presented in Table 3 suggest that rates of change in total commodity prices, and in prices for individual commodity groups, can be associated with rates of change of import unit values, domestic consumer prices, wholesale prices, and industrial share prices. A rough evaluation of the extent of the Granger-causality present can be made by summing those bivariate pairs in Table 3 reporting causality Y, causality with feedback Y*, and no causality N. The proportion of total possible causality confirmed for direct commodity price effect amounts to 21/30 bivariate cases for import unit values, 14/30 cases for wholesale prices, 7/30 cases for consumer prices, and 17/25 cases for share prices. One would not expect the commodity price effects to be the same in each country nor for each commodity group. According to Bosworth and Lawrence (1982), the strength of the commodity price effects will vary depending on the openness of a particular national economy to particular commodity imports. For example, the United States has a high self-sufficiency in raw materials. Japan represents the opposite extreme, being highly dependent on materials and fuel imports. F. R. Germany also imports much of its primary commodity needs, but the effect of food price increases is to some extent buffered by the common agricultural policies of the European Community. Bosworth and Lawrence have evaluated this openness by examining the relative importance of different commodity groups in final demand using available input-output tables for the United States, Japan and Germany. Their results (Table 4) thus show the impact on U. S. final demand prices that would be expected from a full dollar-for-dollar pass-through of commodity prices, employing data from 1971 to 1979.

The United States is shown to have the smallest percentage share of raw materials in final demand; it also has the smallest import share. Although commodity prices directly affect import unit values, there are very few positive causality

confirmations reported in Table 3. The impact of commodity prices on consumer prices is slightly larger, but this impact is restricted to the total commodity price index and to the oil price index. These results were suggested earlier by Bosworth and Lawrence. They found that individual domestic agricultural prices do not remain in line with world prices, and that previous controls on petroleum and natural gas prices prevented domestic prices from being highly correlated with world oil prices.

Given the greater dependence of the Japanese economy on imported materials and energy, one expects commodity prices to have a greater effect on domestic price levels in that country. Table 3 shows this to be true for the import unit value effects and for the wholesale price index effects. The impact on consumer prices is less, suggesting that the already high prices of many goods and products may partially isolate the Japanese consumer price index from world price fluctuations.

Table 3
GRANGER - CAUSALITY TESTS OF DIRECT AND INDIRECT PRICE
EFFECTS^a
(Quarterly data, first differences of logs, 1957.1 - 1986-4)

Dependent Economic Variables	Independent Commodity Price Variables				
	Total Prices	Agricultural Materials Prices	Agricultural Food Prices	Mineral Prices	Energy Prices
<u>Direct Price Effects</u>					
<u>Import Unit Values (21/30)</u>					
United States	Y	Y	Y	Y	N
United Kingdom	Y	Y	Y*	N	N
Japan	Y*	Y	Y	Y	Y*
France	N	Y	N	N	N
F. R. Germany	Y*	N	Y*	Y*	Y
Italy	Y*	Y	Y	N	Y

Wholesale Prices (14/30)

United States	N	N	N	N	N
United Kingdom	Y	Y	Y	N	Y*
Japan	Y*	N	Y*	Y*	Y*
France	N	N	N	Y*	N
F. R. Germany	N	N	N	N	N
Italy	Y	Y	Y	Y	Y*

Consumer Prices (7/30)

United States	Y	N	N	N	Y*
United Kingdom	N	N	N	N	N
Japan	N	N	N	N	N
France	N	N	N	N	N
F. R. Germany	Y	N	N	N	Y*
Italy	Y	N	N	Y	Y

Indirect Price EffectsUnit Labour Costs (7/25)

United States	N	N	N	N	N
United Kingdom	Y	Y	N	N	Y
Japan	Y*	N	N	N	Y*
France	N	N	N	N	N
F. R. Germany	Y	N	N	N	Y
Italy ^b	-	-	-	-	-

Wages (11/30)

United States	N	N	N	Y	N
United Kingdom	Y	Y	Y	Y	Y*
Japan	N	N	N	N	N
France	N	N	N	N	N
F. R. Germany	N	N	N	N	Y
Italy	Y	Y	N	Y	Y

Share Prices (17/25)

United States	Y	N	N	N	Y*
United Kingdom	Y	Y*	Y*	Y	Y*
Japan	N	Y*	Y	Y*	Y*
France	Y	Y*	Y*	Y	Y
F. R. Germany	Y	N	N	N	N
Italy ^b	-	-	-	-	-

^a Y = causality, Y* = causality with feedback effect, N = no causality

^b Data unavailable

Note The ratios in brackets show the proportion of tests resulting in Y or Y*.

In the case of Germany, Table 3 reports the presence of strong economic impact effects at the import unit value level, but not at the wholesale price level. Although Germany lies between the United States and Japan in terms of its openness to the global economy, Table 4 suggests the contribution of commodity prices to

consumer prices to be stronger in Germany than in Japan. Changes in the total and the oil price indexes both affect changes in Germany's consumer price index. According to Bosworth and Lawrence, the low response of domestic prices to the agricultural food and raw materials price indexes was to be expected, since in prior years Germany has maintained domestic agricultural prices above the world level by a variable levy on imports equal to the difference between the domestic target price and world prices. As world prices moved up to those of the Community in 1972-1973, the import levy was reduced, while when world prices for cereals rose above domestic agricultural prices, exports rather than imports were taxed.

Table 4

PERCENTAGE SHARE OF RAW MATERIALS IN FINAL DEMAND, UNITED STATES, JAPAN AND F. R. GERMANY, 1970^a

	United States		Japan	F. R. Germany
	Consumption Expenditures	Final Demand		
Livestock and livestock products	4.9	2.7	(8.3	(
Other agricultural products	3.5	2.0	((9.3
Forestry and fisheries	0.3	0.6	2.7	(
Iron ores	0.1	0.2	0.5	0.3
Nonferrous metal ores	0.1	0.3	0.5	0.2
Coal mining	0.3	0.3	0.6	1.3
Petroleum and natural gas	2.2	2.2	1.3	1.2
Stone and clay quarrying	0.1	0.3	(1.1	(0.4
Other non-metallic minerals	0.1	0.2	((
Total	11.6	8.8	15.0	12.7

^a Final demand is defined as GDP or GNP (United States) plus imports.

Source: Bosworth and Lawrence (1982), p. 49.

Similarly, the impact of the OPEC price increase was also moderated by Germany's reliance on high-priced domestic coal. Before 1974, coal prices were held at artificially high levels, with heavy taxes on imported coal and petroleum. After the oil shock, however, the price of coal did not rise in step with that of petroleum. Thus, in domestic currency terms, the average price increase for fuel was limited to about one-half that of Japan and the United States. The more modest rate of commodity price inflation is reflected in a much lower rate of overall inflation in Germany than in other countries. In Germany the exogenous shock to final demand prices over the 1972-75 period was about one-half of that in Japan.

The United Kingdom and France display similar degrees of commodity price impacts. In the case of the former, the import unit value index and the wholesale price index reflect some response to the total commodity price index and the agricultural materials and food price indexes. The wholesale price index also reflects a response to the oil price index. The commodity price impacts recorded for France reflect causality only from agricultural materials prices to import unit values and from mineral prices to wholesale prices; neither country demonstrates a consumer price response. These results confirm those of Durand and Blöndal (1986) and Bosworth and Lawrence (1982).

The Italian economy appears as more open than the others in terms of confirmed Granger - causality. This causality appears between commodity price and import unit value changes and wholesale price changes, except for the mineral price and import value pairs. Consumer price impacts are also more prevalent than for other countries, with the total price index, mineral price index and energy price index all showing some causality.

The most surprising direct price impact, if the relation can be identified as such, is that bearing on domestic industrial share prices. For the United Kingdom,

Japan and France, and to a lesser extent Germany, some degree of causality is present. Although more sophisticated explanations of this effect can be devised, the following two come to mind. The first is that commodities and shares are now considered more suitable in an investor's portfolio than they were prior to 1970. Since prices on speculative markets can be said to respond to new information, industrial share prices appear to reflect the same informational innovations implicit in commodity prices. References to this form of causality appear in Labys and Granger (1970), based on Working (1958). A second reason is that international commodity prices are now considered a more important information source as to cyclical conditions in the world economy. This prospect has been mentioned in several of the above studies which have suggested that commodity prices act as a guide to domestic price movements.

Regarding the results with confirmed causality, Suny et. al. (1989) has shown that commodity prices provide a stronger statistically-confirmed influence on domestic price changes than do adjustments in the money supply. While their study was restricted to price movements in the United States and the United Kingdom, the study of Durand and Blöndal (1986) also included Japan, Germany, France, Italy and Canada. Their results, derived from cointegration forms of time series tests, did not support causality going from commodity prices to domestic prices. However, when Granger-causality tests were applied to more disaggregated price series, changes in the UNCTAD agricultural raw materials prices index and the HWWA metals and mineral price index were also shown to influence domestic prices.

The above results confirm the existence of some form of direct price effect. As would be expected, the strongest causality results occur for commodity price impacts on import unit values. More unexpected, strong causality results also appear for share prices. The weaker impact results for consumer prices are more difficult to explain, particularly if the price variables as transformed reflect inflationary impacts. However, the present results are in line with those of previous studies, which have

employed just the total commodity price index. Boughton and Branson (1988) provide confirmation also using an aggregate country price index. Webb (1988), however, finds a similar but weaker confirmation just for the United States. While Klein (1986) also confirms an inflationary price impact, both Bosworth and Lawrence (1982) and Durand and Blöndal (1986) found much weaker evidence for this price effect.

Indirect Price Effects

The hypothesis concerning the indirect price effect is concerned with how commodity price fluctuations cause fluctuations at the final demand level in an economy (as opposed to the import price level). Earlier it has been stressed that while commodity prices for the most part are demand determined, industrial prices are cost determined. Changes in the price of basic materials and fuels are passed through the various stages of production into final prices and become amplified on the way by a succession of percentage additions to producer costs which, in effect, yield an increase in cash margins at each stage. In the case where these additions increase profits, the possibility exists of a price-induced rise in wages. This rise will be larger, the more sensitive wages rates are to changes in the cost of living.

The domestic price variable which might be most accurate for measuring this amplification process would be some form of final demand price, normally the GDP deflator. The indirect price effect can also be reflected in unit manufacturing costs. However, comparable data were not available for either variable, and the only surrogate variable which could be adopted was unit labour costs in manufacturing. As shown in Table 3, the United Kingdom appears to exhibit the strongest indirect effect. Commodity prices are a significant causal factor in changes in unit labour costs, based on the total price index and the agricultural raw materials and the energy price indexes. The test results for Japan and Germany also confirm the possibility of an

indirect price effect. Causality is found for Germany in terms of the total price index as well as the energy price index. For Japan the causality embodies the same price indexes, but the confirmation is weaker (presence of feedback).

Because of the lack of additional data for testing the indirect price effect, one additional variable, the domestic wage level, has been selected as a possible surrogate. However, caution is necessary in employing this variable, since the possibility that commodity prices act through domestic wage rates to change domestic inflation continues to be controversial. Although it is generally agreed that higher prices exert an upward effect on wage rates, empirical confirmations of this effect vary greatly. Bosworth and Lawrence (1982) attribute this inconsistency to the lack of structural stability in the underlying models which trace commodity price effects. In particular, model specifications which describe inflation in the United States perform poorly when extended to Germany or Japan. Perry (1975) found that import prices and the GDP deflator affected wage behaviour in Germany, but that prices had no such effect in Japan. Sachs (1979) also confirmed this result for Germany. But in the latter two studies, the underlying model explained a far smaller proportion of wage inflation in Germany and Japan than it did in the United States.

One possible explanation of these results is that labour market institutions in Germany and Japan differ markedly from those in the United States. Long-term contracts do not extend from one year to the next; there are no formal cost-of-living escalator provisions; and bargaining is far more centralised than in the United States. Also, government policies in the former countries play a more prominent role in the wage determination process. Negotiations over wages are likely to focus on a relatively short time horizon and on the problems of the moment rather than on long-term expectations. In contrast to the shorter-term wage contracts that are negotiated in the United States, average annual wage-rate changes negotiated in both Japan and Germany show greater variability.

The results presented in Table 3 do not provide a strong confirmation of the indirect price effect. Mineral prices do influence wages in the United States, but one might expect a stronger confirmation, because of the ease with which wage inflation can spread in that country. A stronger confirmation is found for the United Kingdom and Italy; the causality of commodity prices to wages has been found to be significant for four out of five price indexes in each of these countries.

For Germany, causality is confirmed only from the energy price index. Bosworth and Lawrence suggest that there is some evidence which would support this causality, but because of the flexibility of the wage determination process and its greater sensitivity to demand-management policies, there is less of a conflict between the goals of inflation and unemployment than in the United States. There is no confirmation that commodity prices have a cost-of-living effect on wages in Japan. Thus, the institutional arrangements for wage determination imply that commodity price disturbances might be more difficult to correct with an anti-inflationary policy in the United States than in either Germany or Japan.

While these results do provide limited confirmation of an indirect price effect on wages, no differentiation between upward and downward wage movements has been made here. At the same time, however, the results do corroborate those of Beckerman and Jenkinson (1986) who found statistical evidence of indirect wage impacts using pooled cross-country time series methods for a wide sample of OECD countries.

Macroeconomic Effects

Several theories were mentioned above which purport to explain how fluctuations in commodity prices can affect the macroeconomy and induce

macroeconomic policy responses of a monetary or fiscal nature. These theories suggest that commodity prices have a causal relationship with the following variables: industrial activity and gross domestic product, interest rates and money supply, employment and wages, balance of payments and, to a lesser extent, exchange rates. Other variables could be included in this list, but it proved difficult to compile quarterly data for them over a continuous period since 1957, or even more recently from 1960 or 1965. Below, the test results are discussed according to the price impacts suggested.

Output. Fluctuations in commodity prices have tended to be associated with movements in world industrial production or activity. If for no other reason, most commodities are used as input to industry and thus industry outputs or production serve as a good proxy for the demand for commodities. While the pressure exerted by rising industrial production suggests an output-to-price causality, there is also reason to hypothesize a reverse causality. High commodity prices can dampen increases in industrial production, because the prices of goods now increase relative to consumer income levels. Low commodity prices, in turn, can lower costs of production and hence can stimulate the demand for goods as well as industrial production. Considine (1988), in particular, has found this to be true in the case of energy price declines.

The results reported in Table 5 suggest a causality in the direction of commodity prices to industrial production. In the case of Germany and Italy, strong or weak (with feedback) causality is found between all of the commodity price indexes and production. For the United Kingdom, weak causality is confirmed for agricultural raw materials and food price indexes, and for mineral prices, and total prices, while for Japan weak causality is present only for agricultural raw materials and total commodity prices. The weakest causality is found for the United States, where only the food price and mineral price indexes suggest some influence. This may be due to the fact that the US economy is strongly self-sufficient in this area. The lack of a

strong causality for the United States and its absence for France confirms the result found by Pikkarainen and Viren (1988) over a much longer period of time.

Table 5
GRANGER - CAUSALITY TESTS OF MACROECONOMIC EFFECTS^a
(Quarterly data, first differences of logs, 1957.1 - 1986-4)

Dependent Economic Variables	Independent Commodity Price Variables				
	Total Prices	Agricultural Materials Prices	Agricultural Food Prices	Mineral Prices	Energy Prices
<u>Industrial Output (18/30)</u>					
United States	N	N	Y*	Y*	N
United Kingdom	N	Y*	Y*	Y*	N
Japan	Y*	Y*	Y	N	N
France	N	N	N	N	N
F. R. Germany	Y*	Y	Y	Y*	Y*
Italy	Y	Y	Y	Y*	Y*
<u>GDP (20/30)</u>					
United States	N	N	Y	N	N
United Kingdom	Y	Y*	Y	Y*	Y
Japan	Y	N	N	N	Y
France	Y	N	Y	N	Y
F. R. Germany	Y	Y	N	Y	Y
Italy	Y	Y	Y	Y	Y
<u>Exchange Rates (16/30)</u>					
United States ^b	N	Y*	N	N	N
United Kingdom	N	N	Y*	Y	N
Japan	N	N	Y	N	N
France	Y	Y*	Y	Y*	N
F. R. Germany	Y*	Y	Y	N	Y*
Italy	N	Y	Y	Y	Y
<u>Money Supply (13/30)</u>					
United States	N	Y*	Y	N	N
United Kingdom	N	N	N	N	Y*
Japan	N	N	N	N	N
France	Y	Y*	N	Y*	N
F. R. Germany	N	N	Y	Y*	N
Italy	Y	Y	Y	Y	Y

Employment (12/30)

United States	N	Y*	Y*	N	Y*
United Kingdom	N	Y	N	N	N
Japan	N	N	N	N	N
France	N	N	N	N	N
F. R. Germany	Y*	N	Y	N	Y*
Italy	Y	Y	Y	Y	Y

Balance of Payments (8/25)

United States	N	N	N	N	N
United Kingdom	Y	Y	Y	Y	Y*
Japan	N	N	N	N	N
France ^c	-	-	-	-	-
F. R. Germany	N	Y*	Y*	Y*	N
Italy	N	N	N	N	N

^a Y = causality, Y* = causality with feedback effect, N = no causality

^b US dollar rate (IMF) against basket of currencies

^c Data not available.

Note: See Note to Table 3.

The causality between commodity prices and gross domestic product (GDP) is not as strong as that appearing for industrial production. (GDP data began in 1968 rather than in 1957, as was the case for production.) If we accept GDP as a measure of economic activity, then commodity prices can influence economic growth through changes in consumption. In addition, higher rates of fixed business investment can be encouraged by greater profits which accrue when prices rise faster than wages. This process often continues until governments react with contractionary policies. Table 5 shows that commodity prices have impacted on GDP in the United Kingdom, Germany and Italy, GDP fluctuations in France also display this impact, but it disappears for Japan, except for energy prices and total commodity prices. As for industrial production, causality does not appear evident in the United States, except in the case of food prices.

Exchange Rates. To the extent that the relations between commodity prices, domestic prices, and changes in output and GDP are linked with movements in international economic cycles, there is good reason to expect some interaction

between prices and changes in exchange rates. This has been particularly true since the float of the major currencies began in 1972. According to Bosworth and Lawrence (1982), it is possible that movements in exchange rates are simply a reflection of differences in relative inflation rates among the major countries; the differences in raw materials price increases can then be the result of, rather than the cause of, differences in domestic inflation rates. For example, the failure to control inflation within the United States could lead to a fall in its exchange rate and a relative increase in the costs of imported raw materials. However, it is obvious that exchange rate changes can be strongly influenced by other intervening factors as well as by commodity prices.

It is also possible that if commodities trade at a uniform world price adjusted for exchange rates, raw materials price increases, for example, in Japan and Germany could be adjusted for the full amount of the change in exchange rates relative to the dollar. On this basis, primary commodity price changes are no greater an inflation problem for the United States than for Japan and Germany; the larger domestic price increases for these commodities in the United States might thus possibly reflect a failure to restrict inflation as effectively as do Japan and Germany. Again, this influence is limited by the reality that most primary commodities are not traded at a uniform world price.

Another possibility for a relation between commodity prices and exchange rates is that posed by Golub (1983), who has studied oil price impacts. He argued that a rise in the price of oil over time may generate a current-account surplus for OPEC or other oil-exporting countries and current account deficits for the oil-importing countries. Where this might lead to an appreciable reallocation of wealth, exchange rates would have to adjust because of different portfolio preferences. As an example, if the increased demand for dollars made by oil exporters falls short of the reduction

in the demand for dollars by oil importers, there would then be an excess supply of dollars in the foreign exchange market and the dollar would tend to appreciate.

The results of the tests between commodity prices and exchange rates shown in Table 5 are mixed (all exchange rates are in dollar terms). Commodity price fluctuations appear to influence exchange rate changes against the dollar in France, Germany and Italy. This relationship is found less frequently in the case of Japan and the United Kingdom. For the disaggregated agricultural prices, a strong exchange rate effect is shown. These results may suggest that world economic instability reflected in primary commodity prices plays a stronger role in exchange rate markets than has hitherto been perceived.

In the case of commodity prices and the adjustment of the United States exchange rate against other currencies, Koch, Rosenweig and Whitt (1988) using the all-item consumer price index found causality in the reverse direction, with exchange rate changes influencing price fluctuations, but only at the consumer level. Fleisig and van Wijnbergen (1985) also found the same directionality in comparing appreciation of the dollar exchange rate with that of other industrial countries using the World Bank total commodity price index.

Monetary Effects. Fluctuations in commodity prices induce inflationary and deflationary patterns in international and national business cycles. Because governments have monetary policies available which can possibly help to reduce inflationary and deflationary impacts, they can influence levels of interest rates and the money supply to induce counter-cyclical effects. However, inflationary and deflationary behaviour often mix.

According to Kaldor (1976), inflation itself - as mentioned earlier - has a deflationary impact on the effective demand for industrial output in real terms, partly

because the rise in the profits of producers in the primary sector is not matched by a rise in their expenditure. Additionally, governments of the industrial countries may react to this inflation by fiscal and monetary policies which reduce consumer demand and put a brake on industrial investment. Thus, the rise in commodity prices may well result in a wage/price spiral type of inflation in the industrial sectors which, in turn, causes industrial activity to be reversed. If this behaviour is fairly synchronised among the industrial countries, then a fall in their aggregate demand can slow down the general inflation via the resulting downward effect on commodity prices.

The monetary policies employed to reduce demand, in this case, act through interest rates and money supply. Increasing inflation leads to a tightening of monetary policy. This in turn implies an increase in interest rates and/or a decrease in the money supply. While this policy is best reflected in the base rate, intervention rate or Central Bank rate of each country, data limitations have demanded that a short term or 3-month rate be employed. Some controversy also exists as to which measure of the money supply is best. The variable most frequently used and adopted here is M1 (plus quasi-money).

Table 5 suggests a surprisingly strong causality between commodity prices and interest rates. The United States displays the weakest possible causal confirmation. Agricultural food prices and mineral prices display some Granger-causality to interest rates, except for Japan, while agricultural materials prices reflect a weaker causality. Those countries showing some causality for three out of the five price indexes include the United Kingdom, France, Germany and Italy.

The attempt to provide some confirmation of a causality between commodity prices and the money supply was less successful. The impact of agricultural materials prices and mineral prices on fluctuations in the money supply in Table 5 was found for three countries, but mostly in the form of weak causality. The total commodity

price index does display Granger-causality to the money supply in France and Italy. The overall country impact was the strongest in Italy, where it appears that commodity prices and monetary adjustments are causally related across all forms of price indexes. There is not much empirical evidence available that would deny or confirm this result. Pikkariainen and Viren (1988) suggest opposite causality, that the money supply can influence prices, but their empirical work deals only with consumer prices and is long run in nature, covering the years, 1875-1984.

Employment Effects. Commodity price effects are interrelated in a complex manner with both wage and employment adjustments. As for general price-wage effects, price-employment effects can be identified with swings in the business cycle that are associated with fluctuations in commodity prices. Recent empirical tests such as those by Geary and Kennen (1982) have suggested that aggregate real wage and employment effects might be sufficiently independent to cast doubt on the applicability of neoclassical theory concerning the aggregate demand for labour. However, other researchers such as Kirkpatrick (1982), Symons (1985), and Symons and Layard (1984) have found that the relationship between wages and employment can be explained only when the influence of commodity materials prices is considered. These results, based on Sargent's (1978) dynamic theory of labour demand (where lagged real wages are a main determinant of current employment levels), demonstrate the importance of the materials price effect. More recently, Drobny and Gausden (1988) have re-examined these results employing Granger-causality tests to evaluate the sensitivity of the wage and employment relation to the influence of materials prices.

Employing trivariate rather than bivariate test methods, their results cast some doubt on the interrelation between these three variables. However, they do find that innovations in materials prices generate positive innovations in employment. This result was obtained using the method of Pierce and Haugh (1979) and Geary and

Kennen (1982). This required fitting ARIMA models to the variables and calculating cross-correlation coefficients between the current innovation in one variable and current and lagged innovations in the other.

The test results regarding commodity price and employment causality summarised in Table 5 are mixed. One interesting confirmation concerns the Granger-causality investigated by Drobny and Gausden which dealt with materials prices in the United Kingdom. The present results based on agricultural raw materials prices confirm these findings. Although only weak causality has been found for the United States, the effect seems similar; it comes from agricultural raw materials and food prices as well as energy prices. Both Germany and Italy reflect causality from food and energy prices, but exceptionally include a total commodity price effect as well. The strong response of the Italian wage and employment variables to commodity prices should be noted. With one exception, strong Granger-causality is clearly confirmed for both wages and employment.

Balance of Payments Effects. While commodity price fluctuations can affect export earnings or import expenditures of developing countries, not much evidence is available regarding empirical tests of the impact of commodity price fluctuations on the trade balances of the industrial countries. Available studies, such as Johnson (1980), explained how oil price increases have affected the current account or balance of payments of the industrial countries during the second half of the 1970s. However, the test results provided in Table 5 do not reveal much of a direct relationship between commodity prices and the current account of the balance of payments, except for the United Kingdom, where the relationship appears to be quite strong. An energy price impact also is confirmed, though only with weak causality, which may reflect the change in the United Kingdom position from a net importer to a net exporter of petroleum during the period covered. For Germany as well, some form of causality is confirmed from both agricultural food and materials prices and from mineral prices.

VI. Conclusions

The results of this study suggest that a much stronger relationship exists between primary commodity prices and domestic prices, cost and other macroeconomic variables in the selected countries than was anticipated. The number of confirmations of Granger-causality including its weak form reported in Tables 3 and 5 are surprisingly many. The first sets of tests dealing with direct and indirect impacts of commodity prices on domestic prices and wages were mixed, and the indirect effects were not as strong as others have suggested. This may have been due to present limitations to perform tests of the ratchet effect, i.e. the hypothesis that direct and indirect price and wage effects operate differently in the upward phase and in the downward phase of cyclical movements. The relation of industrial share prices to commodity prices was unexpectedly strong in several countries and should be further explored.

The second set of tests dealt with a variety of theories and hypotheses describing the impacts of commodity prices on adjustments in macroeconomic behaviour. The results achieved in most of these tests suggest that commodity price fluctuations might play a more important role in the economic instability and performance of the developed countries, than was previously believed. The commodity price and output relations were strong, as would have been expected. But more important has been the identification of the direction of causality, which is from prices to output. There was also strong confirmation that commodity prices have led changes in interest rates and, to a lesser extent, adjustments in the money supply. This suggests that the major countries did, in fact, practice monetary policy adjustments of some form, to counter major commodity price swings. Again, these responses might more usefully be evaluated by distinguishing between upward and downward price movements.

The relation between commodity prices and wages and employment was found to be strong. The results tended to corroborate what other researchers have suggested concerning the impact of commodity prices on employment. The results of the tests regarding the international sector of the economies were mixed. A surprising strong causality of commodity prices to exchange rates was discovered. However, except for two countries, the relation of commodity prices to the current balance of payments account was weak.

It is obvious that these results, although promising, constitute but an initial step in investigating the impact of commodity price fluctuations on the industrialised economies. Most previous research in this area has instead focussed on developing country impacts. A closer scrutiny of the above results suggests that our understanding of commodity price impacts could be greatly improved by extending research in several directions.

(1) Most obvious is the need to investigate the hypotheses surrounding the ratchet or asymmetry effect. Commodity price impacts should be tested in the upwards or inflationary as compared to the downwards or recessionary direction. These same directional tests should also be extended to the other bivariate relationships considered. There is also the need to study these various impacts over subperiods of the total time period.

(2) Energy price swings are known to have caused the major price disruptions over the period studied here, so that there is thus a need to investigate the energy price impacts further. Particular emphasis also should be placed on the price effects, and consequential policy responses made, during the upward phase of oil price movements from 1973, compared to the downward movements beginning in

1985. The impact of rising energy prices associated with the Gulf crisis beginning in August 1990 also requires investigation.

(3) A more comprehensive interpretation should be made of other results already obtained. For example, gold price behaviour could usefully be studied in relation to commodity prices, stock prices and exchange rates. This would provide further insights into the role played by speculation in international commodity and financial markets. A more careful investigation should also be made as to the wide differences in commodity price impact behaviour found among countries.

(4) The response of fiscal policy to changes in commodity prices should be investigated with a careful formulation of hypotheses surrounding the behaviour of fiscal stance. Existing annual stance data need to be extended to a quarterly basis and to a longer time period.

(5) The nature of the causality and vector autoregression methods employed should be improved. One possibility would be to subject the causal relationships found to a greater degree of statistical confidence by employing appropriate analysis of variance tests. Another need would be to expand the testing of the various hypotheses to include trivariate causality relationships.

The goal of this research has been to illuminate the role of primary commodity price fluctuations in world economic instability. The results attained suggest that their role is greater than was previously understood. The principal policy implication is that developed countries might want to explore more extensively just how international primary commodity price stabilisation policy measures might benefit this group of countries.

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