# The Pricing Mechanism of Primary Commodities since the 1970s

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# THE PRICING MECHANISM OF PRIMARY COMMODITIES SINCE THE 1970s

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## INTRODUCTION

ONE of the characteristics of developing economies is that they are highly dependent on exports of primary commodities for their foreign exchange earnings. The major issues of international commodity policy have been price instability and declines in real price and producer export earnings (see Chapter 1 in Finlayson and Zacher [1]).

However, when we analyze these problems we cannot come to a solution without understanding how prices of primary commodities are determined. The cause of the market crash in the New York Stock Exchange in October 1987, or Black Monday, which recorded a historical plunge and was followed by the price drops of primary commodities, was partly explained by the rise of the discount rate of the United States. And it was the preceding price hikes of primary commodities, in particular crude petroleum and gold, that forced the Federal Reserve Bank to raise the discount rate. In this case we can find the linkage of commodities, bonds, and stock prices.

It is a common perception among economists and traders involved in the international trade of primary commodities that some fundamental changes have occurred in the pricing mechanism of these commodities since the early 1970s. Therefore, it seems essential for both producing and consuming countries of primary commodities, as well as for those who reflect on the relevance of the existing international commodity agreements, to have a clear grasp of the pricing mechanism now in effect. Nevertheless, so far no conclusive answer has been presented to this question. G. L. Rees and D. W. Colenutt [5] and D. J. S. Rutledge [6] studied the grain market and presented analyses suggesting that the observed instability of the grain price may be attributed to the futures markets. However, an OECD report that touched on this theme stated that any definitive conclusion on the point made by Rees and others had yet to be reached [3, p. 74]. Thus, the object of this paper is to try to make clear the pricing mechanism for primary commodities since the 1970s through an analysis of price movements of primary commodities over the ensuing period.

The pricing mechanism has basically changed since the 1970s. The three characteristics of the changes are as follows.

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(a) Volatility: The cyclical periods of commodity prices have become shorter, and the amplitudes of the cycles have intensified.

(b) Linkage: A linkage of primary commodity markets with the financial markets (stocks, bonds, and currencies) has formed, though the relationships have time differentials (leads or lags). The price of crude oil is leading other commodity markets, including the financial markets.

(c) Cycles: The prices of crude oil, gold, T-bills, and stocks provide the same periods of cycles.

In the background underlying changes in the pricing mechanism are the following seven factors.

(1) Gold: President Nixon delivered in 1971 an executive order to cease the convertibility of the dollar to gold.

(2) Currencies: In February 1973, major currencies shifted to a floating exchange rate system from a fixed exchange rate system.

(3) Crude oil: Petroleum changed from being a cartel commodity to a market-sensitive commodity. The price of crude oil in the New York Mercantile Exchange tends to lead other commodity prices.

(4) Interest rates: In 1979, the Federal Reserve Bank of the United States adopted a policy that the money supply should be kept stable, which has brought more volatile markets in interest rates (T-bonds, T-bills).

(5) New financial instruments: Futures markets and option markets of interest rates, currencies, and stock indexes opened. In the course of these developments, commodities necessary for portfolio investment, such as bonds, stock indices, currencies, gold, crude oil, and traditional commodities have started to trade in the futures and option markets. This situation is supported by the following two facts:

(6) Information revolution: Program trading and a round-the-clock trading system have become active because of the development of computers.

(7) The money glut in major advanced countries: The portfolio investment of funds by institutional investors, such as investment trust banks and insurance firms, has expanded.

Section I quantitatively analyzes the three characteristics of the pricing mechanism: volatility, linkage, and cycles, which are tested by coefficients of variations, time lag correlations, and spectral analyses, respectively. Section II makes clear in detail the background of the changes in the pricing mechanism since the 1970s. Section III explains why futures markets in open exchanges make commodity prices more volatile. The final section presents conclusions and policy implications.

## I. EVIDENCE OF CHANGES IN PRICE MOVEMENTS

The structural change in pricing mechanism can be demonstrated by showing the new development that emerged in the relationship among petroleum, non-oil primary commodities, and financial instruments.

(1) The coefficients of variations have become greater in the period since 1970 compared with those of the earlier period (Table I).

(2) Each of the observed primary commodities fluctuates cyclically around

TABLE I

PRICE MOVEMENT OF INTERNATIONAL COMMODITIES: COMPARISON OF COEFFICIENTS OF VARIATIONS ACCORDING TO MONTHLY DATA

| Item | 1957-69 | 1970-86 | Durbin-Watson Ratio between 1970-86 |
|---|---|---|---|
| Coffee | 14.1 | 49.8 | 0.17 |
| Tea | 16.6 | 51.9 | 0.13 |
| Sugar | 11.3 | 45.0 | 0.13 |
| Lumber | n.a. | 46.5 | 0.21 |
| Rubber | 21.2 | 39.2 | 0.13 |
| Palm oil | [a] | 21.6 | 0.21 |
| Tin | 23.1 | 46.8 | 0.11 |
| Copper | 16.6 | 20.4 | 0.17 |
| Jute | n.a. | 27.8 | 0.12 |
| Oil | 2.8 | 52.2 | 0.04 |
| Gold | [b] | 42.8 | 0.12 |
| Stocks (U.S.A.) | 18.8 | 24.4 | 0.13 |
| T-bills (U.S.A.) | no trading | 33.7 | 0.25 |

Sources: Estimated according to the data of Commodity Research Bureau, *Commodity Yearbook*, 1962–85. See also Appendix Table I. Figures for tea were estimated according to data of *Tea Statistics* (Calcutta: J. Thomas & Co.), 1966–85.

Notes: 1. Trend removed by the functions of polynomials of degree three.
2. If the Durbin-Watson ratio is smaller than 1.48 when the number of samples is 100, there is a serial correlation of the first degree, with the level of significance being 1 per cent.

[a] Expansion of world production began from the end of the 1960s.

[b] Gold-dollar standard system with $35 to 1 ounce of gold.

the trend line. As the Durbin-Watson ratios in Table I indicate, other commodities besides lumber, palm oil, and T-bills (United States Treasury bills) take values of approximately 0.1, suggesting the existence of positive linear serial correlations.

(3) Table II shows that prices of primary commodities have had similar periods of cycles since 1970. Except for coffee and lumber, price movements of other commodities, including gold, present basically similar periods of cycles of 23 and 35 months.

(4) The prices of petroleum, gold, T-bills, and the stock price index (Dow 30) provide the same periods of cycle. These are 2.5, 8, and 23 months.

(5) Since 1970, cycles for individual commodities have begun to share common periods, and at the same time cyclical changes in general have become faster (compare Table II and Table III). In fact, monthly data between 1957 and 1969 given in Table III indicate the presence of few similar cycles, except perhaps for the long-term ones of 39 and 52 months.

(6) The following equations show time lag correlations between the price of crude oil and others.

$$TB3 = 1.7107 + 0.2771\ Oil(-1), \qquad (1)$$
$$(2.21) \quad (10.4)$$
$$R^2 = 0.511,\ F = 108,\ DW = 0.30.$$

TABLE II

SPECTRAL ANALYSIS (ACCORDING TO MONTHLY DATA FOR 1970 AND AFTER)

| | Less Than 10 Months | 11–20 Months | 21–29 Months | 30–59 Months |
|---|---|---|---|---|
| Yen rate | 2.5 8 | | | |
| NY stock price | 2.4 | | 23 | 35 |
| T-bills (90-day term) | 2.7 9 | | 23 | |
| Tokyo stock price | 2.4 7 | | 23 | |
| U.S. WPI | 2.5 8 | | 23 | 35 |
| Petroleum | 2.5 8 | | | |
| Gold | 2.4 7 | | | 35 |
| Tea | | 11 16 | 25 | 36 |
| Rubber | | 12 16 | 25 | 30 |
| Sugar | | 14 18 | 23 | 39 |
| Tin | | 13 15 | 23 | 36 |
| Jute | | | 24 | 33 |
| Palm oil | | 12 16 | 25 | |
| Copper | | 13 17 | | 34 |
| Coffee | 9 | | | 45 |
| Lumber | | 11 19 | | |

Source: See Table I.

TABLE III

SPECTRAL ANALYSIS (ACCORDING TO MONTHLY DATA BETWEEN 1957 AND 1969)

| | Less Than 10 Months | 11–20 Months | 21–29 Months | 30–59 Months | More Than 60 Months |
|---|---|---|---|---|---|
| Rubber | | 10 12 17 | | 39 | |
| Cocoa | | 17 | | 30 51 | |
| Tin | | 10 13 | | 31 51 | |
| Coffee | | 16 | 23 | 52 | |
| Sugar | | 20 | | 39 52 | |
| Copper | | | | 39 52 | 78 |

Source: See Table I.

$$TB3 = 3.723 + 0.01447\ GOD(-2), \qquad (2)$$
$$(7.43)\quad (10.5)$$
$$R^2 = 0.451,\ F = 111,\ DW = 0.12.$$

$$WPI = 763.2 + 0.7949\ GOD(-15), \qquad (3)$$
$$(36.1)\quad (13.6)$$
$$R^2 = 0.606,\ F = 187,\ DW = 0.07.$$

$$GOD = 1.208 - 3.4394\ YEN(-22), \qquad (4)$$
$$(21.7)\quad (-15.2)$$
$$R^2 = 0.670,\ F = 227,\ DW = 0.30.$$

$$GOD = 199.8 + 7.151\ Oil(-3), \qquad (5)$$
$$(5.74)\quad (6.00)$$
$$R^2 = 0.257,\ F = 36,\ DW = 0.17.$$

$$Oil = 49.60 - 0.01938\ DU3(-6), \tag{6}$$
$$(35.2)\quad (-15.4)$$
$$R^2 = 0.711,\ F = 239,\ DW = 0.26.$$

$$Oil = 52.89 - 0.002887\ Nik(-15), \tag{7}$$
$$(43.0)\quad (-20.7)$$
$$R^2 = 0.828,\ F = 430,\ DW = 0.35.$$

$$Oil = 78.30 - 0.04844\ WPI(-25), \tag{8}$$
$$(16.0)\quad (-10.5)$$
$$R^2 = 0.580,\ F = 110,\ DW = 0.11.$$

*TB3* denotes United States Treasury bills (90-day term), *Oil* is the price of crude oil (U.S. dollars), *GOD* is the price of gold (U.S. dollars), *WPI* is the United States wholesale price index, *YEN* is the currency rate of the Japanese yen, *DU3* is the New York Stock Exchange Dow 30, and *Nik* is the Nikkei average stock index 225. The sample period covers from November 1978 to May 1987.

Now equation (1) means that the price of United States Treasury bills correlates with the price of crude oil with a one-month time lag (minus one in the parentheses). It is noted that the roles of crude oil and gold are of great importance in the linkages of traditional commodities with financial instruments. The signs of coefficients of $Nik(-15)$ and $WPI(-25)$ in equations (7) and (8) respectively can be understood as follows. The negative sign of the coefficient of $Nik(-15)$ means that the oil price is inversely correlated with the Nikkei index of 15 months back. The prospect of cheaper price of crude petroleum will raise the Japanese stock prices beforehand since the Japanese economy heavily depends on petroleum imports. As to the rise in the wholesale price index (*WPI*), it brings a drop in both consumption and investment, which leads to the stagnation of the economy. That is why the demand for crude petroleum and the oil price will decrease about 25 months later.

The above findings confirm, first, that the prices of petroleum, gold, United States stocks, T-bills, and other primary commodities have begun to share similar periods of cycles after 1970, even though these cycles have "time differentials" and, second, that cyclical changes in their price movements have become faster and the amplitude of fluctuations has intensified.

Two salient points must be noted pertaining to the preceding analysis. First, one of the major factors determining the periods of cycles in price movements is mass psychology or market sentiment. In detecting periods of cycles the original time-series data were detrended by polynomials of degree three (the results were almost the same by either polynomials of degree two, four, or more), and spectral analyses were made for the detrended data. Sometimes sellers and buyers in the markets do not take into account long-term trends. In fact, the flow of funds into and out of the markets has become much faster, and traders enter markets in such an instance looking only two or three months ahead. In an extreme case, so-called paper-tradings or dealings take place with the same account being traded a few times in a day. In contrast, the production cost of a primary commodity does not change over such a short period as a single day, nor does the production cost of petroleum or gold move in exact parallel to the

price movements of bonds and stocks, and this is the reason mass psychology among traders in the markets is an important determinant of the short-term periods of price cycles. Against the fundamental factor of supply and demand for a commodity price, this is called a "technical factor."

The second point concerns the correlation of the period of price cycles with price movements of such primary commodities that present a weaker correlation with the crude oil price. The following explanation can be made. Correlations are not always strong because of the diverting effects exerted by speculative money which flows into the commodity markets anticipating an inflationary circumstance in the months ahead (e.g., the oil crisis), or, conversely, flows out of the commodity markets due to a reaction against the prior rush into the markets or due to psychological anticipation for future deflation (e.g., the depressed price situation for primary commodities in 1986). It is true that prices of all the primary commodities move likewise. However, commodity prices sensitive to the business cycle (e.g., nonferrous metals) and those which consume a lot of fuel oil (including electricity) show stronger correlations with the crude oil price. On the other hand, farm products and other commodities, which are largely dependent on weather conditions (frost damage to coffee, for example), show price movements for a dominant period of time not associated with the price movement of crude oil. Therefore, correlations between prices of these commodities and the crude oil price give weaker correlation coefficients.

## II. FACTORS ACCOUNTABLE FOR THE INCREASING PRICE INSTABILITY

There are three basic factors accounting for the increasing instability of primary commodity prices (petroleum and non-oil primary commodities): the so-called Nixon shock, two oil crises, and the adoption of floating exchange rate system. A brief explanation is in order.

First, President Nixon delivered in 1971 an executive order to cease the convertibility of the dollar to gold, causing the collapse of the gold-dollar standard system that had linked a value of U.S.$35 to an ounce of gold. As a result, gold, as a commodity providing a hedge against inflation, began to be subject to speculation in the commodity exchanges.

Second, petroleum (crude oil) became a market-sensitive commodity, from a cartel commodity, in the 1980s after having been controlled by the international oil majors and OPEC for a long time. Even though OPEC was formed in 1960, it had virtually no command over the market until the 1970s. It was the 4th Middle East conflict in October 1973 and the Iranian Revolution in February 1979 that provided OPEC with the opportunity to directly challenge the oil majors (see Prast and Lax [4]). Petroleum then became a market-sensitive commodity in the 1980s. As Table I shows, the price of petroleum has become highly volatile.

Third, as for currency, the floating exchange rate system was adopted in 1973 changed from the previous fixed exchange rate system. With this change, exchange rates of major currencies started fluctuating, and consequently speculative money was given an opportunity to play a role in the markets.

TABLE IV

A HISTORY OF THE OPENING OF THE TRADE OF NEW COMMODITIES

| | |
|---|---|
| 1972 | Currencies (International Monetary Market, IMM) (May) |
| 1974 | Crude oil (New Orleans Commodity Exchange) (Sept.) |
| 1974 | Gold (Commodity Exchange, Inc., COMEX) (Dec.)<br>(NY Mercantile Exchange, NYMEX) (Dec.)<br>(Chicago Board of Trade, CBOT) (Dec.)<br>(Chicago Mercantile Exchange, CME) (Dec.) |
| 1975 | GNMA (Government National Mortgage Association Exchange) |
| 1976 | Treasury bonds and others (see Table V) |
| 1981 | London International Petroleum Exchange (April) |
| 1982 | Gold, etc. (Tokyo Metal Exchange) (March) |
| 1982 | London International Financial Futures Exchange (LIFFE) (April) |
| 1984 | Gold, Deutsche mark, pound sterling, U.S. Treasury bonds, Nikkei average stock price, etc. (Singapore International Monetary Exchange, SIMEX) |
| 1986 | U.S. T-bills, Eurodollar, gold (Sydney Futures Exchange, SFE) |
| 1986 | The Big Bang (deregulation by London Stock Exchange) |
| 1986 | Tokyo Offshore Market (as a result the three major international financial centers—New York, London, and Tokyo—each now has an offshore market) |

These three factors combined have brought about volatile price fluctuation in the markets and have resulted in the introduction and development of futures markets in many commodities, including financial instruments, which were designed to assume functions to hedge against drastic price fluctuations (see Table IV).

In the course of these developments, commodities necessary for portfolio investment, such as bonds, stocks, gold, petroleum, and other primary commodities, appeared in the futures markets. The theory of portfolio selection had been formed since as early as the 1950s, but the theory could not be put into practice in actual operations until the 1970s when a full-fledged futures markets appeared and volume data began to be processed by computers. Thus, in the 1970s the role of futures markets and financial instruments became important in portfolio investment. The major commodities transacted in futures markets are listed in Table V.

As a result of these developments, prices of commodities traded on commodity exchanges have come to reflect to a lesser degree the actual supply and demand situations for those products in the 1970s. This argument is supported by the primary commodity models jointly developed by the Institute of Developing Economies and the University of Pennsylvania.[1] The econometric models take into account (1) tin, (2) copper, (3) coffee, and (4) sugar. In principle, the models comprise demand functions, supply functions, and price equations.

1. Institute of Developing Economies and the University of Pennsylvania, *Econometric Models of World Commodity Markets for ELSA-Comlink* (Tokyo: Institute of Developing Economies, 1985): (i) M. E. Adams, "Coffee Model"; (ii) R. A. Pilo, "Sugar Model"; (iii) N. Vasavada and S. A. Claessens, "Tin Model"; and (iv) N. Vasavada and S. A. Claessens, "Copper Model."

TABLE V

MAJOR FUTURES TRANSACTIONS IN THE U.S. IN THE LATE 1970S

| | |
|---|---|
| Grains | wheat, corn, oats, barley, grain sorghums |
| Oilseeds and products | soybean, rapeseed, flaxseed, soybean meal, soybean oil, coconut oil, palm oil |
| Livestock and products | cattle, feeder cattle, hogs, broilers, turkeys, skinned hams, boneless beef, eggs |
| Foods | potatoes, orange juice, sugar, coffee, cocoa |
| Fibers | cotton, wool |
| Forest products | plywood, lumber |
| Metals | gold, silver, platinum, palladium, copper, U.S. silver coins |
| Petroleum | propane, crude oil, industrial fuel oil, heating oil |
| Currency | British pound, Canadian dollar, Deutsche mark, Japanese yen, Mexican peso, Swiss franc, French franc, Dutch guilder |
| Other financial commodities | federal guaranteed mortgages (GNMA), 90-day T-bills, 1-year T-bills, 30-day commercial paper, 90-day commercial paper, T-bonds, T-notes (4-year term) |

Sources: A. H. Thomas, *Economics of Futures Trading* (New York: Commodity Research Bureau, Inc., 1980), p. 18; M. Peters and D. Vogel, *Inside the Financial Futures Markets* (New York: John Wiley & Sons, 1981), p. 17.

TABLE VI

THE RATE OF PRICE DEVIATION (WHEN WORLD ECONOMIC GROWTH RATES WERE ASSUMED TO BE 10 PER CENT HIGHER THAN THE ACTUAL RATE)

(%)

| | Tin | Copper | Sugar | Coffee |
|---|---|---|---|---|
| 1974 | 0 | −15.9 | 0 | +2.8 |
| 1975 | −1.0 | −2.5 | −0.9 | +2.3 |
| 1976 | 0 | +20.6 | 0 | +5.2 |
| 1977 | −1.8 | +18.4 | +7.5 | +10.5 |
| 1978 | 0 | +9.2 | 0 | +8.7 |
| 1979 | +0.5 | +10.5 | 0 | +0.3 |
| 1980 | −0.8 | +7.7 | 0 | −0.3 |

Source: The author's estimation.

The demand function is determined by income levels, prices of primary commodities, and prices of substitutable goods for these primary commodities. For the income level, the indices of industrial production or per capita GNPs of the United States, Japan, and the EC (or alternatively, the OECD) were used. Of the models a comparison was made between the case where the income level would continue at 10 per cent higher than the actual level throughout the 1970s and the actual case. The results obtained from this simulation are given in Table VI. It shows changes in the world prices of four commodities in relation to the corresponding changes in production. The simulation indicates that even

if the growth in GNP for the world economy had been 10 per cent higher than the actual growth, the world price of each commodity under review would have remained almost the same, with the exception of copper.

Specifically, the price of tin would have changed by less than 1 per cent over the 1974 to 1980 period under the 10 per cent higher GNP growth scenario. By the same token, the sugar price would have remained almost unchanged. Also, the coffee price would have risen by 10 per cent in 1977 and 8 per cent in 1978, but it would have remained almost unchanged in other years under the assumed scenario. Finally, in the simulation copper presented significant price changes: in 1974 its price plummeted markedly, while in both 1976 and 1977 its price rose by 20 per cent or thereabouts. These simulated price movements can be better explained through comparison with the actual price movements of tin, sugar, coffee, and copper. Over the 1970s the tin price actually rose about 5.2 times, from 170 cents to 900 cents per unit, and the coffee price increased about 5.1 times, from 43 cents to 220 cents, while the copper price rose only 2.6 times, from 50 cents to 130 cents. The slower price increase of copper may be partly attributed to the excess supply in the actual copper market during the 1970s due to the considerable production growth from 1960 through the early 1970s. In other words, the copper price was formed in a market where the actual supply and demand situation was overweighed by speculative moves. As a result, a tight copper market was brought about with a corresponding rise in copper price, as the simulation indicates. In short, the results from the simulation suggest that price levels of the four commodities as well as other primary commodities were such that they did not reflect the actual demand and supply conditions in the markets. That is, prices of primary commodities were partly dominated by speculation during the decade.

Therefore, it can be said that the causes of the second oil crisis involved some different aspects from those of the first oil crisis. Specifically, the second oil crisis took place in an environment where the role of speculation in the futures markets had become significant. The growth of speculation can be exemplified by the case of the Hunt Brothers concerning silver, and the situation was almost the same with regard to copper and other primary commodities. Here it will be useful as an illustration to give the case of the New York sugar no. 11 futures market. The average contract volumes in the market were 4,181, 2,939, and 3,196 units in 1973, 1974, and 1975, respectively. The volumes in 1979, 1980, and 1981 increased substantially to 7,147, 14,287, and 9,842 units, respectively. Moreover, whereas the highest volume unsettled by counter trade in the first oil crisis remained as low as 39,435 units, in the second oil crisis it piled up to 106,771 units (see *Shūkan shōhin dēta* [7]). Throughout the 1970s, trading tended to widen the amplitude of the price movements of primary commodities. Since brokers used to take the same type of actions on similar computer programs, it is no wonder that the prices deviated in the same direction.

Proceeding into the 1980s, this tendency further intensified because of one or more of the following developments.

(1) The rapid technological progress in high technology and new materials (such as optical fiber cable) has facilitated a kind of information revolution. As

TABLE VII

NUMBER OF CONTRACTS IN ALL FUTURES MARKETS IN THE U.S. IN THE 1980s

(Unit: 10,000)

| Futures Commodities | | Exchange | 1985 | | 1984 | | 1983 | | 1982 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Kind | Commodities | | No. of Contracts | Share (%) | No. of Contracts | Share (%) | No. of Contracts | Share (%) | No. of Contracts | Share (%) |
| Bonds | T-bills | CBOT | 4,044 | 25.4 | 2,996 | 20.1 | 1,955 | 13.9 | 1,673 | 14.9 |
| Stocks | S&P 500 | CME | 1,505 | 9.4 | 1,236 | 8.2 | 810 | 5.7 | 293 | 2.6 |
| Currency | Eurodollar | CME | 890 | 5.6 | 419 | 2.8 | 89 | 0.6 | 32 | 0.2 |
| PC* | Gold | COMEX | 777 | 4.9 | 911 | 6.1 | 1,038 | 7.4 | 1,228 | 10.9 |
| PC | Soybeans | CBOT | 739 | 4.6 | 1,136 | 7.6 | 1,368 | 9.7 | 916 | 8.1 |
| Currency | Deutsche mark | CME | 644 | 4.0 | 550 | 3.6 | 242 | 1.7 | 179 | 1.6 |
| PC | Corn | CBOT | 639 | 4.0 | 910 | 6.1 | 1,192 | 8.5 | 794 | 7.0 |
| PC | Silver | CBOT | 482 | 3.0 | 674 | 4.5 | 264 | 1.8 | 77 | 0.7 |
| Currency | Swiss franc | CME | 475 | 3.0 | 412 | 2.7 | 372 | 2.6 | 265 | 2.3 |
| PC | Live cattle | CME | 443 | 2.8 | 355 | 2.3 | 424 | 3.0 | 444 | 3.9 |
| PC | Crude oil | NYMEX | 398 | 2.5 | 164 | 1.2 | 32 | 0.2 | — | — |
| PC | Soybean oil | CBOT | 364 | 2.3 | 400 | 2.6 | 385 | 2.7 | 304 | 2.7 |
| PC | Soybean meal | CBOT | 333 | 2.1 | 382 | 2.5 | 387 | 2.7 | 278 | 2.4 |
| PC | Sugar | CS&C | 301 | 1.9 | 244 | 1.6 | 320 | 2.2 | 203 | 1.8 |
| Bonds | T-bills | CBOT | 286 | 1.8 | 166 | 1.1 | 81 | 0.5 | 88 | 0.7 |
| Stocks | NYSE composite index | CME | 283 | 1.7 | 345 | 2.3 | 350 | 2.5 | 143 | 1.2 |
| Currency | British pound | CME | 279 | 1.7 | 144 | 1.0 | 161 | 1.1 | 132 | 1.1 |
| PC | Copper | COMEX | 244 | 1.5 | 250 | 1.6 | 318 | 2.2 | 236 | 2.1 |
| Currency | Japanese yen | CME | 241 | 1.5 | 233 | 1.5 | 344 | 2.4 | 176 | 1.5 |
| Bonds | T-bills (90-day term) | CBOT | 241 | 1.5 | 329 | 2.2 | 378 | 2.7 | 659 | 5.8 |
| PC | No. 2 heating oil | NYMEX | 220 | 1.3 | 290 | 1.4 | 186 | 1.3 | 174 | 1.5 |
| | Total | | 15,869 | 100.0 | 14,937 | 100.0 | 13,992 | 100.0 | 11,240 | 100.0 |

Source: Futures Industry Association.

* PC stands for primary commodity.

a result, every entrant in the markets can share the same information on real time and at an inexpensive cost throughout the world.

(2) New futures markets have emerged and a variety of new commodities have been taken up in the markets (see Table IV).

(3) In the course of these developments, the round-the-clock trading system for futures markets of gold, petroleum, currencies, stocks, and international commodities, in which the New York, Tokyo, and London markets assume the major role, has been established. In the past, such new commodities would have been separately developed and transacted in individual markets. Now, a newly developed commodity has begun to be offered to plural markets through tie-ups, for example, between the Sydney and Chicago, Chicago and New York, or London and Singapore markets. Therefore, virtually all of the key commodities will be covered by round-the-clock operation in the worldwide markets in the near future. Table VII shows the volume of contracts in various futures markets in the United States. It must be noted that all the T-bonds, stocks, currencies, and primary commodities have been chosen as portfolio assets. Another noteworthy aspect is that in terms of the number of contracts, the top three commodities were in the financial category, and by adding gold in the fourth rank to the top three, they accounted for 45.3 per cent of the total contracts in 1985. The position of these financial commodities in 1985 presented a sharp contrast with 1983, when soybeans and corn still accounted for 9.7 per cent and 8.5 per cent of the total contracts, respectively.

Under these circumstances, movements of interest rates, currencies, and petroleum prices significantly affect the prices of primary commodities. In particular, movements of the petroleum price determine to a substantial extent the price levels of the other primary commodities. And regarding the petroleum price, the futures price of crude oil in the New York Mercantile Exchange has recently been frequently regarded as the leading price. The price of crude oil formed in this market largely influences the spot price, the crude oil prices in other markets, and the prices of other commodities. The futures price of crude oil in the New York Mercantile Exchange has assumed a greater role as the reference price for other markets, because the volume of contracts has increased sharply. Despite that the United States produces only about 9 million b/d (barrels per day) against a world production of crude oil amounting to 45 million b/d, the volume of contracts on futures of crude oil in the New York market has amounted to 30 to 50 million b/d, and in October 1986 the average volume of contracts reached 42 million b/d or more. In this connection, the next section addresses the mechanism of price formation in the futures markets and a mechanism that spurs ups and downs in prices that is related to institutional factors of the futures markets.

## III. THE ROLE OF VOLATILE PRICE MOVEMENTS IN FUTURES MARKETS

The following three reasons will explain the more volatile price movements in the futures markets.

(1) Demand (buying) and supply (selling) in the futures markets are the sum of demands from both hedgers and speculators and the sum of supplies from them. The hedger, as a supplier (hedge-selling), will pursue maximization of profit, and as a purchaser he will pursue maximization of utilities (except derived demand), if you follow economic textbooks; thus, a demand curve and a supply curve can be obtained from their behavior. But, in reality, investors participating in the futures markets who neither produce nor consume (e.g., so-called Locals in Chicago) behave solely according to their expectations of short-term price changes. These expectations may change, taking into account such factors, in the case of rubber futures, as indicators for U.S. business (in particular the sales volume of automobiles), statements of managers in the International Rubber Agreement, practices of major speculators, price movements of other commodities, inventory levels, weather forecasts, and interest rates. This means that both the demand and supply curves inferred from the behavior of speculators do not have specific grounds, and speculators themselves may instantly change from purchaser to supplier, and vice versa.

(2) In addition, institutional factors pertaining to the futures markets such as (a) cash guarantee deposit, (b) additional cover, and (c) settlement date, affect to a large extent the psychology of speculators. The effects of these institutional factors are exemplified by the following case of transactions of rubber futures in Japan (as of September 1982).

(a) Cash guarantee deposit

The minimum trading unit of rubber is 5,000 kg (called *mai*). When the standard price stands at less than ¥250 (per kg), an investor is allowed to buy a unit by depositing ¥70,000 as the cash guarantee. For example, he can buy a unit of rubber futures of ¥1 million (¥200 [standard price] × 5,000 kg) for ¥70,000 in cash, that is, he can purchase an amount of rubber some 14 times (¥1 million/¥70,000) of what he might buy in the spot market. Accordingly, the trading volume in the futures market can be much larger than the volume of actual transactions.

(b) Additional cover

The investor has to deposit an additional cash guarantee when his account has run into the red based on market evaluation. For example, when the standard price has declined to ¥180 per kg against his purchase at ¥200, a loss of ¥20 per kg accrues and his account of the unit (5,000 kg) generates an evaluation loss of ¥100,000 (this is not an actual loss unless he sells the account). Upon the accrual of the evaluation loss, he must deposit an additional amount of money, which is defined as the evaluation loss minus half of the original deposit (¥100,000 − ¥70,000/2 = ¥65,000). It must be pointed out that as stated in paragraph (a), in the rubber futures market he can buy an amount of rubber some 14 times that in the spot market, and likewise the amount of additional cover on his account must be 14 times the actual loss in the spot market. When his invested money in rubber futures was ¥1 million, he has to additionally deposit ¥910,000 (¥65,000 × 14) because of a price decline from ¥200 to ¥180. When he fails to pay for the additional cover, he will be penalized.

Thus, when the price of a commodity falls heavily, those investors who could not pay the additional cover would decide to dump in order to encourage further collapse of the commodity price.

(c) Settlement date

The purchaser of rubber futures who does not settle the account by counter-selling has to take back the purchased rubber. If he is a speculator who does not use natural rubber, he will have to sell his account by the settlement date. For an individual who buys a certain number of units of gold in the spot market, he can hoard it, without being interrupted by any price decline in an intermediate period, until his initial investment virtually yields any profit margin. In contrast, when he purchases the same commodity in the futures market three months ahead, his investment could not yield a profit margin unless its price rises within three months, and when this does not occur, he has to sell his account at a loss. The psychological effects of daily fluctuations of prices on the investor in the spot market and on those in the futures market vary to a great extent. Investors who are not affected by any time constraint will not have to respond so sensitively to price fluctuations as the investors in the futures market. Therefore, buyers in the futures market, overly sensitive to price changes, further help widen the amplitude of the price fluctuations.

(3) Price fluctuations in the futures markets are apt to be intensified by the reasons delineated below. The indigenous role of speculators in the futures markets is to help in mitigating price fluctuations. Their counter-selling in a bullish market serves to restrict a lopsided rise in prices, and likewise their counter-buying has a counter-effect in a bearish market to stop a lopsided fall in prices. In actual operations in the futures market, however, a rise in price sometimes takes place accompanied by an increases in buying by speculators. When a rise in the rubber price is anticipated because of some favorable factors, speculators' incentive to buy more is encouraged and hence the rubber price increases. When the price rise reaches a certain level, profit-taking sales by investors who had bought at lower prices and counter-selling by speculators take place, and consequently the rubber price plummets. However, when there is a strong anticipation of a rise, the slight price decline may induce a substantial amount of buying by speculators, resulting in a rebound of the rubber price. Sometimes this process results in the rubber price soaring in the futures market. At the stage of a sharp price increase, speculators' purchasing of contracts without commensurate counter-selling, or their outstanding purchasing of contracts which remain unsettled, may expand. If a number of buyers begin to feel uncertain about the much higher price level and commit themselves at once to counter-selling for settlement, the price of the commodity will collapse. This is the behavior that underlies the fluctuations in prices of commodities. Furthermore, these phenomena are fundamentally attributed to the psychology of investors and entrants in the market. During a soft market period there are a lot of potential sellers outnumbering potential buyers who are reluctant to buy in the market. When the market turns tight for any reason, the price begins to rise and potential sellers begin to refrain from selling, which further facilitates a tighter supply, resulting in another price

rise. At the last stage of this price increase process, the price rises sharply. When most of the potential buyers have completed their purchases, there remain only potential sellers, and this will lead to a price decline. The price decline spurs potential sellers' uncertainty about the higher price level, so they begin to sell accounts they have so far reserved. This triggers a price collapse.

## IV. CONCLUSIONS AND POLICY IMPLICATIONS

First, the world economic environment greatly changed during the period between the end of the Second World War and the 1970s. In the 1970s, reflecting these changes and with the Nixon shock and the first oil crisis as a starting point, the prices of gold and petroleum and currency exchange rates began to fluctuate from fixed prices. In the process of searching anchor levels for their prices, the ups and downs of prices, including those of primary commodities, temporarily intensified. In the futures markets, more importance was often attached to the "sentiment" of the market, and the prices of primary commodities were often formed ignoring the costs. Accordingly, prices have greatly fluctuated in the short run.

Second, since the latter part of the 1970s, with the phenomena of the money glut in the major advanced countries, caused by an expanded tertiary industry and an increase in pension funds due to the aging population, the investment of funds by institutional investors (corporate bodies) became very active. Thus, financial instruments such as bonds, currencies, and stocks, which are necessary for a portfolio selection, all appeared. The prices of bonds, stocks, primary commodities, and currencies strengthened their linkage with the same cycles with some time lag.

Third, with the development of advanced technologies, brought about under the influence of the so-called Kondratieff wave which is said to occur around once every 50 years, the use of computers has developed and realized the information revolution. This fact is manifested in the following three points. First, the speed of information processing has become fast and the cost cheap. Therefore, the portfolio selection, which used to exist only in theory, as it requires a large amount of data processing, has become applicable in actual tradings. Second, program trading began to be performed. After making several indices and sending signals for selling and buying by integrating these indices, trading can be done automatically. Recently the development of artificial intelligence (AI) has been accelerating this trend. In this way, the quality of the programs has become competitive. However, when there are many similar programs the price moves simultaneously in one direction, accelerating the ups and downs of prices. Third, a round-the-clock trading system is well organized for currencies, gold, petroleum, bonds, stocks, and other primary commodities. This is partly because information has become available in real time at a cheap cost. Institutional investors try to gain a margin by revolving the funds in a very short term, through what we call dealings or paper trading. This is also a big factor causing volatile price movements in the short run.

As mentioned before, the three characteristics of price movement, volatility, linkage, and cycles, have been observed since the 1970s, and this can be explained

theoretically by "the catastrophe expectations formation hypothesis" (Kuchiki [2]). Then, what will be the policy implications based on the characteristics explainable by both empirical study and theoretical model?

First, the futures markets can be utilized in order to mitigate the "volatility" in the short run. One of the merits of this type of policy is that this intervention is effective to the same degree both for declining prices and for rising prices. In contrast to this, recent cases of the International Commodity Agreements have proven to be a failure, because of a lack of buffer stock, when prices soared drastically. It must be pointed out, however, that enough funding is needed to carry out the policy and illegal trading, like insider trading, should be strictly excluded. Also, the prospects should be carefully read from the indices which give signals as to when the intervention to the market should be made. At any rate, discussing the possibility of making use of futures markets will be worthwhile.

Second, in the light of the deepened "linkage" being formed between traditional commodity prices and financial asset prices, it should be encouraged that the opinions of developing countries are more reflected in the G7 conference. Changes in interest rates and exchange rates will profoundly affect economies of producing countries, especially those who have debt problems. At the same time, the inflationary pressures caused by the price hikes of primary commodities will accelerate higher discount rates in consuming countries. In the circumstances, it will be vital for producing countries to make their opinions represented by taking part in the continuing discussions on "the commodity price indicator" proposed in the G7 conference.

Third, since "cycles" are endogenous phenomenon in open exchanges, they cannot be completely excluded from the price movements unless counteracting measures are implemented to mitigate them. This is well supported by the catastrophe expectations formation hypothesis. For example, each country can make use of the cycles as follows: a country should save the fund when prices are high, whereas it should adopt compensatory financing in the form of loans which will be effective when the prices are low.

Finally, we refer to the effectiveness of the International Commodity Agreements (ICAs). They may not be as effective as expected in the long term, but they should become so in the short term. An ICA can exert an influence on the price movement for a short while, but its capacity is limited and cannot change the trend. This means that intervention by an ICA will work as a smoothing operation to mitigate drastic price changes. Because prices of a commodity are linked with prices of other commodities, including financial instruments, influences of one party will be felt by the other, and in the long run an ICA will become less and less effective. To repeat, intervention in the markets by ICAs will be effective only in terms of the shorter perspective.

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## APPENDIX TABLE I

DATA SOURCE OF TABLE I

| Commodities | Terms | |
|---|---|---|
| Copper | Jan. 1957–Dec. 1969 | Average spot electrolytic copper prices, N.Y. |
| Cocoa | Jan. 1957–Dec. 1969 | Spot cocoa bean prices (ACCRA), N.Y. |
| Tin | Jan. 1957–Dec. 1969 | Average price of Straits tin (prompt), N.Y. |
| Coffee | Jan. 1957–Dec. 1969 | Average price of Manizales coffee, N.Y. |
| Rubber | Jan. 1957–Dec. 1969 | Average spot crude rubber prices (smoked sheets), N.Y. |
| Sugar | Jan. 1957–Dec. 1969 | Average raw cane sugar (90°) prices, duty paid, N.Y. |
| Tin | Jan. 1970–Feb. 1985 | Average price of Straits tin (alloyer price), N.Y. |
| Sugar | Jan. 1972–Feb. 1985 | Raw sugar N.Y. spot price (c.i.f., duty/free paid, No. 12) |
| Rubber | Jan. 1970–Jan. 1985 | Average spot crude rubber prices (smoked sheets), N.Y. |
| Petroleum | Jan. 1973–Nov. 1978 | Average price of crude petroleum at wells |
| | Dec. 1978–Feb. 1985 | Arabian Light spot price |
| | Mar. 1985–Sept. 1986 | North Sea Brent, London spot price |
| Palm oil | Jan. 1974–Aug. 1984 | Average wholesale palm oil prices, c.i.f., bulk, U.S. ports |
| Lumber | Jan. 1974–Feb. 1985 | Average index price of Ponderosa pine softwood, No. 2 |
| Copper | Jan. 1971–Dec. 1984 | Producer prices of electrolytic (wirebar) copper |
| Jute | Jan. 1971–Feb. 1985 | Average wholesale price of burlap (40 inch —10 oz.), N.Y. |
| Coffee | Jan. 1970–Dec. 1984 | Average spot price of coffee (Santos No. 4), N.Y. |
| Cocoa | Jan. 1975–Dec. 1984 | Spot cocoa bean prices (ACCRA), N.Y. |
| Gold | Jan. 1976–June 1983 | Monthly average price (unfabricated) Engelhard Industries |
| | July 1983–Sept. 1986 | London spot price |
| T-bills | Jan. 1976–Dec. 1985 | United States Treasury bills (90-day term) |
| U.S. stock | Jan. 1970–July 1985 | S&P 500 |