The Developing Economies, XXXVIII-3 (September 2000): 330–42

SHORT-TERM CYCLES IN PRIMARY COMMODITY PRICES

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I. INTRODUCTION

Commodity price fluctuations have always been of importance to developing countries. While positive price swings have led to rising export earnings and domestic income growth, negative price swings have lowered income growth and disrupted investment programs. Longer-term price swings in their downward phase have reinforced secular declining trends in commodity terms of trade, while shorter-term price fluctuations have led to earnings and balance of payments instability. Much of the research in this area has been directed to the instability problem, often without recognizing that the underlying price fluctuations might be cyclical and to a certain extent predictable. Examples of this research include domestic price stabilization (Schmitz 1984), speculation-induced instability (Privolos and Duncan 1991), international price stabilization (Brown 1975; Labys 1977; Newbery and Stiglitz 1981), and commodity export instability (Coppock 1962; Maizels 1992; MacBean 1966).

In previous studies it was emphasized that commodity price movements have often led to and sometimes caused major turns in business cycles. For example, Burns and Mitchell (1946), Lewis (1949), and Mills (1936) have pinpointed price movements for the role they played in the Great Depression. Examples of studies on the role of prices in business cycles include those of Bosworth and Lawrence (1982), Chu and Morrison (1984), Cooper and Lawrence (1975), Fama and French (1988), Labys and Maizels (1993), and Moore (1988).

More recent studies have focused on the cyclical nature of commodity price movements themselves. Among recent attempts made in this direction are those of Davidson, Labys, and Lesourd (1998), Davutyan and Roberts (1994), Labys, Lesourd, and Badillo (1998), Reinhart and Wickham (1994), Thirlwall and Bergevin (1985), and Cuddington and Urzúa (1989). However, with few exceptions no formal methods of identification of cyclical fluctuations have been employed. The purpose of this study is thus to further define the cyclical nature of commodity prices, concentrating on short-term price movements. We begin with the basic National Bureau of Economic Research (NBER) chronology that is presented in Moore (1980) to determine the particular timing, frequency, and amplitude of price cycles. The application of appropriate methods of cyclical detrending is essential to this identification. We then confirm the existence of such cycles by demonstrating their statistical significance using the structural time series (STS) approach developed by Harvey (1989, 1993).

This paper consists of the following parts. Section II presents the measurement of price cycles, while Section III provides their statistical confirmation. Conclusions are given in Section IV.

II. MEASUREMENT OF PRICE CYCLES

Our measurement of the cyclical characteristics of the commodity prices of interest follows closely but not exactly the identification procedure of the NBER.[1] This procedure provides a chronology which can benchmark price cycles, based on a search for cyclical expansion, contraction, and turning points. A cycle consists of an expansion phase from trough to peak plus a contraction phase from peak to trough, i.e., a trough-to-trough measurement. From an empirical point of view, a peak in a cycle is defined as following a trough and is preceded by a fixed number of observations on prices that are lower than at the peak, followed by at least an equal number of observations of lower prices. A trough follows a peak and is preceded by observations of higher prices which are then followed by observations of prices higher than those at the trough. These rules do not require that every change of direction is taken as a turning point, but they establish criteria to recognize the more significant ones. In addition, a turning point cannot be determined until at least a fixed number of observations are examined after it occurred.

The data we employ for cyclical measurement consist of twenty-one individual monthly commodity price series that span the years 1960 to 1995. The major criterion for selecting the respective series is that they reflect prices on international markets that are important for developing country exports. Monthly price sampling has been selected, since this frequency better reflects demand and supply forces (compared to speculative forces) and thus will display cycles embodying some form of microeconomic or macroeconomic dynamics. The statistical sources for the data are the major markets or exchanges where trading takes place.[2] Exceptions include jute and tungsten where an import unit price series is used. All of the series were checked for consistency of definition over time and possibility of errors in recording. Price values are nominal and quoted in the currency of a particular market. To reduce problems of foreign exchange contamination, no series were additionally converted to U.S. dollar terms.

1 See Moore (1980).
2 See Appendix and UNCTAD (various issues).

TABLE

CHARACTERISTICS OF COMMODITY
(Nominal Price Deviation from Polynomial Trend

Commodity	Data Range	Expansion						
		No. of Cycles	Minimum Duration	Maximum Duration	Mean Duration	Standard Deviation	Amplitude	No. of Cycles
Aluminum	1970:01–1993:07	10	7	31	18.70	6.98	0.39	8
Cocoa	1960:01–1993:07	7	8	25	22.42	9.68	0.63	8
Coffee	1960:01–1993:07	7	12	44	28.71	8.92	0.63	9
Copper	1960:01–1993:07	13	7	28	13.54	2.09	0.46	11
Corn	1960:01–1991:08	8	6	35	13.88	3.58	0.39	10
Cotton	1960:01–1993:07	10	7	34	17.70	2.67	0.42	8
Gold	1970:01–1993:07	4	12	41	22.75	7.29	0.61	7
Jute	1970:01–1993:07	6	7	47	20.83	6.42	0.60	7
Lead	1960:01–1993:07	7	7	48	21.86	5.69	0.65	9
Petroleum	1970:10–1993:07	3	8	33	18.33	9.22	0.70	4
Rice	1960:01–1993:07	8	6	36	16.88	4.16	0.50	6
Rubber	1960:01–1993:02	7	6	63	22.86	7.81	0.54	10
Silver	1960:01–1993:07	7	8	29	18.28	3.36	0.76	10
Soybeans	1960:01–1992:01	9	7	44	16.78	4.62	0.51	9
Sugar	1960:01–1993:07	8	7	42	22.25	4.96	1.23	10
Tea	1960:01–1993:07	8	7	28	16.62	3.22	0.59	14
Tin	1960:01–1993:07	6	13	42	25.17	4.93	0.49	5
Tungsten	1960:01–1993:08	6	7	68	25.83	9.56	0.78	5
Wheat	1960:01–1993:07	7	6	44	29.85	8.65	0.57	6
Wool	1960:01–1993:07	12	6	48	14.33	1.96	0.38	8
Zinc	1960:01–1993:07	7	6	64	19.71	5.80	0.66	8

A most important problem in analyzing the cyclical nature of these series is the choice of a method of detrending which can most accurately reveal the periodic nature of the embedded cycles. These transforms can be mechanical as in the case of first-differences or they can embody univariate detrending methods, as with the use of ARIMA or exponential smoothing models. If a transform is not correctly selected, it can induce false cycles in the detrended series.[3] The advice most often given to researchers is to select a detrending method which is most appropriate for capturing the inherent periodicity of given series. Based on extensive test comparisons using the major forms of detrending such as those of Beveridge and Nelson (1981) (results available from the authors), we selected polynomial trend removal.[4]

The results of application of the NBER chronology to the detrended series are

[3] See Blackburn and Ravn (1993), Canova (1993), and King and Rebelo (1993).
[4] See Pollock (1994).

I

PRICE CYCLE DURATION
Based on Six-Month Minimum Duration)

Contraction					Overall					
Minimum Duration	Maximum Duration	Mean Duration	Standard Deviation	Amplitude	No. of Cycles	Minimum Duration	Maximum Duration	Mean Duration	Standard Deviation	Amplitude
6	33	18.25	3.22	0.50	18	6	33	18.50	3.92	0.39
6	67	28.12	9.33	0.68	15	6	67	25.47	6.19	0.69
6	134	26.89	3.52	0.54	16	6	134	27.69	6.20	0.62
6	46	17.18	3.84	0.44	24	6	46	15.21	1.99	0.45
6	63	18.02	6.09	0.38	18	6	63	16.17	3.56	0.41
9	57	24.88	7.39	0.51	18	7	57	20.89	3.36	0.46
7	29	19.43	3.99	0.48	11	7	41	20.64	3.24	0.53
9	31	15.57	2.40	0.47	13	7	47	18.00	2.93	0.53
8	56	21.33	5.49	0.59	16	7	56	21.56	3.71	0.65
7	80	45.00	17.69	1.00	7	7	80	33.57	9.34	0.96
8	66	32.17	9.53	0.68	14	6	66	23.43	4.30	0.62
9	37	17.50	2.94	0.42	17	6	63	19.71	3.36	0.51
6	47	23.10	4.35	0.58	17	6	47	21.12	2.85	0.69
6	39	20.46	4.43	0.52	18	6	44	18.61	3.01	1.51
6	58	18.20	5.25	1.03	18	6	58	20.00	3.42	1.53
6	39	14.86	2.61	0.47	22	6	39	15.50	1.94	0.57
9	41	43.00	21.39	0.58	11	9	42	33.27	8.91	0.53
14	113	45.40	19.53	1.03	11	7	113	34.72	9.16	0.94
19	40	29.50	4.82	0.49	13	6	44	29.65	4.77	0.61
7	24	21.50	6.16	0.45	20	6	48	17.20	2.56	0.40
11	32	28.78	8.35	0.67	15	6	64	24.60	4.86	0.69

shown in Table I and include the number of cycles, their minimum-maximum-mean duration, their amplitude from peak to trough, and their standard deviation. These properties are determined over the expansion and contraction phases of the cycle and the total cycle as well. The cyclical behavior of the price series ranges from those with a very high reversal activity to those with a very low activity. Commodities with the most frequent expansion, contraction, and overall cycles are cocoa with fifteen cycles overall, copper with twenty-four, lead with sixteen, tea with twenty-two, and wool with twenty. There appear to be roughly the same number of cycles in expansion as in contraction. Commodities with greater cyclical duration in expansion, contraction, and overall cycles include coffee with 134-month maximum duration overall, petroleum with 80 months, and tungsten with 113 months. Note that the mean duration of the cycles in contraction is generally longer than that of the mean cycles in expansion. The maximum duration in expansion is 68 months for tungsten, while in contraction 134 months for coffee.

III. CONFIRMATION OF PRICE CYCLES

Structural time series (STS) models as those developed by Harvey (1989, 1993) provide an approach to identify and to model the cyclical components of a variety of economic variables in time series form. These models are typically specified in terms of components that have a direct interpretation. Define Y_t as the time or price series variable of interest:

$$Y_t = \mu_t + \psi_t + \varepsilon_t, \tag{1}$$

where μ_t is the trend component, ψ_t is the cyclical component, ε_t is the irregular component, and t ranges between 1 and T (total number of observations). The trend component is a local linear trend defined by

$$\mu_t = \mu_{t-1} + \beta_{t-1} + \pi_t, \tag{2}$$

and

$$\beta_t = \beta_{t-1} + \zeta_t. \tag{3}$$

Here, β_t is the slope and the normal white noise disturbances are such that π_t is NID $(0, \sigma_\pi^2)$, ζ_t is NID $(0, \sigma_\zeta^2)$,[5] and π_t and ζ_t are independent of each other. The cyclical component ψ_t is a function F of time with frequency λ_c, which is measured in radians

$$\psi_t = \alpha \cos\lambda_c t + \beta \sin\lambda_c t. \tag{4}$$

Here $(\alpha^2 + \beta^2)^{1/2}$ is the amplitude and $\tan^{-1}(\beta/\alpha)$ is the phase. When time variation is introduced, the cycle can be modeled recursively by introducing ψ_{t-1}:

$$\begin{bmatrix} \psi_t \\ \psi_t^* \end{bmatrix} = \begin{bmatrix} \cos\lambda_c & \sin\lambda_c \\ -\sin\lambda_c & \cos\lambda_c \end{bmatrix} \begin{bmatrix} \psi_{t-1} \\ \psi_{t-1}^* \end{bmatrix}. \tag{5}$$

Here ψ_t defined by equation (4) must be rotated to obtain ψ_t such that $\psi_0 = \alpha$ and $\psi_0^* = \beta$.

The cycle can be made stochastic by the addition of independent white noise disturbances ω_t and ω_t^* to model (5):

$$\begin{bmatrix} \psi_t \\ \psi_t^* \end{bmatrix} = \begin{bmatrix} \cos\lambda_c & \sin\lambda_c \\ -\sin\lambda_c & \cos\lambda_c \end{bmatrix} \begin{bmatrix} \psi_{t-1} \\ \psi_{t-1}^* \end{bmatrix} + \begin{bmatrix} \omega_t \\ \omega_t^* \end{bmatrix}. \tag{6}$$

The statistical properties required for specifying, estimating, and interpreting this model are well known and indicated in the above studies by Harvey.

According to Harvey (1993), estimation problems can arise when the residual

[5] NID stands for "normal and independently distributed."

process from equation (1) no longer meets the required conditions of stationarity and of homoscedasticity.[6] When the price models were estimated over the full time period, this problem was encountered. However, these conditions were met once we divided the sample period into appropriate subperiods, representing the major macroeconomic expansions and recessions since 1970, i.e., structural benchmarks suggested by Badillo, Labys, and Wu (1999). This process also reduced problems of structural non-constancy which are common to such long price series. The first subperiod between 1960 and 1970 represents a relatively calm period, except for the rise in prices caused by the Vietnam war at the end of the decade. The second subperiod between 1971 and 1975 reflects the onset of a general commodity price increase that was induced by the OPEC price shock of 1994. Price volatility amplified by further OPEC price shocks describes the third subperiod between 1976 and 1979. During the fourth subperiod between 1980 and 1990 a world recession led to a decrease of prices. The brief recovery which occurred at the beginning of the fourth subperiod between 1991 and 1995, eventually stalled.

The final cyclical specification of equation (1) that we adopted combines a trend with a stochastic level and slope, a stochastic irregular component, and two cycles. As suggested by Harvey (1993), the choice of two cycles ensures that more than one cyclical component would be selected, as is appropriate to harmonic construction. Further details regarding test results from the model specification and estimation based on the STAMP 5.0 estimation program (Koopman et al. 1995) are presented in Labys and Kouassi (1996).

To further simplify the interpretation of the results, Table II summarizes only those price cycles that proved to be significant at the 5 per cent level. Explanation of these results is best obtained based on generic commodity groupings. Depending on the relative strength of the demand and supply forces and of external shocks affecting particular commodity markets, one would expect differences in the cycle length among the generic groups. The agricultural commodities of interest include cocoa, coffee, corn (maize), cotton, jute, rice, rubber, soybeans, sugar, tea, wheat, and wool. Cyclical activity in the food and beverage commodities is often production-driven with one-year cycles for annual crops and up to six-year cycles for perennial crops. However, demand as well as external market shocks often confound such agronomic cycles. As shown in Table II, price cycles are confirmed, but for only certain commodities over different subperiods. For example, over subperiod 2, coffee displays periods of 4.2 months and 9.3 months, surprisingly similar to rubber for which cycles are confirmed at 5.5 and 12.2 months. More pronounced cyclical activity occurred during the stormy subperiod 3 following the first petroleum price shock. Corn has a first cycle of 12.2 months; sugar has cycles of 4.0 and 13.8 months; wheat has cycles of 12.4 and 34.0 months; while wool has cycles of

[6] See Cromwell, Labys, and Terraza (1994).

TABLE II

STATISTICAL SIGNIFICANCE OF STS COMMODITY PRICE MODELS
(Significance Present Only for Cycles Indicated Below)

	Subperiod 1		Subperiod 2		Subperiod 3		Subperiod 4		Subperiod 5		Total Period	
	Cycle 1	Cycle 2	Cycle 1	Cycle 2	Cycle 1	Cycle 2	Cycle 1	Cycle 2	Cycle 1	Cycle 2	Cycle 1	Cycle 2
Aluminum	—	—	10.5	35.3	—	—	—	—	—	—	5.4	47.1
Cocoa	—	—	10.7	5.2	—	—	9.3	31.6	—	—	10.0	17.1
Coffee	—	—	4.2	9.3	—	—	4.8	10.6	—	—	4.7	9.8
Copper	11.6	17.1	—	—	10.8	18.9	11.7	10.7	—	—	11.8	49.0
Corn	—	—	—	—	12.3	5.6	—	—	—	—	11.5	30.0
Cotton	—	—	—	—	2.7	11.3	—	—	—	—	4.9	10.4
Gold	10.2	3.1	—	—	—	—	3.2	32.4	—	—	11.2	16.5
Jute	—	—	—	—	—	—	—	—	—	—	7.4	14.5
Lead	—	—	4.7	9.8	5.5	9.6	—	—	—	—	5.7	8.7
Petroleum	18.4	11.4	3.7	12.8	4.7	8.5	3.4	11.4	—	—	4.7	10.2
Rice	18.4	—	—	—	17.9	—	18.0	—	—	—	17.5	—
Rubber	5.1	13.7	5.5	12.2	—	—	—	—	—	—	5.0	6.4
Silver	—	—	3.8	8.7	—	—	—	—	—	—	3.9	10.6
Soybeans	—	—	—	—	—	—	5.3	10.0	—	—	6.4	15.4
Sugar	—	—	6.2	15.0	4.0	13.8	5.0	8.6	12.7	8.5	4.8	12.1
Tea	—	—	—	—	11.8	30.7	—	—	—	—	11.8	41.9
Tin	14.3	—	—	—	20.2	—	26.7	—	—	—	23.6	—
Tungsten	4.3	6.9	5.9	13.2	5.1	13.3	5.4	9.7	5.9	11.2	5.8	12.9
Wheat	—	—	—	—	12.4	34.0	11.4	—	—	—	11.7	—
Wool	—	—	—	—	4.0	11.6	—	—	—	—	4.4	10.9
Zinc	4.8	6.2	4.2	22.6	5.1	10.6	4.2	8.6	—	—	4.7	8.7

Note: Timing of the subperiods varies from metal to metal. On average, the subperiods are: 1: 1960–70, 2: 1971–75, 3: 1976–79, 4: 1980–90, 5: 1991–95.

4.0 and 11.6 months. During the subperiod 4, cocoa has cycles near 9.3 and 31.6 months. The periodicity of sugar remains similar to that of the earlier subperiods.

Some further understanding of the agricultural commodity cycles can be obtained by observing and by averaging the behavior of the two cycles identified according to commodity types. For example, beverages show average price cycles of 9.8 and 22.9 months, which are close to the average 7.9 and 18.8 months found for perennial crops. Agricultural raw materials shows the shortest average price cycles of 5.4 and 10.6 months. The longest average price cycles are 14.5 and 30.0 months for the grains. While the average duration of the second cycle for perennial crops does not approach the approximate four to six years needed for gestation, the second grain price cycle reflects periods during which world markets seem to be short of grains.

The mineral prices studied include aluminum, copper, gold, lead, silver, tin, tungsten, and zinc. Again cyclical price activity can only be confirmed over certain subperiods rather than the entire period. From Table II, it appears that aluminum displays first and second cycles of 10.5 and 35.3 months during subperiod 2. Corresponding results are 4.7 and 9.8 months for lead, 3.8 and 8.7 months for silver, 5.9 and 13.2 months for tungsten, and 4.2 and 22.6 months for zinc. Besides tungsten, copper displays some form of confirmed periodicity during most subperiods. The first cycle for copper appears to have a period of 11 months. This cycle is closer to the cycle found in Labys, Elliott, and Rees (1971) who performed spectral analysis over similar London Metal Exchange (LME) prices, though over an earlier period. As demonstrated by Labys and Granger (1970), the "typical spectral shape" of commodity prices often results in the identification of one long-term cycle, with the secondary and tertiary cycles being of less significance. In the case of copper, the findings of Davutyan and Roberts (1994) and Slade (1981) suggest the existence of much longer cycles ranging from five to ten years, presumably due to the use of annual data and linear methods of detrending. The average length of overall metal price cycles is 9.0 and 21.0 months. The latter duration comes close to the 24.0-month period identified for short-term business cycles.

The only energy price series included is the important petroleum or crude oil price series. The cycle of about 12 months for the second component is only weakly confirmed over the subperiods 1, 2, and 4. This weak confirmation is surprising since Mork, Mysen, and Olsen (1991) strongly supported such shorter-term cycles. While these cycles could represent certain residual, seasonal demand influences, they are shorter than the mean duration of cycles overall at 33.6 months shown in Table I.

Concerning the duration of the commodity price cycles during the five selected subperiods, the following can be observed. Averages have been taken for the first and second cycles over all commodities for each of the subperiods. Since not all the commodities showed significant cycles over all of the cycles and all of the subperiods, averages only applied to the cycles depicted in Table II. Surprisingly the average length of the first and second cycles is roughly the same for subperiod 1 (10.9 and 9.8 months), subperiod 3 (9.0 and 9.9 months), and subperiod 5 (9.3 and 9.8 months). During the subperiod 2 with rising prices culminating at the time of the OPEC price shock, the cycle averages are 6.0 and 14.3 months. During the subperiod 4, the cycle averages are 9.0 and 4.8 months. The shorter cycles of subperiods 2 and 4 reflect the rapid changes that occur during periods of high international economic instability.

In general, the STS approach resulted in the identification of cycles of shorter-term duration than those observed with the NBER method. This is not surprising since the mechanical NBER approach searches for cycles simply by selecting disparate peaks or troughs. In addition to employing stochastic detrending, the STS method has captured price cycles which represent a complete but stochastic sinusoid over shorter, succint periods. This is in contrast to the NBER method which is more suitable for capturing longer irregular waves than more geometric cycles.

IV. CONCLUSIONS

In this study, the chronology, frequency, duration, and amplitude of some twenty-one primary commodity price series of export importance to developing countries were examined over the period 1960 to 1995. Our findings provide evidence for cyclical behavior in the expansion, contraction, and overall phases for a number of commodities. This includes statistical confirmation of the cycles identified employing the STS method. These findings which suggest the existence of shorter-term cycles than were previously recognized, may be associated with the ability of the STS approach to improve the detrending process by the use of Kalman filter methods that incorporate a trend with both stochastic level and stochastic slope.

Concerning the cycles identified, our results at this stage suggest the predominance of two kinds of cycles. Over the total time span the first cycle usually shows a periodicity of less than twelve months or one year. This was confirmed for most of the commodities. The second cycle shows a periodicity close to two years or more. This is particularly evident for cocoa, copper, corn and tea, though the amplitude of the cycles is low. These two cycles may reflect the kinds of fluctuations found in the economy relative to commodity markets. The first or shorter-term cycles of less than a year reflects the speculative influences that commodity futures trading can have on spot markets. The duration of the second cycles reflects some of the basic findings on the duration of short-term macroeconomic cycles in the U.S. economy.

Regarding the speed with which commodity price cycles rise and fall, the related cyclical damping factor appears to be about 0.8 for the first cycle and 0.6 for the second cycle. The amplitude of the cycles was found to be less than what might be expected, given the relatively high volatility of commodity prices. However, the NBER method enables to scale the amplitude more compactly.

The above results do not completely preclude the existence of longer-term swings of five to ten years that were pointed out in several studies, since these swings may have been eliminated by the polynomial detrending procedure we employed.[7] Thus the investigation of the policy implications of longer-term price swings associated with secular declining terms of trade is a subject for future research.

Finally, the presence of cycles in a certain range is consistent with the notion that a very large (petroleum) price shock pervaded the commodity markets in the 1970s. This result further illustrates the already expressed notion that petroleum price affects most severely developing countries. In addition the duration of the first cycle suggests that policy prescriptions for developing countries may still include export quotas, if buffer stocks are too illusory. The identification of the second cycle im-

[7] See Cuddington and Urzúa (1989).

plies that compensatory finance might be reconsidered. While our results suggest the existence of cycles of a less dominant nature attempts to promote export revenue stabilization schemes in the developing countries might want to take these findings into account.

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APPENDIX

DEFINITION OF PRICE SERIES

Aluminium: London Metal Exchange, high grade, cash. From February 1970 to December 1978: virgin ingot, 99.5 per cent purity, c.i.f. Europe. Prior to January 1970: virgin ingot, spot London (*Metal Bulletin*, London), January 1970–December 1995.

Cocoa: Average of daily prices of the nearest three active future trading months on the London Terminal Market and on the New York Coffee, Sugar, and Cocoa Exchange at the time of the London close. Article 26 of the International Cocoa Agreement, 1986 (International Cocoa Organization, London), January 1960–December 1995.

Coffee: Average of daily prices (Secretariat of the International Coffee Organization, London). Robustas, weighted average of ex-dock New York (60 per cent), Angola Ambriz 2 BB, Uganda standard, January 1960–December 1995.

Copper: London Metal Exchange, electrolytic wire bars, high grade, cash (*Metal Bulletin*, London).

Corn/Maize: U.S. Yellow, No. 3, average cash price, Chicago (United States Department of Agriculture; USDA, Washington, D.C.), January 1960–December 1995.

Cotton: Medium: U.S. Memphis Territory (medium staple), Middling 1–3/32. Prior to July 1981: S.M. 1–1/16 (USDA, Washington, D.C.), January 1960–December 1995.

Gold: United Kingdom, 99.5 per cent fine, London afternoon fixing, average of daily prices (*Metal Bulletin*, London), January 1970–December 1995.

Jute: Raw Bangladesh, B.E.D., f.o.b. Chittagong-Chalna, actual market prices (*Public Ledger*, Watford, United Kingdom). Prior to March 1980, minimum export price (Bangladesh Ministry of Jute), January 1960–December 1995.

Lead: London Metal Exchange settlement and cash seller's price in warehouse excluding duty, range main United Kingdom ports, purity 99.97 per cent Pb (*Lead and Zinc Statistics*, International Lead and Zinc Study Group, London), January 1960–December 1995.

Petroleum: Average of Dubai, United Kingdom Brent and Alaska N. Slope crude prices, reflecting relatively equal consumption of medium, light, and heavy crude worldwide. Dubai Fateh 32 API, spot f.o.b. Dubai; United Kingdom, Brent Bland 38 API, spot f.o.b. United Kingdom ports; United States, Alaskan N. Slope 27 API, spot f.o.b. U.S. Gulf of Mexico ports, January 1970–December 1995.

Rice: Thailand, White, 5 per cent broken, end of month price, f.o.b. Bangkok, including export duty (IMF Secretariat, Washington, D.C.), January 1960–December 1995.

Rubber: Singapore, f.o.b. in bales, No. 1 RSS. Closing quotations (*Public Ledger*, Watford, United Kingdom), January 1960–December 1995.

Silver: Handy & Harman, 99.5 per cent grade refined, average daily quotations, New York (*Metal Bulletin*, London), January 1960–December 1995.

Sugar: Caribbean ports, f.o.b. bulk basis (International Sugar Organization, London), January 1960–December 1995.

Soybeans: U.S. Yellow No. 1, average cash price, Chicago (USDA, Washington, D.C.), January 1960–December 1995.

Tea: London, auction prices, all tea (*Monthly Statistical Summary*, International Tea Committee, London), January 1960–December 1995.

Tin: Ex-works price Kuala Lumpur market (ITC reference price since 4 July 1972). Tin trade was suspended from October 24, 1985 to the end of January 1986 (*Metal Week*, New York), January 1960–December 1995.

Tungsten: Wolfram, c.i.f. European ports concentrates, basis minimum 65 per cent WO_3 (*Metal Bulletin*, London), January 1960–December 1995.

Wheat: U.S. No. 2, Hard Red winter (ordinary), f.o.b. Gulf (International Wheat Council, London), January 1960–December 1995.

Wool: UK64's (dry-combed basis) (New Zealand Wool Marketing Corporation, Clacton-on-Sea, United Kingdom), January 1960–December 1995.

Zinc: London Metal Exchange, settlement and cash seller's price in warehouses excluding duty, range main United Kingdom ports; Virgin zinc, high grade (*Lead and Zinc Statistics*, International Lead and Zinc Study Group, London), January 1960–December 1995.