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The Myth of Co-moving Commodity Prices

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Abstract[1]

There is a common perception that the prices of unrelated commodities move together. This paper re-examines this notion, using a measure of co-movement of economic time series called concordance. Concordance measures the proportion of time that the prices of two commodities are concurrently in the same boom period or same slump period. Using data on the prices of several unrelated commodities, the paper finds no evidence of co-movement in commodity prices. The results carry an important policy implication, as the study provides no support for earlier claims of irrational trading behavior by participants in world commodity markets.

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1 Introduction

It is generally believed that commodity prices rise and fall in unison. Such co-movements are typically attributed to common macroeconomic shocks on world commodity markets, and complementarity or substitutability in the production or consumption of related commodities. Co-movement is also often presumed for the prices of unrelated commodities, that is, those commodities for which the cross-price elasticities of demand and supply are close to zero, even after controlling for the effects of common macroeconomic shocks. This notion of "excess" co-movement was popularized by Pindyck and Rotemberg (1990), who found that the prices of a group of unrelated commodities had a tendency to move together, even after accounting for the effects of common macroeconomic variables such as inflation, industrial production and the level of interest and exchange rates.

A finding of excess co-movement of unrelated commodity prices represents a rejection of the standard market-clearing, competitive-storage model of commodity price formation (Samuelson (1971)), as it would imply the presence of irrational or herd behavior by market participants in what are typically regarded as highly competitive markets. However, if unrelated commodity prices do not move together (even without controlling for the effects of common macroeconomic shocks), then there can be no excess co-movement in commodity prices, and so the hypothesis of competitive markets for world commodities is not rejected.

Using a variety of time series techniques, previous work takes as given the notion of co-movement, and has attempted to measure the extent of excess co-movement in commodity prices (Palaskas and Varangis (1991), Palaskas (1993), Trivedi (1995), Deb et al. (1996)). These analyses typically find that the extent of co-movement is less "excessive" than that found by Pindyck and Rotemberg. Unlike this literature, our paper is concerned with examining the veracity of the notion of co-movement of unrelated commodity prices.

In this paper we use a measure of co-movement of economic time series called concordance. This concordance statistic was first suggested by Pagan (1999) and Harding and Pagan (1999), and its distributional properties have been examined by McDermott and Scott (1999). Concordance measures the extent to which the cycles of two series are synchronized. It is used here to calculate the proportion of time that the prices of two commodities are concurrently in the same phase (that is, a boom period or a slump period). Concordance is also a useful concept of co-movement because it represents a way to summarize information on the clustering of turning points – that is, whether booms (slumps) in prices for different commodities turn into slumps (booms) at the same time.

This paper is arranged as follows. Section 2 discusses the concept of concordance and its use in analyzing co-movements in economic time series. Unlike previous analyses which examined the cross-correlation of detrended commodity price series, the concordance approach used in this paper is immune to spurious cross-correlation induced by large shifts in the level of commodity prices. Section 3 measures the extent to which concordance is present in the prices of the seven unrelated commodities studied by Pindyck and Rotemberg

(1990). No evidence of co-movement in the prices of these unrelated commodities is found. However, there is strong evidence of co-movement in the prices of groups of related commodities. Accordingly, this paper argues that the notion that prices of unrelated commodities typically move together is a myth. Section 4 concludes with some policy implications of our findings.

2 Measuring co-movement

We are interested in how the cyclical patterns of economic time series compare to each other. To facilitate this, we make use of a test that determines whether the proportion of time two series (x_i and x_j) spend in the same state is statistically significant or not. In the case of commodity prices, the two states will be a boom (expansionary) phase and a slump (contractionary) phase. Let $S_{i,t}$ be a dichotomous variable taking the value unity when the series x_i is in a boom phase and zero when it is in a slump phase. Define the variable $S_{j,t}$ in the same way for the series x_j. The degree of concordance in the cycles of the two series is then

$$C_{ij} = T^{-1}\left\{ \sum_{t=1}^{T} \left(S_{i,t} S_{j,t}\right) + \left(1 - S_{i,t}\right)\left(1 - S_{j,t}\right)\right\}, \tag{1}$$

where T is the sample size and C_{ij} measures the proportion of time the two series are in the same state.

Before we are able to employ the concordance statistic we need to determine whether a time series is in a boom phase or a slump phase. While it is easy to imagine what a booming or slumping market is, and despite such terms being frequently used to describe the state of commodity markets, there is no formal definition in the literature. One definition would describe a boom (slump) in commodity markets as a period of generally rising (falling) commodity prices. Accordingly, we work with a definition of booms and slumps in commodity prices which emphasizes movements in the level of commodity prices between local peaks and troughs. This approach is in line with the business cycle literature going back to Burns and Mitchell (1946). The definition essentially implies that a commodity market has shifted from a boom phase to a slump phase if prices have declined since their previous (local) peak. Such a definition does not rule out sequences of price falls during a boom or price rises during a slump, but there are constraints on the extent to which these sequences of price reversals can occur and yet still be considered part of any given boom or slump.

The phase of the commodity price series can be determined with the assistance of an algorithm used for business-cycle dating—that of Bry and Boschan (1971). The algorithm is used here to date turning points (peaks and troughs) in commodity price series, and proceeds in three basic steps. First, a potential set of peaks and troughs is determined by the application of a turning point rule that defines a local peak in series *x* as occurring at time *t* whenever $\{x_t > x_{t\pm k}\}$, k=1, ..., K, while a local trough occurs at time t whenever $\{x_t < x_{t\pm k}\}$, k=1, ..., K, where K is set to two. The second step enforces the condition that peaks and troughs must alternate. Thirdly, the peaks and troughs are revised, or "censored", according a range of criteria. In its present application to commodity price data, a complete cycle must be at least 24 months long, while all phases must be at least 12 months.[2] There are further rules designed to avoid spurious cycle dating at the ends of series (for further details see Cashin, McDermott and Scott (1999)).

When the peaks and troughs in each of the time series have been dated, key features of these cycles can be measured. In particular, we can construct the concordance statistic and examine the relationships between the cycles in each of these series. As it is a proportion, the values of C_{ij} are clearly bounded between zero and one. Faced with a realized concordance statistic of, for example, 0.7, it is natural to assume that this is large relative to zero.[3] However, even for two unrelated series the expected value of the concordance statistic may be 0.5 or higher. For example, consider the case of two fair coins being tossed. The probability that both coins are in the same phase—that is, both heads or both tails—is 0.5. Alternatively, consider the case when two series follow a Brownian motion. In this case there is an equal chance that the series are in or out of phase with each other, and the distribution of the statistic will be around 0.5.

If the two series are independent, then the variance of the concordance statistic is $1/\{4(T\text{-}1)\}$. However, the Bry-Boschan algorithm involves censoring, which that means independence cannot be assumed. McDermott and Scott (1999) show that censoring increases the variance and kurtosis in the distribution, and that if the series are trending in the same (opposite) direction, then the distribution of the statistic will be skewed towards one (zero). The effect of a trend on the distribution is summarized by the drift: standard error ratio, which is simply the ratio of the slope of the trend to the variation of the residuals from the series.[4]

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[2] We selected a minimum phase of 12 months due to the dominance of the annual production process in many agricultural commodities. For similar reasons, the minimum cycle length needs to encompass at least two harvests, which is the minimum time necessary for the occurrence of both a good and a bad harvest (for annual crops). While it could be argued that different phase and cycle lengths would be more appropriate for certain commodity price series, for the sake of a systematic examination of commodity prices, we prefer to maintain a consistent rule.

[3] The series x_i is exactly pro-cyclical (counter-cyclical) with x_j if $C_{ij} = 1$ ($C_{ij} = 0$).

[4] McDermott and Scott (1999) show how critical values for the concordance statistic may be derived from a Monte Carlo simulation. The results hold for the typical NBER business-cycle censoring rule of 6 months for phases and 15 months for cycles. In the present application for commodity prices, the censoring rule was changed to 12 months for phases and 24 months for cycles. Consequently, the critical values used in this paper were derived from a Monte Carlo simulation using this censoring rule, holding the sample size constant, and varying the drift: standard error ratio of the data generating process over a range encompassing the empirical values from the commodity price data. Two sets of critical values were generated: one for the longer sample (T=512), and one for the shorter sample used by Pindyck and Rotemberg (T=308). The innovations in the simulation were normally-distributed. However, McDermott and Scott (1999) show that there is potential size distortion when the data are nonnormally distributed

Pindyck and Rotemberg (1990) use correlation analysis as their measure of co-movement in commodity prices. In measuring concordance we are interested in whether two series move together in any given period. That is, we are explicitly and solely interested in *periodicity* – the proportion of time two series spend together in booms or slumps – and not in the amplitude of movements in a given phase (boom or slump). Correlation, on the other hand, is based on covariance, which picks up amplitude (shifts in the level) as well as periodicity.

It is possible for a large, one-time shift in the level of two series (for example, those induced by the oil shock of 1974) to induce significant correlation in otherwise unrelated series. In contrast, such a shock will only be important under the concordance test to the extent that the co-movement lasts for a lengthy period of time. To illustrate, McDermott and Scott (1999) consider an example with two independent random walks of 100 observations each, with variances chosen so as to generate series which look like 'typical' economic time series. A jump point is added halfway through both series. As expected, the concordance statistic measures 0.5. However, the correlation of the first-differenced series is large and significant, even though the two series are otherwise random.

It would, in theory, be possible to correct a correlation analysis by accounting for known break points, but in practice the dating of break points is highly contentious. Perron (1989) selected 1929 and 1973 as dates of key breaks for US macroeconomic time series. Zivot and Andrews (1992) criticized this ex post selection of breaks, as a priori there is no reason for selecting these dates, and argued that the correct procedure is to allow the data to select the break point. However, even the Zivot-Andrews approach founders if there is more than one break in a given sample. In contrast, the concordance measure is immune to the problem of selecting a break date, because by definition it is unaffected by the amplitude of a time series. Moreover, the concordance measure can allow for multiple breaks in any given time series. To the extent that level shifts are common to many economic time series (particularly commodity prices), we regard the concordance statistic as having advantages for the analysis of co-movement between time series.

3 Results

We examine the same seven seemingly-unrelated commodities as Pindyck and Rotemberg: wheat, cotton, copper, gold, crude oil, lumber and cocoa. As noted by Pindyck and Rotemberg, these commodities are unrelated in that none are coproduced, none are substitutes or complements in demand, and none are inputs to the production of another.

3.1 Results of correlation analysis

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and the drift: standard error ratio is high. While innovations in commodity prices tend to be nonnormal, their actual drift:standard error ratios are low, and in a range where size distortion does not occur. Moreover, experimentation using a fat-tailed distribution bootstrapped from the commodity price data did not markedly change the results.

Using world commodity price data for the same sample period as Pindyck and Rotemberg (1960:4-1985:11), table 1 replicates their correlation results for the monthly change in the logarithm of the nominal prices.[5] The same test as that used by Pindyck and Rotemberg implies that individual cross-correlations exceeding 0.112 in magnitude are significant at the 5 percent level.[6] Pindyck and Rotemberg find that 9 out of 21 correlations satisfy this criterion; using our data we find that an even larger number, 11 out of 21 correlations, satisfy this criterion. In particular, lumber is correlated with copper, cotton, gold and wheat; wheat is correlated with cotton and oil; gold is correlated with cocoa and copper; oil is correlated with gold; cotton is correlated with copper; and copper is correlated with cocoa.

As a group, we find (like Pindyck and Rotemberg) that these correlations are statistically significant. The likelihood ratio test statistic of the joint significance of the group's cross-correlations (distributed as χ^2 with (1/2) $p(p$-1) degrees of freedom, where p is the number of commodities) is 190.42; the 5 percent critical value is 38.9. With 21 degrees of freedom, this is an even more emphatic rejection than Pindyck and Rotemberg of the null hypothesis that price movements in these seven commodities are uncorrelated.[7]

3.2 Results of concordance analysis

The results of the application of the Bry-Boschan algorithm can be seen for the seven nominal commodity price series in figure 1. The cycles are demarcated by peaks (solid lines) and troughs (dashed lines), with periods from peaks to troughs being slumps, and periods from troughs to peaks being booms. Clearly, not all the movements in the respective series are identified as peaks and troughs. For example, the first peak in cotton prices is dated as 1958:1, the second peak is dated as 1964:6, and the first trough in cotton prices is dated as 1959:7. Hence the first slump phase for cotton prices is the period 1958:1 to 1959:7, and the first boom phase for cotton prices is the period 1959:7 to 1964:6. In the particular case of cotton, the concordance test measures the proportion of time that cotton prices and the prices of each of the other six series spent in the same phase (that is, the proportion of time that the pairs of commodities were in boom or slump together).

Table 2 presents concordance statistics (C_{ij}), which allow us to examine if cycles in commodity prices move together. The i, j th cell represents concordance between the i^{th} and

5 Pindyck and Rotemberg use U.S. average monthly cash prices as data for their seven commodities. We use the same series as they did for lumber, but the data for the other six commodities are taken from the International Monetary Fund's *International Financial Statistics* (IFS). While the IFS data (apart from wheat) are defined slightly differently from those used by Pindyck and Rotemberg, oil is the US price, and the US prices of the other four commodities closely follow the IFS data. The data are described, and sources given, in Appendix 1.

6 The 5 percent critical value is calculated as $1.96\big/\sqrt{T}$, where T is the number of observations.

7 LR is the likelihood ratio statistic for the null hypothesis that the correlation matrix is the identity matrix. The LR statistic is defined as: LR=-2.ln $\det(R)^{T/2}$, where T is the number of observations and det (R) is the determinant of the correlation matrix.

j^{th} commodity; the numbers along the diagonal are therefore unity. When we follow Pindyck and Rotemberg and analyze the data on the seven commodity price series over the same sample period (1960:4-1985:11), we find that the null hypothesis of no concordance in the bilateral relationship is not rejected for any of the 21 pairs of commodities (table 2A). This lack of synchronization in movements in commodity prices is also clear from the heterogeneous turning points depicted in figure 1, and these results clearly conflict with the correlation results of Pindyck and Rotemberg.

An example of the above-mentioned spurious correlation induced by a large one-time shift in the level of price series is depicted in the plots of the lumber and cotton price series (figure 1). Both series show a pronounced level shift around the time of the oil shock of 1974. While the correlation between the two series is significant at 0.17 (as was found by Pindyck and Rotemberg), these series really do not co-move in any period other than the 1974-80 period.[8] This lack of co-movement is picked up in our concordance statistic, which indicates that 51 percent of the time, lumber and cotton prices are in boom and slump together (table 2A). Such synchronization is only marginally larger than what would be expected from the toss of two fair coins.

We then turned to analyze the concordance between the seven seemingly unrelated commodities using data for a longer sample period (1957:1-1999:7). Of the 21 pairs of commodities, only 1 pair displayed statistically significant concordance in prices (table 2B).[9] The significant concordance recorded between oil and gold might be due to the desire to hold gold in inflationary periods – rising oil prices are viewed as inflationary, and the demand for gold as an inflation hedge rises with oil prices (Melvin and Sultan (1990)). Overall, our results do not support the hypothesis of co-movement in unrelated commodity prices, let alone the existence of co-movement in excess of that driven by changes in macroeconomic fundamentals. Accordingly, we conclude that the notion that prices of unrelated commodities move together is a myth.

As a check of the power of the concordance statistic to detect co-movement, our analysis was then extended to a sample of related primary commodities measured over the longer sample period (1957:1-1999:7).[10] We follow Deb et al. (1996) and focus on groups of commodities which are potentially related, either because they are substitutes in demand (vegetable oils

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[8] While lumber prices were in a long expansion between 1970 and 1980 (accentuated by the jump in prices, which accompanied the oil shock in 1974), cotton prices enjoyed three boom periods (and two slump periods) during the 1980s (see figure 1).

[9] While some of the concordances for a given commodity pair are higher in the shorter sample (1960:4-1985:11) than in the longer sample (1957:1-1999:7), the appropriate critical values are also higher. For example, the concordance between oil and cotton is 0.67 in the shorter sample and drops to 0.60 in the longer sample (tables 2A and 2B). The higher number would be significant at the 5 percent level using the critical values applicable to the longer sample, but in the shorter sample it is not statistically significant. However, there is no tendency for concordances to be systematically higher for one sample than the other.

[10] The commodities examined are listed and described in Appendix 2, and the data are taken from the International Monetary Fund's *International Financial Statistics* database.

and beverages), or, on the supply side, the commodities are coproduced (metals for alloys, such as aluminum-copper-gold-lead-tin-zinc). The results for these commodities are given in table 3, and we find that indeed the prices of these related commodities do move together. Four of the six pairs of vegetable oils are concordant at the 5 percent level of significance, two of the three pairs of beverages are concordant, as are 10 of the 15 pairs of metals. This finding that the concordance test recognizes the co-movement in the prices of related commodities indicates the test has reasonable power (see McDermott and Scott (1999) for an econometric analysis of the power of the concordance test).

4 Conclusions and policy implications

There is a common perception that the prices of unrelated commodities move together. Pindyck and Rotemberg provided empirical evidence that gave support to this notion. In this paper we re-examined the validity of this notion of co-movement, using the same set of seemingly unrelated commodities and for the same sample period as Pindyck and Rotemberg. When we defined co-movement in terms of concordance, that is, the proportion of the time that the prices of commodities are in the same boom period or slump period, we found no evidence that unrelated commodity prices move together. When the sample period was extended we again found no evidence that unrelated commodity prices move together, except for gold and oil prices, which may be linked by inflation expectations. The concordance analysis was then conducted on groups of related commodities, and our empirical technique detected co-movement in the prices of these commodities. Consequently, we conclude that the notion that prices of unrelated commodities move together is a myth.

Our results have several important policy implications. First, earlier work suggested that a finding of co-movement in commodity prices, over and above that explainable by common macroeconomic variables, is evidence of irrational “herd” or “fad” behavior by commodity traders. Since we find that unrelated commodity prices do not move in a synchronous manner, then there obviously cannot be any “excess” co-movement, and so there is no evidence of irrational trading behavior by participants in world commodity markets.

Second, our results suggest that caution is warranted when drawing policy implications for developing countries from analyses of movements in aggregate commodity price indices. For industrial countries, which import a wide range of commodities, aggregate commodity price indices may be useful indicators of general movements in commodity prices. However, developing countries often export only a limited range of commodities. In such cases, market conditions faced by a particular commodity-exporting country will not be well-represented by an aggregate index formed from indices of individual commodities, particularly as many commodity prices do not move in a synchronous manner.

Finally, many developing countries have a comparative advantage in the export of primary commodities and usually little else. Consequently, the economies of these countries are heavily dependent on the prices these commodities fetch in world markets. If prices of unrelated commodities move together, then an important way these countries may be able to reduce the risk associated with commodity price movements is to diversify into the export of manufactured goods, in which they may not have a comparative advantage. However, if, as we demonstrate, cycles in the prices of unrelated primary commodities are not synchronized, then it is also possible for some of these countries to reduce their exposure to price fluctuations by expanding the range of primary commodities they export.

Appendix 1

Data for the Seven Unrelated Commodities

Monthly nominal data on the prices of the seven unrelated commodities analyzed by Pindyck and Rotemberg (1990) were taken from the International Monetary Fund's *International Financial Statistics* (IFS) database, except for lumber, which was taken from the United States Bureau of Labor Statistics. The period covered ranged from 1957:1 to 1999:7. The description and sources of the data are as follows, with the unit of index (in US dollars) given in parentheses.

Cocoa: International Organization daily price. Average of the three nearest active futures trading months in the New York Cocoa Exchange at noon and the London Terminal market at closing time, c.i.f. US and European ports (The Financial Times, London). ($/Mt)

Copper: London Metal Exchange, grade A cathodes, spot price, c.i.f. European ports (Wall Street Journal, New York and Metals Week, New York). Prior to July 1986, higher grade, wirebars, or cathodes. (Cents/lb)

Cotton: Middling 1-3/32 inch staple, Liverpool Index "A", average of the cheapest 5 of 14 styles, c.i.f. Liverpool (Cotton Outlook, Liverpool). From January 1968 to May 1981 strict middling 1-1/16 inch staple. Prior to 1968, Mexican 1-1/16. (Cents/lb)

Crude oil: Average of: U.K. light, Brent Blend 38o API, spot price, f.o.b. U.K. ports; Dubai, medium, Fateh 32o API, spot price, f.o.b. Dubai; and US, West Texas Intermediate 40o API, spot price, f.o.b. Midland Texas (Bloomberg Business News). Prior to 1984, Saudi Arabian Light 34o API, posted price, ex Ras Tanura (Platt's Oil Price Handbook and Almanac, New York). ($/barrel)

Gold: UK 99.5 percent Fine, PM Fixing, Average Daily. ($/oz)

Lumber: United States Bureau of Labor Statistics, Aggregate price index for lumber and primary lumber products. ($/Mt)

Wheat: US No.1 hard red winter, ordinary protein, prompt shipment, f.o.b. Gulf of Mexico ports. ($/Mt)

Appendix 2

Data for Related Commodity Prices

The monthly nominal data on the prices of 13 related primary commodities were taken from the International Monetary Fund's *International Financial Statistics* (IFS) database, for the period 1957:1 to 1999:7, and are defined below, with the unit of the index (in US dollars) given in parentheses.

Vegetable Oils:

Coconut oil: Philippine/Indonesian, bulk, c.i.f. Rotterdam (Oil World, Hamburg). ($/Mt)

Groundnut oil: Any origin, c.i.f. Rotterdam (Oil World, Hamburg). Prior to 1974, Nigerian bulk, c.i.f., U.K. ports. ($/Mt) 2/

Palm oil: Malaysian/Indonesian, c.i.f. Northwest European ports (Oil World, Hamburg). Prior to 1974, UNCTAD. ($/Mt) 2/

Soybean oil Dutch, f.o.b. ex-mill (Oil World, Hamburg). Prior to April 1973, Dutch crude oil, ex-mill. ($/Mt) 2/

Metals:

Aluminium: London Metal Exchange, standard grade, spot price, minimum purity 99.5 percent, c.i.f. U.K. ports (Wall Street Journal, New York and Metals Week, New York). Prior to 1979, U.K. producer prices, minimum purity 99 percent. ($/Mt) 1/

Copper: London Metal Exchange, grade A cathodes, spot price, c.i.f. European ports (Wall Street Journal, New York and Metals Week, New York). Prior to July 1986, higher grade, wirebars, or cathodes. (Cents/lb) 1/

Gold: United Kingdom 99.5 percent Fine, PM Fixing, Average daily. ($/oz)

Lead: London Metal Exchange, 99.97 percent pure, spot price, c.i.f. European ports (Wall Street Journal, New York and Metals Week, New York). ($/Mt) 1/

Tin: London Metal Exchange, standard grade, spot price, c.i.f. European ports (Wall Street Journal, New York, New York). From December 1985 to June 1989 Malaysian, straits, minimum 99.85 percent purity, Kuala Lumpur Tin Market settlement price. Prior to November 1985, London Metal Exchange (Wall Street Journal, New York and Metals Week, New York). (Cents/lb) 1/

Zinc: London Metal Exchange, high grade 98 percent pure, spot price, c.i.f. U.K. ports (Wall Street Journal and Metals Week, New York). Prior to January 1987, standard grade. ($/Mt) 1/

Beverages:

Tea: From July 1998, Mombasa auction prices, for best PF1, Kenyan tea (International Tea Committee, London). Prior to July 1998 is London auctions, average price received for good medium, c.i.f. U.K. warehouses (The Tea Brokers Association, The Financial Times, London). (Cents/kg) 2/

Coffee (arabica): International Coffee Organization (New York) prices. Average of El Salvador central standard, Guatemala prime washed and Mexico prime washed, prompt shipment, ex-dock New York (Bloomberg Business News). (Cents/lb) 1/

Coffee: International Coffee Organization (New York) prices. Average of C⊥te d'Ivoire

(robusta): Grade II and Uganda standard, prompt shipment, ex-dock New York (Bloomberg Business News). Prior to July 1982, arithmetic average of Angolan Ambriz 2 AA and Ugandan Native Standard, ex-dock New York. (Cents/lb) 1/

1/ Average of daily quotations.
2/ Average of weekly quotations.

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Table 1
Correlations of Monthly Log Changes in Commodity Prices, 1960:4-1985:11

	Cocoa	Copper	Cotton	Gold	Oil	Wheat	Lumber
Cocoa	1						
Copper	0.199**	1					
Cotton	0.060	0.133*	1				
Gold	0.176**	0.233**	0.027	1			
Oil	-0.019	-0.011	0.031	0.197**	1		
Wheat	0.005	0.002	0.270**	0.022	0.113*	1	
Lumber	0.098	0.187**	0.171**	0.117*	-0.037	-0.130*	1

Notes: One (two) asterisk denotes significance of the concordance statistic at the 5 (1) percent level.

Table 2
Concordance Results, Prices of Seven Unrelated Commodities

A. Concordance Statistics, 1960:4-1985:11

	Lumber	Wheat	Oil	Cocoa	Gold	Copper	Cotton
Lumber	1.00						
Wheat	0.51	1.00					
Oil	0.61	0.66	1.00				
Cocoa	0.62	0.54	0.60	1.00			
Gold	0.57	0.61	0.65	0.47	1.00		
Copper	0.54	0.45	0.52	0.57	0.53	1.00	
Cotton	0.51	0.56	0.67	0.50	0.53	0.47	1.00

B. Concordance Statistics, 1957:1-1999:7

	Lumber	Wheat	Oil	Cocoa	Gold	Copper	Cotton
Lumber	1.00						
Wheat	0.62	1.00					
Oil	0.52	0.63	1.00				
Cocoa	0.60	0.53	0.51	1.00			
Gold	0.55	0.60	0.69*	0.51	1.00		
Copper	0.55	0.50	0.59	0.49	0.62	1.00	
Cotton	0.47	0.56	0.60	0.54	0.50	0.45	1.00

Notes: One (two) asterisk denotes significance of the concordance statistic at the 5 (1) percent level.

Table 3
Concordance Results, Prices of Related Commodities, 1957:1-1999:7

A. Concordance Statistics, Vegetable Oils

	Palm Oil	Coconut Oil	Soybean Oil	Groundnut Oil
Palm Oil	1.00			
Coconut Oil	0.60	1.00		
Soybean Oil	0.68*	0.65*	1.00	
Groundnut Oil	0.64*	0.53	0.66*	1.00

B. Concordance Statistics, Metals

	Aluminum	Copper	Tin	Zinc	Gold	Lead
Aluminum	1.00					
Copper	0.62	1.00				
Tin	0.67*	0.72**	1.00			
Zinc	0.61	0.62	0.74**	1.00		
Gold	0.77**	0.62	0.66*	0.65*	1.00	
Lead	0.62	0.65*	0.70**	0.69*	0.73**	1.00

C. Concordance Statistics, Beverages

	Tea	Coffee (robusta)	Coffee (arabica)
Tea	1.00		
Coffee (robusta)	0.63	1.00	
Coffee (arabica)	0.73**	0.80**	1.00

Notes: One (two) asterisk denotes significance of the concordance statistic at the 5 (1) percent level.

Figure 1
Datings for Peaks and Troughs, Seven Unrelated Commodities, 1957:1-1999:7
(Logarithm of nominal price indices)

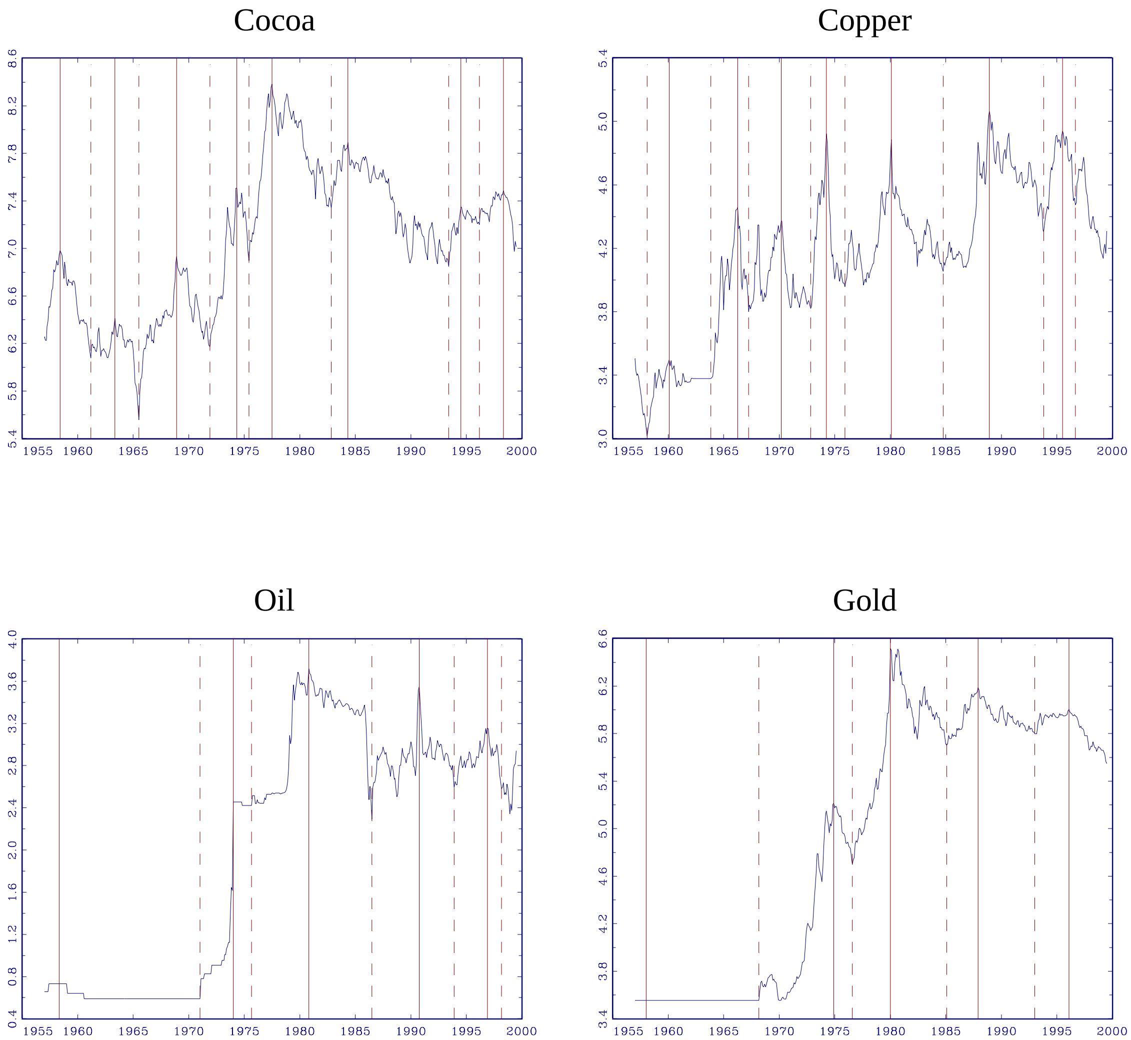
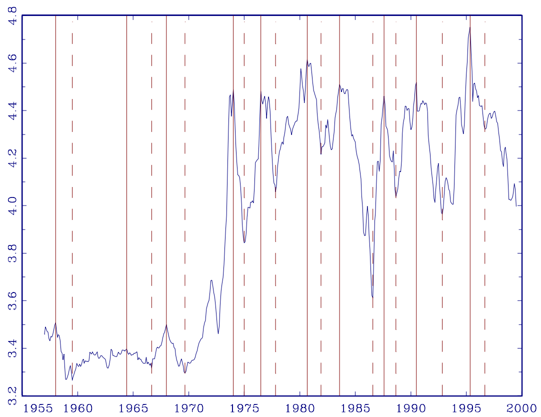
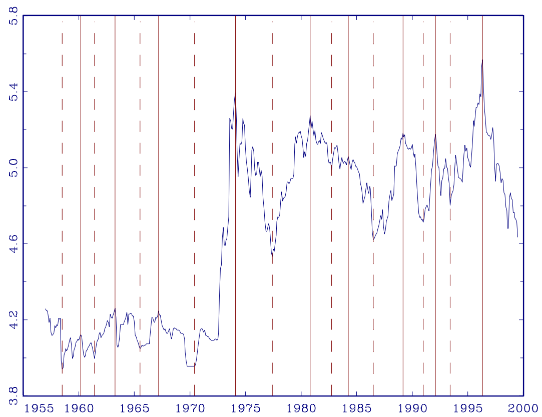


Figure 1(Continued)
Datings for Peaks and Troughs, Seven Unrelated Commodities, 1957:1-1999:7
(Logarithm of nominal price indices)

Cotton



Wheat



Lumber