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Pricing and Causality Among Selected Fats and Oils

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ABSTRAK

Artikel ini bertujuan untuk mengkaji pola perhubungan bagi sejumlah lima minyak sayuran dan lemak terpilih (kelapa sawit, soya, kelapa, ikan dan lemak binatang) untuk menghasilkan bukti-bukti empirikal mengenai struktur persaingan pasaran lemak dan minyak. Pasaran lemak dan minyak menunjukkan ciri-ciri persaingan yang tinggi, maka harga dijangka ditemui serentak oleh peserta-peserta pasaran dengan lencungan dan jeda yang minimum. Model statistik sebab-musabab yang dipadankan oleh Granger, Sims dan Haugh-Pierce telah digunakan bagi menguji hipothesis ini. Beberapa rumusan dibuat mengenai kesesuaian dan ketepatan model dan kefahaman mengenai pasaran.

ABSTRACT

This paper studies the nature of price relationships among selected prices of five fats and oils (palm oil, soybean, coconut, fish oils and tallow) to provide empirical evidence as to the competitive structure of the fats and oils market. The fats and oils market is highly competitive and price is shown to be simultaneously discovered by the market with minimum lags and distortions. Statistical causality models developed by Granger, Sims and Haugh-Pierce were used to examine this hypothesis. Inferences are made as to the applicability of the models in understanding the nature of the market.

INTRODUCTION

The world fats and oils market is highly competitive where a total of 16 types of oils - most of which are substitutable for each other - are traded. These fats and oils are traded among a large number of producers and consumers worldwide. In such a market, price is expected to be simultaneously discovered by the market participants with minimum lags and distortions. However, in the case of the fats and oils market, soybean appears to take the lead role in the price discovery mechanism as it accounts for about 22% of the world fats and oils production (World Bank 1992). The prices of other fats and oils tend to move in tandem with the soybean price.

As shown in *Fig. 1*, the prices of five major fats and oils (coconut, soybean, palm, fish oils and tallow) tend to move parallel - though not perfectly - to each other. Although soybean leads, it does not fetch the premium price that coconut oil does. In fact, soybean oil falls within the medium - range prices together with palm oil and other vegetable oils. As shown in Table 1, the correlation coefficient between soybean and crude palm oil prices is 0.908, suggesting a high interdependency between the two.

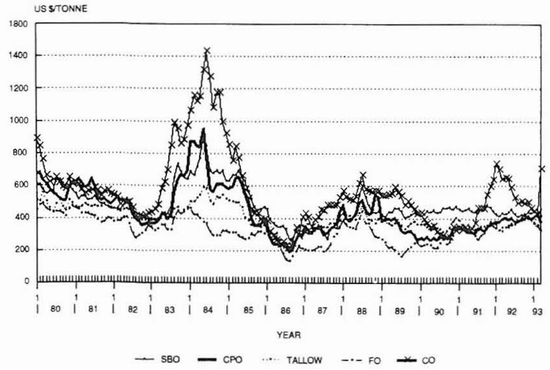

Fig. 1: Annual average of selected prices of fats and oils 1980-1993

This paper examines the nature of price relationships of the five selected fats and oils prices, in particular the direction of causality between them. It attempts to ascertain whether the price relationships conform with the simultaneous relationships expected in a highly competitive market. The three major causality tests

TABLE 1
Correlation coefficients among selected fats and oil price series,1976-1987

Fats and Oils	Correlation coefficient				
	CPO[a]	SBO[b]	CO[c]	FO[d]	TO[e]
CPO	1	0.908	0.849	0.689	0.209
SBO	0.908	1	0.875	0.620	0.264
CO	0.849	0.875	1	0.434	0.117
TO	0.209	0.264	0.117	0.160	1

a CPO - Crude Palm Oil
b SBO - Soybean Oil
c CO - Coconut Oil
d FO - Fish Oil
e TO - Tallow

- Granger, Sim and Haugh-Pierce are adopted and compared. The arrangement of the paper is as follows: The paragraphs that follow provide the salient characteristics of fats and oils market structure and their bearing on price behaviour. The methodology of analysis is discussed in the following section. The last section concludes with the findings and derives some implications for the fats and oils industry.

MARKET STRUCTURE CHARACTERISTICS

Unlike other agricultural commodities such as rubber, cocoa, sugar and coffee, the fats and oils market is unique in its characteristics. Firstly, the fats and oils trade is fairly complex since it encompasses a broad category of oils and fats of diverse origins, vegetable and non-vegetable. These oils and fats provide a wide variety of products and by-products which are utilised in a vast range of applications, both edible and non-edible. Hence, price determination in the fats and oils market is a function of numerous fundamental and technical factors, not only within the system but also those outside the sectors. For instance, prices of fats and oils are determined by the demand for livestock and dairy products which in turn affect the supply of fats and oils. Beef, pork and dairy production add to the supplies of tallow, lard and butter. Expansion of livestock and dairy production increases the demand for animal feeds whose main ingredients are feedgrain and high protein meal.

Secondly, most fats and oils are interchangeable, as a result of technological improvements in refining. Increase in interchangeability causes their markets to be closely linked. Hence, the price of an individual fat or oil reflects the demand and supply situation for all fats and oils. The extent to which the price of an oil moves with the overall price level for all fats and oils depends on whether it can be replaced by other oils. Close substitutability of these commodities affects their prices in several ways: (i) the market is much more price-competitive as prices become more important in the manufacturer's choice of fats or oils, (ii) price differentials among fats and oils have narrowed; and (iii) it has encouraged the use of cheaper oils like soybean and palm oil at the expense of higher-priced oils (World Bank 1984). This is turn has increased the long-term price level of the less expensive oils and lowered the price level of the expensive oils.

The producers and consumers of fats and oils products are spread all over the world - a characteristic which is in contrast to other agricultural raw materials where production and consumption are often concentrated in clearly defined regions. For instance, oilseeds production is heavily concentrated in about 25 countries, 18 of which are developing countries. In the case of soybean, production is concentrated in the U.S., China and Brazil. Perennial crops are distributed among the African and ASEAN regions, with concentration of palm oil in Malaysia and coconut in the Philippines. The consumption of fats and oils is almost evenly spread all over the globe. In the 1970s, the industrial countries accounted for more than 70% of the total world imports but this proportion has dropped to about 30% in the 1980s. In contrast, the share of developing countries has increased from 30% in the 1970s to 60% in the 1980s.

PRICE TRANSMISSION IN A COMPETITIVE MARKET

The above structural characteristics render the market highly competitive and complex. One characteristic of a competitive market is that prices are transmitted efficiently through the market system. Brorsen *et al.* (1984) points out that efficient price transmission can be regarded as exhibiting minimum lags and distortions. This is important as price serves as the market signal that relates to changing demand and supply conditions between consumers and producers. The major elements of pricing efficiency are timeliness (rapidity of transmission) and accurancy (reliability) of price signals (Sporleder and Charas 1979). Whether such price behaviour is applicable to the fats and oils market remains untested.

The competitive system in a static sense is defined as having instantaneous price adjustment. However, most operative markets are characterised by lead and lag and other forms of distortions as price gravitates towards long-run equilibrium. Price adjustment may be initiated by causal or lead market level which results in prices in other markets reacting, possibly asymmetrically, through some distributed lag structure. There are reasons for the existence of lead-lag in price transmission. Ward (1982) implies the existence of a relationship between assimilation of market information and causality. Gupta and Mueller (1982a) support this contention by testing the hypothesis of lead-lag structure in terms of markets concentration and information. The tested hypothesis is that concentrated market levels have an advantage over information which may in turn allow the more informational market to lead other market levels in price formulation.

Some studies in agricultural markets tend to indicate that price leadership is consistent with an oligopolistic market although the definite pattern of relationship between the two variables is yet to be identified. Studies on wheat markets (Mc Calla 1966, 1970; Alouze *et al.* 1978) indicate this phenomenon although the exact structural dimensions of the market are still unclear (Sprigg and Kaylen 1982). Using past data, Sprigg and Kaylen indicated that the leadership occurred during periods where the leading markets were oligopolistic in structure. In another study, Gupta and Mueller (1982b) indicate that long distance and small markets (in terms of its share of the total trade) are not impediments to price transmission as long as there is efficient informational flow between market centres. In other words, market structure and information availability play an important role in determining the lead-lag relationship which characterises the price transmission process between markets.

The analysis of lead-lag relationship among agricultural prices has invariably been based on Granger's causality. Since Granger's publications, three approaches and tests have been postulated in applying the Granger causality criterion to economic time series. Feige and Pearce (1979) have compared the three tests, cross-correlation technique suggested by Haugh (1976) and Pierce (1977), the one-sided distributed lag approach implied by Granger (1969) and the two-sided distributed lag method advanced by Sims (1972). The Sims procedure suffers from the use of an arbitrary prefilter. The Haugh-Pierce cross-correlation procedure has been criticized for the bias imposed by the two-sided filtering. Nonetheless, the procedure offers an insight into the lead-lag relationship between series. Feige and Pearce (1979) concluded that the choice of approach can significantly affect the nature of economic conclusions derived from the test procedures. In fact there has been some criticism of the Granger causality (Conway *et al.* 1984; Cooley and Le Roy 1985; Bassmann 1988). Despite the criticism, Covey and Bessler (1992) maintain that the Granger-type causality is a well-defined method for determining whether an empirical relationship is present in the data. It provides a testable framework for testing causal relationship between economic variables.

Fatimah and Ghaffar (1987) have applied the Haugh and Pearce method to test the hypothesis that soybean price plays the lead role in price transmission. The study indicates that this hypothesis cannot be rejected. In view of the possibility of variation in results, the three tests are employed here to examine the nature of price transmission between the selected fats and oils prices. Since the details of the three methodologies have been described by the authors concerned, only a brief account of them is provided in the following section.

METHODOLOGY

The Granger test applies ordinary least square regression to the time series under consideration. Gamber and Hudson (1984) showed that the testing procedure performs best when the data are filtered to remove such systematic components as trend and seasonality. To test whether causality runs from X to Y (i.e., causality is "one-way"), the following pair of the model is specified:

$$Y_t = a_{10} + \sum_{j=1}^{p} a_{1j} Y_{t-j} + e_{1t} \qquad (1)$$

$$Y_t = a_{20} + \sum_{j=1}^{p} a_{2j} Y_{t-j} + \sum_{k=1}^{q} b_{2k} X_{t-k} + e_{2t} \qquad (2)$$

Where the a_{1j} and a_{2j} are parameters which relate Y_t to past values of Y_t the b_{2k} are parameters relating Y_t to lagged values of X_t and e_{1t} and e_{2t} are white-noise residuals. Causality, in the Granger sense from X and Y is presence, if the inclusion of the past values of X significantly improve the estimation of Y as verified by the F test.

The test for no instantaneous causality is by using equation (2) and adding current values of X (Geweke 1980):

$$Y_t = a_{30} + \sum_{j=1}^{p} a_{3t} Y_{t-j} + \sum_{k=0}^{q} b_{3k} X_{t-k} + e_{3t} \quad (3)$$

with a_{3j}, b_{3k}, and e_{3t} having the same intrepretation as those in equations (1) and (2).

The Sims procedure is based on the regressions of the form

$$X_t = \sum_{i=-n}^{n} a_i Y_{1t-i} + e_t \quad (4)$$

X does not cause Y, if a for i < 0 as a group equals zero and X i does not cause Y at all if for i < 0 are all zero. An i analogous regression of Y on past and future X is then estimated to determine whether Y causes X. According to Sims (1972),

> "Y can be expressed as a distributed lag function of current and past (but not future) X ..... if, and only if Y does not cause X in Granger's sense".

Because the error term of the above regression equation is generally serially correlated, Sims suggested the prefiltering of the X and Y series so as to eliminate the serial correlation problem.

The Haugh-Pierce test involves two-stage procedures. First, the original series are filtered using the ARIMA procedure to produce white-noise. Secondly, the innovations from these ARIMA models are cross-correlated.

Assume initially that two time series, X_t and Y_t, can be represented by

$$F(B)\ X_t = u_t \quad (5)$$
$$G(B)\ Y_t = v_t \quad (6)$$

where F(B) and G(B) are converging invertible polynomial filters n lag operator B (backshift notation) and the innovations v_t and u_t being white noise processes which are uncorrelated themselves. The cross-correlation between the innovations at lag k is given as

$$r_{uv}(k) = \frac{E(u_{t-k}, v_t)}{[E(u_t^2)\ \ E(v_t^2)]^{\frac{1}{2}}}$$

Since individual estimated cross-correlations can be misleading, Pierce suggests the portmanteau statistic to test the hypothesis that cross-correlations are equal to zero at positive or negative lags. Haugh (1976) and Box and Pierce (1970) suggest that the following statistic be tested against chi-square distribution at m degrees of freedom.

$$U = N\sum_{i=1}^{m} (r_{ki})^2$$

where m = integer large enough to include any suspected relationship (or expected nonzero coefficient)

N = the number of innovations in each series

r_{ki} = the squared cross-correlations at lag k

Pierce suggests the null hypothesis of independence is rejected between m innovations and, by extension, concluding X causes Y if

$$N\sum_{k=1}^{m} r_k^2 > \chi\propto^2(2m+1)$$

where the right-hand figure is the upper-percentage point of the $X\propto^2(m)$ distribution. Similarly the hypothesis that X and Y are unrelated would not be rejected at level a if and only if

$$N\sum_{k=-m}^{m} r_k^2 < \chi\propto^2(2m+1)$$

The methodology outlined above was applied to monthly data on five of the selected oils and fats covering the period of 1976-1987. The prices are:

CPO – Price of crude palm oil

SBO – Price of soybean oil
CO – Price of coconut oil
FO – Price of fish oil
TO – Price of tallow

CPO and SBO are the two major types of vegetable oils accounting for 22% and 10% of the world production of fats and oils respectively. SBO represents the soft oil or the seed oil category while CO is one of the lauric oils. FO and TO each represents its own category. The prices are monthly prices expressed in US dollars per metric ton from the North West European Market from January 1976 - December 1987 (reported in *Palm Oil Update* and *Oil World*, various issues).

EMPIRICAL RESULTS

In applying the Granger test the prices (P_t) were first differenced (P_t - P_{t-1}) to transform them to an approximate stationary series. The results (Table 2) indicate that in most cases the null hypothesis of no unidirectional causality is rejected; with the exception of the case of "CPO does not cause TO", which the test fails to reject. The hypothesis of non-instantaneous relationship is rejected for all pairs of prices. At the 1% level of significance, there appears to be a unidirectional causality running from TO to the other four oils and not vice versa. The overall results seem to suggest a feedback relationship between almost all the pairs of prices.

The Sims procedure offers a second alternative test for unidirectional causality between prices. Under this method the series were deseasonalised to achieve stationarity. Short-term lags of 2 and 4 months as well as medium and long lags of 8 and 12 months respectively were applied to study the nature of price relationship between these lags. The analysis suggests the following: there is a feedback relationship between SBO, CPO, CO and FO prices in the short and medium lags of 2 and 4 months respectively (Table 3). The test on feedback relationship from SBO, CPO, CO and FO to TO are rejected at the 1% level. In other words, there is unidirectional causality running from TO to the other four oils but not vice versa.

The picture changes a little in the medium lag of 8 months. Again, a similar set of feedback relationships exists among SBO, CPO, CO and FO prices. Unidirectional causality occurs from TO to CPO. In addition, the test does not detect any relationship between SBO and TO, and between TO and FO. In the long lag of 12 months, unidirectional causality is observed from CPO, SBO and FO to TO, while feedback relationship occurs among the rest of the pairs.

TABLE 2
Granger causality test on monthly prices of selected fats and oils using first difference data

Hypothesis	Uni-directional Test	No. Instantaneous Test
CPO and SBO		
CPO does not cause SBO	6.51**	66.81**
SBO does not cause CPO	9.29**	71.21**
CPO and CO		
CPO does not cause CO	15.69**	46.23**
CO does not cause CPO	9.48**	32.35**
CPO and FO		
CPO does not cause FO	7.26**	25.66**
FO does not cause CPO	10.18**	29.31**
CPO and TO		
CPO does not cause TO	3.02**	3.26*
TO does not cause CPO	9.36**	9.49**
SBO and CO		
SBO does not cause FO	8.04**	27.91**
FO does not cause SBO	6.03**	24.03**
SBO and FO		
SBO does not cause FO	8.04**	27.91**
FO does not cause SBO	6.03**	24.03**
SBO and TO		
SBO does not cause TO	3.04*	3.11**
TO does not cause SBO	6.06**	6.11**
CO and FO		
CO does not cause FO	6.54**	21.11**
FO does not cause CO	15.71**	26.29**
CO and TO		
CO does not cause TO	3.37*	4.29*
TO does not cause CO	13.84**	14.92*
FO and TO		
FO does not cause TO	4.23*	3.06*
TO does not cause FO	5.94**	5.83*

** Reject null hypothesis at 1% level
* Reject null hypothesis at 5% level

TABLE 3
Sime test on monthly prices of selected fats and oils using first difference data

Hypothesis	F Values			
	Short lag i=2	Medium lag i=4	Medium lag i=8	Long lag i=12
CPO and SBO				
CPO does not cause SBO	33.46**	21.88**	13.05**	9.04**
SBO does not cause CPO	37.74**	27.08**	15.08**	10.11**
CPO and CO				
CPO does not cause CO	24.79**	17.20**	10.64**	8.92**
CO does not cause CPO	19.06**	12.28**	6.84**	5.08**
CPO and FO				
CPO does not cause FO	12.65**	8.87**	5.11**	3.98**
FO does not cause CPO	14.46**	10.43**	6.99**	5.71**
CPO and TO				
CPO does not cause TO	1.84	1.24	1.14	4.76**
TO does not cause CPO	4.69**	3.44**	2.40**	1.64
SBO and CO				
SBO does not cause CO	23.23**	16.35**	9.34**	7.54**
CO does not cause SBO	16.21**	10.50**	7.87**	6.00**
SBO and FO				
SBO does not cause FO	16.23**	10.49**	6.36**	4.50**
FO does not cause SBO	12.38**	8.15**	5.63**	4.18**
SBO and TO				
SBO does not cause TO	1.65	1.18	1.17	6.68**
TO does not cause SBO	3.14**	2.22*	1.31	1.19
CO and FO				
CO does not cause FO	10.87**	7.17**	4.24**	2.86**
FO does not cause CO	16.17**	10.45**	6.07**	6.26**
CO and TO				
CO does not cause TO	3.39*	2.23*	2.39*	5.39**
TO does not cause CO	7.74**	5.26**	3.66**	2.64**
FO and TO				
FO does not cause TO	2.08	1.36	0.81	3.73**
TO does not cause FO	3.22**	2.30*	1.83	1.23

** Reject null hypothesis at 1% level
* Reject null hypothesis at 5% level

The analyses provide contradictory results in the sense that some pairs do not behave consistently in all the lags. Nevertheless, the pairs of SBO, CPO, CO and FO consistently move together in a bidirectional manner. Similar to the results of the Granger test, TO is independent and does not have any feedback relationship with other fats and oils prices in the short and medium lags. In the long lag, however, there is a feedback relationship from TO to the others. Although a specific deduction from case to case (or comparison between the lags) does not show consistency, the general trend indicates a strong inter-dependency

TABLE 4

Estimated cross-correlation between residuals of selected oil prices by using the selected ARIMA model, (0,1,1)

Hypothesis	Lag													
	0	1	2	3	4	5	6	7	8	9	10	11	12	$U^{a/}$
CPO and SBO														
SBO does not cause CPO	0.635	0.012	-0.133*	-0.164	0.166	0.043	0.005	-0.027	0.013	0.076	-0.069	-0.091	0.007	54.51*
CPO does not cause SBO	0.635	0.117	-0.165	0.023	0.108	0.057	-0.034	-0.031	0.017	0.104	-0.072	-0.119	0.074	12.30
CPO and CO														
CO does not cause CPO	0.495	-0.043	0.004*	0.052	0.082	0.017	0.068	-0.033	-0.025	0.228	0.036	-0.047	-0.087	31.03*
CPO does not cause CO	0.495	0.148	-0.119	-0.114	0.278	0.078	0.058	-0.055	-0.056	-0.038	0.213	-0.216	0.038	10.60
CPO and FO														
FO does not cause CPO	0.389	0.083	0.066*	-0.143	0.104	0.085	-0.069	-0.230	-0.000	0.123	-0.057	-0.087	0.128	15.25
CPO does not cause FO	0.389	0.174	-0.114	-0.082	-0.032	-0.054	-0.052	-0.042	-0.017	-0.097	0.188	-0.002	0.114	19.61
CPO and TO														
TO does not cause CPO	-0.045	0.025	-0.009	-0.059	-0.136	-0.121	0.037	0.001	-0.063	0.011	0.020	0.036	0.030	35.9*
CPO does not cause TO	-0.045	-0.050	0.057	0.089	0.000	-0.075	0.020	-0.030	0.171	-0.132	-0.020	-0.032	0.454	5.94
SBO and CO														
CO does not cause SBO	0.454	0.131	-0.041*	0.111	0.000	0.124	0.018	-0.136	0.065	0.248	-0.001	-0.034	0.065	19.25
SBO does not cause CO	0.454	0.134	-0.153	-0.099	0.159	-0.000	0.084	-0.082	-0.009	0.074	0.174	-0.136	-0.049	17.87
SBO and FO														
FO does not cause SBO	0.404	-0.003	-0.087*	-0.077	-0.013	0.228	-0.066	-0.096	0.081	0.065	-0.090	-0.055	0.078	16.39
SBO does not cause FO	0.404	0.221	-0.241	-0.0.045	-0.020	-0.035	0.081	-0.001	-0.066	0.008	-0.016	-0.004	0.058	14.04

TABLE 4 (*continued*)

Estimated cross-correlation between residuals of selected oil prices by using the selected ARIMA model, (0,1,1) (cont'd)

Hypothesis	Lag													
	0	1	2	3	4	5	6	7	8	9	10	11	12	$U^{a/}$
SBO and TO														
TO does not cause SBO	0.036	0.023	0.040	0.020	-0.064	-0.040	0.014	-0.075	0.000	-0.127	0.050	-0.101	0.087	49.51*
SBO does not cause TO	0.034	-0.013	-0.058	0.042	0.073	-0.058	-0.100	0.055	0.149	-0.051	-0.004	0.035	0.570	6.83
CO and FO														
FO does not cause CO	0.378	-0.160	0.004	-0.025	-0.028	0.048	0.045	0.005	-0.017	0.180	0.025	-0.080	-0.111	5.93
CO does not cause FO	0.378	0.139	-0.108	-0.002	0.027	0.046	-0.054	-0.064	-0.001	0.053	-0.030	-0.030	-0.017	11.27
CO and TO														
TO does not cause CO	-0.062	-0.115	0.127*	-0.163	-0.060	-0.172	-0.039	-0.021	-0.027	-0.057	-0.083	-0.053	0.052	55.69*
CO does not cause TO	-0.062	-0.171	0.136	0.055	-0.001	-0.180	0.168	-0.067	0.198	0.024	-0.008	-0.006	0.519	14.07
FO and TO														
TO does not cause FO	0.002	-0.074	0.058	-0.094	-0.019	0.014	0.002	0.120	-0.095	0.007	0.052	0.048	0.018	32.76*
FO does not cause TO	0.002	0.102	0.024	0.003	0.018	-0.009	0.029	-0.065	-0.014	-0.049	-0.259	0.089	0.395	6.16

a/ U-statistics at lag 12

* Reject null hypothesis at 10% of level

* Significant U-statistics

Standard error at low lag is 0.12

between the four oils with tallow being the exception.

The results obtained using the Haugh-Pierce test are reported in Table 4. In this test the ARIMA filter of (0,1,1) was used. The innovations of each series were then cross-correlated. A lag of twelve periods was used on the U-tests at the monthly level - a period long enough to capture all pertinent price responses. In Table 4, the U-statistics indicate that CPO leads SBO and CO, while TO, SBO, CO and FO jointly lead TO with no apparent feedback relationships. The largest individual cross-correlation is at a zero lag for all the pairs except for CO and TO and FO and TO. This suggests that the response of these oils to any price changes is instantaneous. There is no instantaneous relationship observed between CO and TO and between FO and TO, although CO and FO tend to lead TO. The other large correlations are mainly at lags 1 and 2 with a few in the long lags of 8 to 11. U-statistics were further calculated to test the significance of these cross-correlations at lags 1 and 2. As in the cases of CPO with SBO and CPO with CO, the U-statistics at lag 2 (positive) are significant, indicating that price changes in CPO precede price changes in SBO and CO in two months.

CONCLUSION

The central theme of this paper is the determination of the nature of price relationships between selected major fats and oils prices with a view to providing some empirical support to the competitive nature of the market. Three causality tests were employed to provide a wider perspective on the nature of relationships; each method has its own specific properties. For instance, the Haugh-Pierce test is able to indicate the lead/lag relationship while the Sims test provides a test for significance of various lags. The summary of the three tests is shown in Table 5.

The study points out some implications as to the applicability of the methodologies employed and an understanding of the market. Despite the slight inconsistency suggested in the results, the tests tend to indicate a strong feedback and instantaneous relationships between prices of CPO, SBO, FO and CO. The price of TO appears to be either independent in some instances or to lead other prices unidirectionally.

TABLE 5
Summary of unidirectional causality tests among selected fats and oils prices

i j	CPO	SBO	CO	TO	FO
CPO	–	G,S,H	G,S,H	S,H	G,S
SBO	G,S	–	G,S	S,H	G,S
CO	G,S	G,S	–	S,H	G,S
TO	G	G	G,S	–	S,H
FO	G.S	G.S	G.S	G	–

G = Granger, S = Sims and H = Haugh–Pierce testing for causality. Table enters reject null hypothesis.

In terms of the understanding of the market, the findings indicate the interdependency of these prices in the world market. The instantaneous relationships detected between the four series suggest a high degree of efficiency in price transmission in all the markets. Thus, no commodity clearly dominates the others in price formation. TO appears to be relegated in the feedback relationship in comparison to the four other prices. This could be attributed to its declining significance over the last two decades. Since the early 1960s, world production of fats and oils has grown at an average rate of about 4.1% p.a. During this period, supplies of vegetable oils grew faster than those of animal fats and marine oils. The growing demand for soybean meal has led to a sharp increase in soybean supplies. Besides, the sudden increase in palm oil production has expanded the vegetable oil supply. Tallow and lard lost some of the market share as livestock producers began to respond to the demand for leaner meat. Health factors have shifted consumer demand away from butter and animal fats to vegetable oils. This change in consumption pattern occurred at about the same time as supplies of vegetable oils increased in the market. This has made TO a relatively non-active oil in the market which has a negated role in oil pricing in the market.

In terms of methodology, the study confirms the contention of authors such as Feige and Pearce (1979) that the use of a particular filter and method could affect the overall results. The consistency of results, in particular, in detecting feedback relationships between the four prices implies the applicability of these methods in confirming the *a priori* belief that there exists a close association between them.

These tests provide useful tools in discerning the nature of the relationship complimenting the *a priori* knowledge of the market. The causality results would facilitate a more definitive basis for further model specification such as bivariate transfer function to incorporate the dynamic nature of the relationships exhibited by the time-series analysis.

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