An Empirical Examination of Canada's Role as Price Leader in the International Wheat Market

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A problem of primary importance for the American wheat industry is determination of the specific structure of the wheat market in the international sector. Before any change in structure may occur or any critique of the current structure undertaken, the current and historical structure of the wheat market must be identified and the identification supported empirically.

The identification question has been discussed several times in the past decade, notably by McCalla, by Taplin, and by Alaouze, Watson and Sturgess. They all characterize the market, at least for the range of their analysis, as certainly oligopolistic. Only four (five in McCalla's analysis) nations consistently export significant quantities of wheat: Argentina, Australia, Canada and the United States.

They differ regarding the form of the oligopoly, particularly on the number of participants and the nature of the residual demand curve facing those participants. McCalla [1966] offers a market share based price leader/price follower duopolistic structure wherein the residual demand curve facing exporters is linear.

Taplin [1975][1/] introduces the kinked demand curve to McCalla's price leader/price follower duopoly. The rationale here appears to be that factors such as imperfect substitution between grades, inertia on the part of buyers and imperfect knowledge among buyers give slope to the residual demand curve above the upper limit price set by the duopolists.[2/]

1/ As summarized in Alaouze, Watson, and Sturgess.

2/ That is to say, the price beyond which the second seller will not follow the first.

Alaouze, Watson and Sturgess, relying upon the assumptions that exporters hold carryover stocks and that these stocks are the key to exercising market power, argue for expansion of the duopoly to a triopoly with the inclusion of Australia. Australia, they argue, has since 1967 increased its storage capacity sufficiently to exercise such leverage.

The point most relevant to my analysis is that they all agree that Canada has, and is likely to continue, been the price leader. My objective is to empirically examine the oligopolistic hypotheses in terms of this assumption. If Canada does appear to function as the price leader, then arguments supporting an oligopolistic wheat market will be given factual basis.

Several considerations support the view that Canada acted as a price leader. Among them:

1. Canada enjoys both an outright quality advantage by virtue of a higher protein content and an advantage vis-a-vis the grading structure which was based to a great extent on existing Canadian grades.3/

2. The U.S., as a major world power, does not for political reasons want to present the image of over-shadowing or coercing less powerful nations. Furthermore, the American wheat exporting industry is not conducive (particularly given anti-trust laws) to such coercion. The five or six exporting firms create such a diffuse atmosphere that exercise of significant combined power is unlikely.4/

3. Canada, because the objective of its wheat board is to maximize

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3/ McCalla, A.F. "Duopoly Model of World Wheat Pricing" Journal of Farm Economics, 48(1966). p 713.

4/ Ibid. p. 719.

revenue not merely profit, is more aggressive in seeking a fair return price. This allows it to protect its market share, thus it is the price leader.[5/] Also, Canada has several long standing trade relations which the U.S. had not, until 1972, participated in (though Australia had).

As noted above the data will provide solid evidence regarding these arguments. The data is monthly for the U.S. and Canada.[6/] It provides information concerning Rotterdam delivered prices for U.S. and Canadian Wheat, exchange rates and freight rates. From analysis of this data, I will draw conclusions about (1) the quality differential, as reflected in price; (2) the price differential and how it varies in given historical periods; (3) historical explanations of periodic changes in the market, as well as an implicit look at relative marketing efficiencies, and (4) the nature of comparative price relationships between the U.S. and Canada for such variables as freight rates and exchange rates.

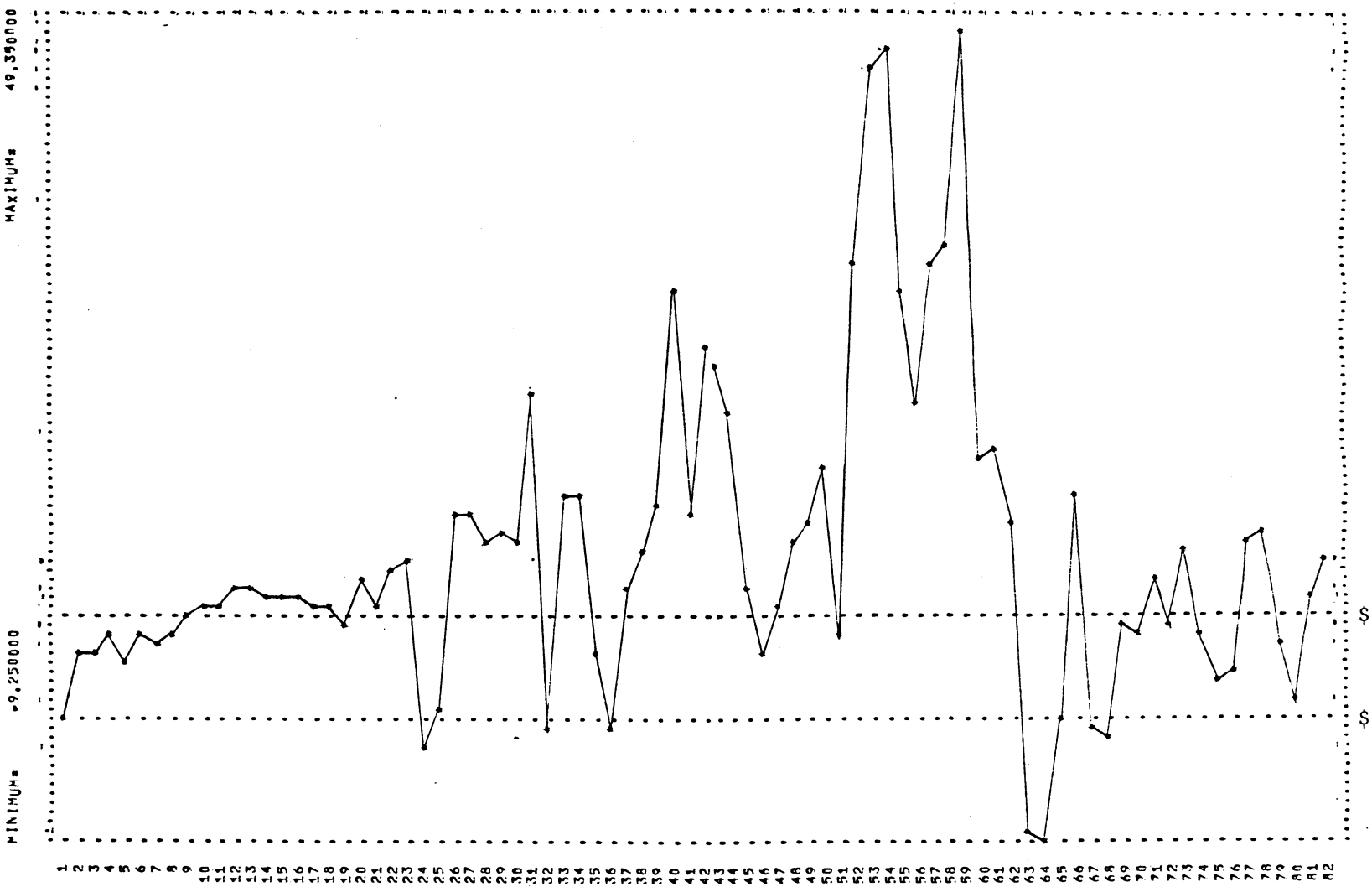
Another interesting point to consider is how the price leader/price follower assumption holds up under the chaotic pressures influencing the market in the 1972-1976 period. The market was relatively stable particularly in terms of the differential (see Figure 1) prior to July of 1972. Then a sharp increase in price, initiated by the failure of the Russian Wheat crop and subsequent purchases on the world market, is accompanied by a wildly fluctuating differential.

5/ Alaouze, Watson and Sturgess, "Oligopoly in the World Wheat Market", American Journal of Ag. Economics, May 1978, p. 180.

6/ Australian and Argentine data was limited, thus I omitted them from examination of the price leader/price follower question. This is justifiable since Canada and the U.S. are the major exporters and as Alaouze, Watson, and Sturgess note, these two nations are faced with two market share questions: (1) maintenance of the North American share of the world wheat market and (2) division between them of that share.

Figure 1: Price Differential:

U.S. Delivered Price minus
Canadian Delivered Price for
Wheat in Rotterdam.



This condition persisted until late 1975. The world market was characterized by exteremely high prices, rapid turnover of grain, and very low carryover stocks. Further complicating the picture were droughts in some of the U.S. and Canada's prime wheat producing areas.

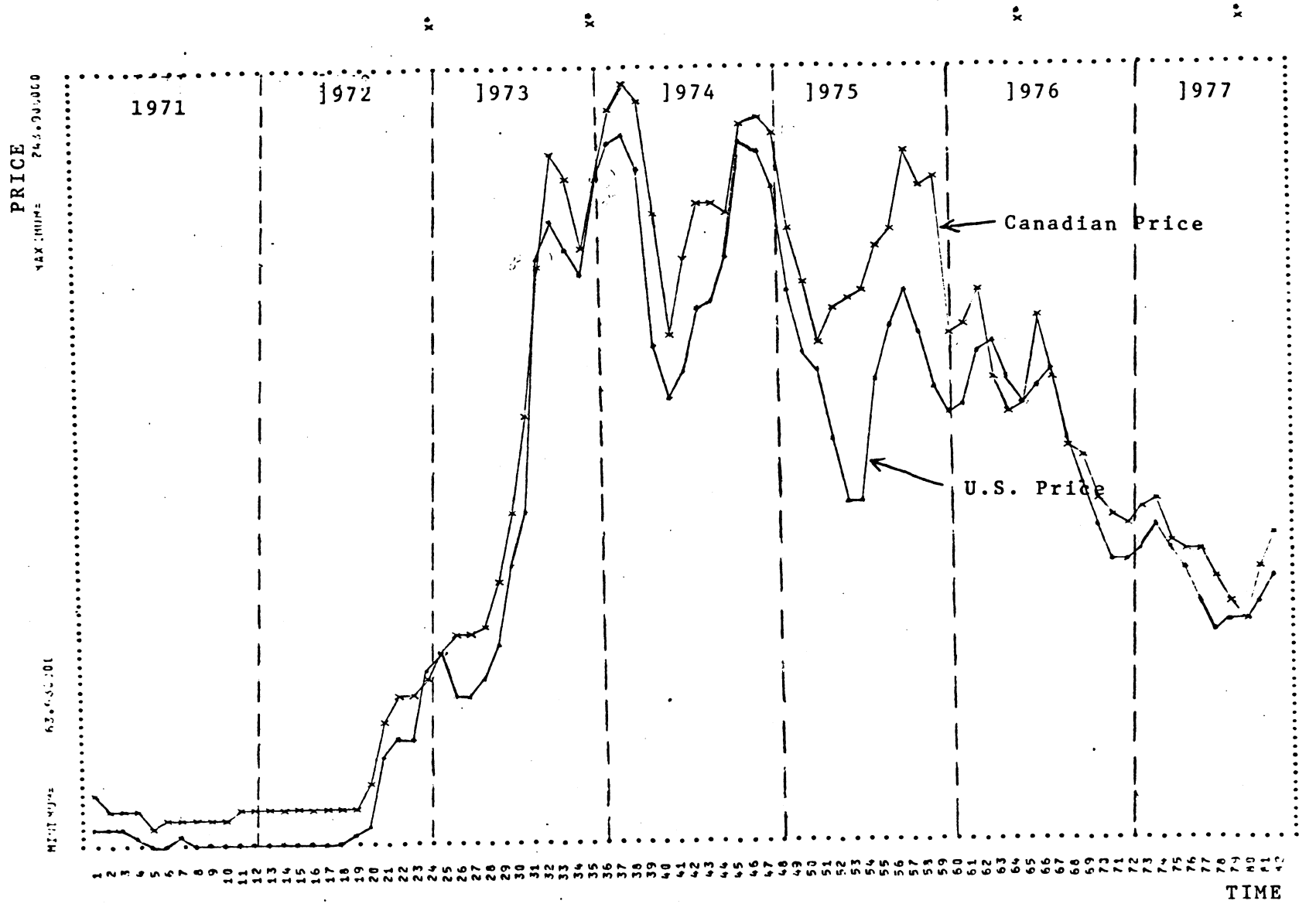
Then in early 1976, after a relatively successful crop year, world wide price begins to taper off. Stocks were up and demand was down. The differential though still highly variable tended to oscillate around the approximate per 1972 level.

In analyzing this market period in terms of a price leader/price follower, or even another oligopolistic market structure, the logical point to begin with is to examine the differential. If the data show that, in any of the three markets identified above (constant, increasing but highly variable and generally decreasing) the differential changes significantly one way or another an oligopolistic market is strongly supported. For example, if the differential widens significantly, given that it is Canadian Rotterdam delivered price less U.S. Rotterdam delivered price, in an increasing market and this increase cannot be attributed to the relevant variables then this is strong evidence that Canada exercises market power sufficient to lead price in its upward movement.

Figure 1 gives the plot of the price differential; as noted above the first eighteen months are relatively stable with only seasonal variations. The differential itself averages around $7.44 per metric ton. This is a fairly reasonable approximation of the quality differential since it is a constant market and neither country appears to be exercising any leverage in the market.

Beyond the eighteen month period the differential widens and fluctuates sharply. Comparing figure 1 to figure 2, the plot of U.S. and Canadian

Figure 2: Canadian Price and U. S. price in Rotterdam for wheat.



Rotterdam delivered prices, we note that the U.S. is lagging Canada slightly, after an initial surge in U.S. price. The differential makes this even more explicit: An increase in the differential is followed by a sharp decrease indicating that the U.S. is, so to speak, playing catch-up.

United States price tends to fluctuate more, while Canadian price rises steadily. This tentatively supports the thesis that Canda is acting as a price leader and the U.S. follows as best it can, given it's goal of maximizing profit. However, other explanations exist: (1) Canada continues to sell to maximize revenue and at the elevated price can afford to reduce its market share. (2) Canada, operating through its Wheat Board is contrained by policies set periodically by that Board and marketing managers are hesitant to follow downward trends. Both theories are supported when one considers the brevity of such opposite movement periods.

Again, as noted above, the differential tends to oscillate around a constant level such as the quality premium level estimated above. This signifies the end of the highly disrupted (relative to previous years) market.

I have described the historical structure of the market and identified the relevant test of the price leader/price follower theory. I now turn to the empirical estimate of the differential. If Canada is acting as a price leader throughout the period we would expect to see the differential widen (relative to a constant market) as price increases and decline (relative to a constant market) when price declines.

To capture this effect I have included dummy variables for a constant (January 1971 through July of 1972), an increasing or very high (August 1972 through January 1976) market, and a decreasing (February 1976 through October 1977) market. Each dummy included in the equation will show the level relative to the omitted period for that type of dummy. For example, the coefficient

on the dummy for a rising market will explain (if the omitted period is the constant period) whether or not the differential changes significantly between these periods.

Other relevant variables are exchange rates and freight rates. I drew upon the work of Kost [4], Schuh [8], and Bredahle and Gallagher [2] to argue that the exchange rate is important (in terms of its price effect) in determining world price. Kost argues that exchange rate change have little quantity effect but some effect on prices. Schuh goes further in attributing changes in quantity to changes in exchange rates, as do Bredahl and Gallagher. All agree that there is a significant price effect, which addresses the problem herein directly.

The assumption that, on at least an inter-regional basis, price should differ only by transportation cost [Tomek and Robinson (10)] is here extended to the international market.[7/] Since I am examining a differential, I used the differences in ocean freight rates to analyze effects of freight rate changes. In doing so, I found that Canada pays lower rates from St. Lawrence Ports than the U.S. from Gulf Ports.

The first equation incorporates dummies for rising and falling markets, freight rate differences, and exchange rates. The form of the model is

$$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + u_i$$

7/ Of course, the international market presents the additional question of currency exchange but this has been answered by inclusion of the exchange rates.

Where:

Y = Canadian Rotterdam Price minus U.S. Rotterdam price (USCNDIF)

X_1 = the rising market dummy. (D2)

X_2 = the declining market dummy. (D3)

X_3 = the frieght rate differential.[8/] (FRDIFF)

X_4 = the U.S. - German exchange rate, expressed in Deutsche marks per U.S. dollar. (XRGERM)

X_5 = the Canadian - German exchange rate, here expressed in Canadian dollars per Deutsche mark. (XRCNGM)

The estimated equation (t-statistics in parenthesis) is:

Equation 1:

$$Y = \underset{(.775853)}{28.1353} + \underset{(.160675)}{.011215X_1} - \underset{(-4.24965)**(.3527)}{18.2659X_2} + \underset{}{.353777X_3} - \underset{(-1.58120)}{11.5727X_4} +$$

$$\underset{(1.08209)}{54.8840X_5} \qquad R^2 = .5514 \qquad DW = 1.9902[9/]$$

**significant at $\alpha = .05$

While the signs are correct the t-statistics are low on all but one variable. That variable is the dummy for declining markets which indicates that the differential does narrow significantly during a declining market. The freight rate differential is not significant and the exchange rate between the U.S. and Germany is only marginally significant while between Canada and Germany it is not significant.

Two problems arise when working with data of this sort: (1) one might expect serial correlation in the residual given the trend oriented nature of

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9/ Of course, this is after correcting for serial correlation.

the data. That is, since trends do occur one might expect the residual of one period to be a function in some manner of the residual from the previous period. I corrected for serial correlation by utilizing the Cochrane-Orcutt technique.

(2) An even greater problem is multicollinearity in the data particularly in the exchange rates. Since Canada and the U.S. interact on several economic and noneconomic levels one might expect their exchange rates to be highly interrelated. To remove this problem, I omitted one exchange rate arbitrarily and examined only the other. A recomputed Canada-Germany exchange rate (expressed in Deutsche marks per Candian dollar replaces both exchange rates in the previous equation.

Also since freight rate differences appear to have little significance I omitted them from the second equation. This allowed me to focus on what I perceived as the key variables: exchange rates and the dummies.

The second equation was estimated to be the following:

Equation 2:

$$Y = 37.8836 + .027855X_1 - 14.37X_2 - 8.03496X_6 \qquad R^2 = .5043$$
$$(4.25246)^* \ (.391670) \quad (-3.62842)^*(-2.6629)^* \qquad DW = 1.8426$$

*significant at $\alpha = .05$

All signs are correct and all but the dummy on rising markets are significant. The equation is strong evidence that Canada leads a price decline during a declining market. The coefficient on X_2, the declining market dummy, suggests that the differential decreases from the constant term when the market is declining. That is to say the differential narrows significantly even given exchange rates and other factors when price declines.

From this analysis several interesting points emerge: (1) it appears that there is no significant leadership activity in either a constant or a rising market. (2) There is a very significant attempt on Canada's part to capture a larger share of the market when price is declining. That is, Canada leads the price reduction probably in the effort to maintain revenues by increasing market share. (3) The 1972 through 1975 "disrupted" market appears to have been essentially competitive. The differential shows high variability and, at that time, exporting nations were carrying over very low quantities. Most exporters pursued policies designed to clear stocks. Demand was great enough to support a competitive market and since no real limit was placed upon potential export quantity neither nation found it necessary to exercise any market power it held.

Furthermore, it is doubtful that the suppliers held any viable market power other than withholding stocks, a politically inadvisable action. The demand existed and action to increase price even further would only have exacerbated an already intense situation.

(4) It is very likely that a major element responsible for the widening gap in this competitive period was the exchange rate. Canada had for the most part a higher exchange rate with Germany (i.e. it required more Deutsche marks to buy a Canadian dollar) than did the U.S. Of course, other factors are also important but less quantifiable.[10/]

(5) In the declining market Canada, as a revenue maximizer which Alaouze, Watson, and Sturgess suggest is so, began to aggressively cut price

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10/ One such factor might be credited arrangements perhaps Canada offered more favorable terms than did the U.S. Another might be that Canada was able to exploit some longstanding trade relations to maintain its price at a higher ldvel. A third would be that Canada did undergo a drought toward the latter end of the period and couldn't export as much as it perviously did. Thus its high quality grain might have commanded even more of a premium.

in order to increase market share and thus maintain revenue levels.

The structure of the market has, then, undergone some dramatic changes in the last eight years. Beginning from a tacit oligopoly-duopoly in the 60's moving to a triopoly in the later 60's and early 70's, becoming competitive for a four year period and now returning to the informal oligopolistic price leader structure. The repercussion of such severe and rapid change are still evident in the fluctuation of the differential.

One question is - did an active triopoly exist in the early 70's? Without Australian data I cannot answer conclusively but it doesn't appear so on the surface. I argue, however, that the structure existed but no real duopolistic or triopolistic activity occurred. The market at that time was glutted with wheat and the major exporters focused on only one thing: maintenance of market share to move stocks. The triopolistic arrangement was in major effect in that periodic meetings[11/] between the major exporters were held and general policies determined but it was not effective given market conditions. Thus an invisible or inactive triopoly existed.

Then came the competitive market period. I believe this period was as near to a free market as is possible given the number of potential wheat exporting countries: any could, if they had the wheat, enter the market at price levels comparable to those of the United States. Buyers, in a period of short supply, actively sought information on quality and production. While the major exporters could dampen price by releasing huge quantities, it was not in their interest to so effect the market (if indeed they had the stocks).

11/ McCalla, P. 722-723; Alaouze, Watson and Sturgess p. 177 and p. 183.

And now that stocks are built up again, price is declining and demand slackening. The activity of Canada in leading the market downward suggests that we are entering or in a period of triopolistic marketing once again. Canada did not have the power to lead prices upward but did exercise the power to lead prices down.

Their rationale was probably to maintain or increase market share in order to maintain revenues. They are less able to control the market as they once did because of structural and trade relation changes but are still the dominant force in the market. Though the price will probably continue to be somewhat similar to the situation in 1970 and 1971; higher carryovers (but not as high) and more stable prices.

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