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VERTICAL EXCHANGE RELATIONSHIPS AND PERFORMANCE IN THE GREAT LAKES YELLOW PERCH INDUSTRY

By

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In recent years agricultural economists have shown a strong interest in vertical exchange relationships for agricultural products and the effect of such relationships on competition, efficiency and equity (Cf. Marion, Hayenga, Campbell and Hayenga). These analyses have, however, largely ignored the fishing sector, a sector generally less well documented and analyzed than agriculture. The purpose of this paper is to fill part of this gap by providing (1) a descriptive analysis of the structure and first handler exchange relationships in the Great Lakes yellow perch industry, and (2) a preliminary analysis of the effects of these relationships on sector performance and equity. This analysis shows that the perch fishery, like some other near-shore fisheries in North America, uses informal exchange relationships rather than written contracts between producers and processors. Further analysis of the perch and other fisheries is needed to document the competitive effect of these arrangements, but they do raise the possibility of restricting factor mobility and thus raising entry barriers. The high buyer concentration, partially a result of the exchange relationships, along with the conduct used by buyers and a limited amount of empirical evidence while not conclusive do suggest that perch fishermen receive sub-competitive prices.

The information for this study was collected from in-person interviews in 1976-77 with fishermen in the major producing areas and with six processors representing about 75 percent of industry throughput. Available secondary information is limited to data on prices and volume at the port market level. For this reason some of the material included here is based on undocumented testimony by participants and should be interpreted with caution.

Background of the Perch Fishery

Commercial stocks of yellow perch are limited to the Great Lakes region,

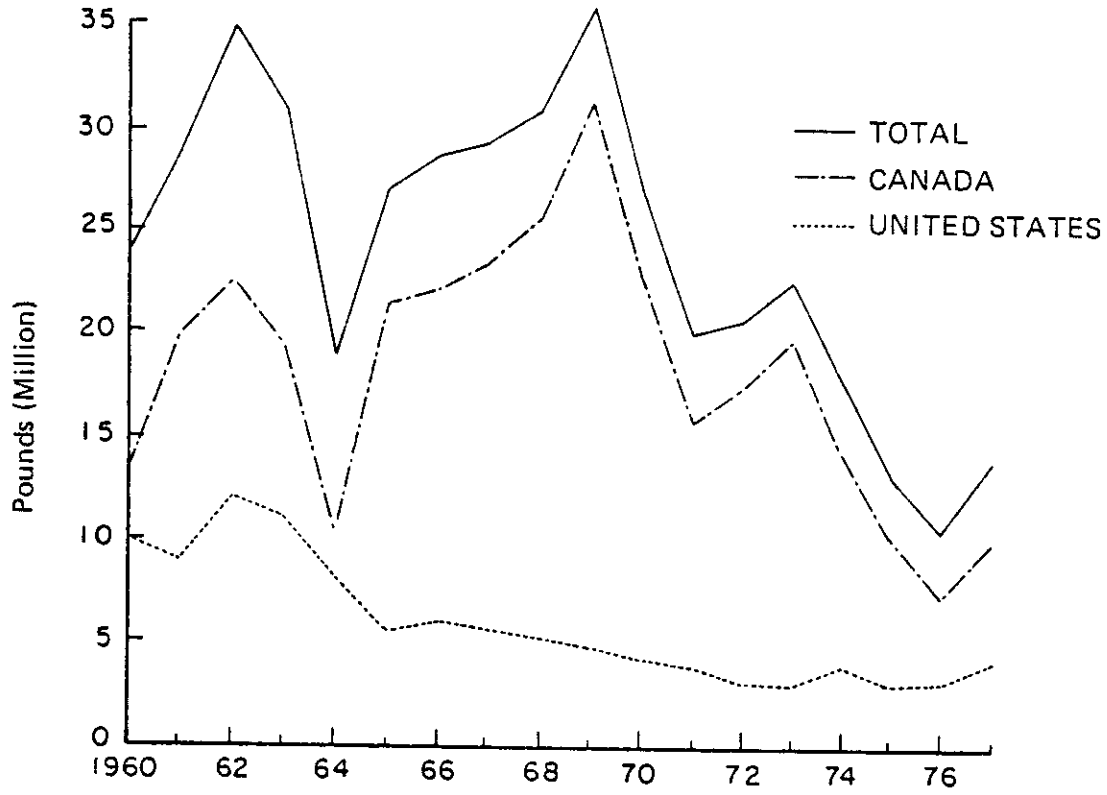
particularly the Canadian western basin of Lake Erie which provides around 67 percent of the catch (National Marine Fisheries Service (NMFS)). Other important producing areas are the U.S. waters of Lake Erie, Green Bay, Wisconsin, and the International Lakes. Since heavy commercial fishing began early in the century supplies have been quite volatile with the total North American catch peaking in 1969 at 36 million pounds then dipping to 10.4 million pounds in 1976 (Figure 1).[1/] The reasons for this volatility are incompletely understood and have variously been laid to pollution, over fishing, predation by smelt, water temperature or a combination of several factors (Leach and Nepszy, Regier and Hartman, Smith and Busch, Scholl and Hartman).

The ex-vessel price for round or unprocessed perch has risen sharply following the supply declines beginning in 1970. The average implicit[2/] price rose from 9 cents/lb. in 1970 to 73 cents/lb. in 1976. In 1977, an increase in landings resulted in the first price decline in nine years (Table 1). The value of the fish measured as percent of edible meat following filleting varies across the season. The yield is lowest during the spring run (approximately March to June) when the fish are heavy with roe and highest during the fall run (approximately August to October) when the fish are fleshier. During the remainder of the year, when landings are generally light, the yields are intermediate between these two extremes. Despite this fluxuation in value the dock price in two recent years has not shown a clear seasonal pattern (Table 2). A discussion of pricing is included below.

[1/] The actual harvest which includes the sport fishing take is significantly larger. For estimates of the sport catch see Applegate and VanMeter, Wells, and the Ohio Department of Natural Resources.

[2/] Prices are estimated from data on landings and receipts reported by the fishermen.

FIGURE 1. North American Yellow Perch Catch by Country, 1960-79 (Round Weight)



Sources: U.S.-NMFS, *Great Lakes Fisheries, Annual Summary.*

Canada—Fisheries and Marine Service, *Annual Statistical Review of Canadian Fisheries.*

Table 1: LANDINGS AND AVERAGE ANNUAL PORT MARKET PRICES FOR YELLOW PERCH IN NORTH AMERICA, 1960-77

Year	Total landings (1,000 lbs.)	Price (Cents/lb.)
1960	24,052	10.4
1961	29,074	11.2
1962	34,622	7.1
1963	30,763	8.4
1964	18,840	17.0
1965	26,851	13.5
1966	28,538	9.5
1967	29,218	10.8
1968	30,928	9.0
1969	36,037	11.2
1970	26,535	16.2
1971	20,029	25.7
1972	20,874	28.3
1973	22,777	31.3
1974	18,069	32.5
1975	13,337	45.8
1976	10,437	73.0
1977	14,013	57.0

SOURCES: U.S. NMFS, Great Lakes Fisheries, Annual Summary, Canada - Fisheries and Marine Service; Annual Statistical Review of Canadian Fisheries.

Table 2: ESTIMATED AVERAGE MONTHLY PRICES IN ONTARIO, 1974 and 1976 (cents/lb.)

Month	1974	1976
January	--	--
February	--	--
March	39	62
April	32	62
May	32	65
June	31	72
July	29	78
August	28	94
September	28	90
October	30	85
November	33	97
December	34	100

SOURCE: Ontario Ministry of Natural Resources, unpublished data.

STRUCTURE

Fishing

The numbers of perch fishermen must be determined by direct observation and catch records since licenses are not species specific. The best estimates for the major fishing areas in 1975-77 suggest 145 perch fishermen in Wisconsin with only 20 full time, 36 in Ohio, a small number in Illinois and between 75 and 100 vessels in Ontario with an average of 2 fishermen per vessel. Limited historical data indicate a substantial decline in the number of Great Lakes fishermen since 1960, probably a response to entry limitations and declines in the stocks of lake trout, whitefish and chubs. In the Ontario waters of Lake Erie which have had limited entry for more than a half century, not only have the total number of perch fishermen been restricted, but also where the fishing may be done. A traditional limitation on the number of licenses for Essex and Kent counties, the prime fishing areas, has been in effect for many years and is considered to limit the amount of effort in these locals. In the United States where limited entry has been broadly applied only during the past decade, the effects on the perch industry do not appear to have been significant through 1976 due to lags in implementation in the major perch fishing areas and the early emphasis on removing the fishermen with the smallest catches. In some areas the number of vessels in the perch fishery actually increased during the 1970's as fishermen concentrating on declining or contaminated species switched to perch, a relatively easy technical change since perch fishing gear (gill and trap nets) does not require extensive vessel modification. For these fishermen entry is limited to a greater degree by lack of experience and restricted access to productive fishing grounds.[3/]

[3/] Perch gear is all fixed and fishermen claim proprietary rights to specific areas. Anyone not honoring these may have his gear removed or damaged.

Besides the independent fishermen, one bargaining-marketing cooperative exists and two processors are backwards integrated into fishing. The cooperative, representing 25 to 30 vessels, is located in Kingsville, Ontario in the heart of the major perch producing region and has maintained an open membership policy although actual membership is determined by the number of vessels in the area, which in turn depends on the number of licenses.[4/] The major processor, also located in Ontario, operates 7 vessels providing 15 percent of its requirements if the catch for all vessels is the same. A second processor in Ohio operates a few vessels which supply all its requirements for perch.

Processing

The processing industry is here defined as the group of firms whose major functions are to fillet the perch and store the fillets for sale during periods of low supply. In addition to these major functions, the processor may be responsible for transporting the product in both its round and filleted form as well as acting as a broker for small quantities of round perch. All of the interviewed firms are diversified into a wide variety of fresh- and salt-water species. Two of the interviewed firms also process vegetables and other non-fish products accounting for 40 to 50 percent of gross sales. Considering fish only, yellow perch accounts for 10 to 50 percent of sales revenues. All firms in the industry are privately held with the owner frequently serving as manager. Two-thirds of the interviewed firms can be characterized as family operations with the business inherited from the preceding generation and family members supplying a large portion of the labor and management.

In 1976-77 there were 12 firms in Ontario, Wisconsin, Michigan and Ohio which filleted yellow perch on a commercial scale. Exact data on throughput by

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[4/] This cooperative has since become a private firm with 15 vessels remaining in the port in 1980. The reasons for this change are not known.

firm from which concentration ratios can be calculated are not available. The best evidence indicates that the largest firm, which is located on Ontario, processes approximately one-half of the total annual volume, about 9 million pounds round weight in 1974. According to informed observers, three or four of the remaining firms in the industry each processed one to one and one-half million pounds in 1974; i.e., the four largest processors have an estimated market share of .67 to .75 in 1974.

The second through fourth firms, which handled only 17 to 25 percent of the volume of the largest firm in 1974, will be designated as second tier firms. The remainder, or third tier firms, handled less than one-half million pounds each in 1974. There are no indications that the relative shares have changed since then. Thus, although some details are lacking, the yellow perch processing industry can be characterized as being highly concentrated with a dominant first tier firm and a fringe of smaller second and third tier firms. This characterization, however, substantially understates the effective local buyer concentration for the highly perishable product sold by the fishermen. As a practical matter, a fisherman typically has access to one to four buyers. In the secondary wholesale markets in which the perch is sold largely as frozen fillets, the market shares of all North American dealers better approximates the true concentration ratio of sellers.

There has been little change in structure from 1970-1977 except for one firm which entered and failed within 6 months. In 1967 the then major firm closed for personal reasons and several firms exited in 1959-60 because of losses incurred from selling perch inventories below cost.

During the low point of perch supplies in 1974-76 all firms in the industry were operating at approximately 50 percent of capacity. This capacity utilization estimate is easiest to make for the dominant firm. It operates 8 to 10

specialized mechanical filleters which with one shift represents an annual capacity of 13 million pounds.[5/] The capacity of the remaining firms which use hand filleters is more variable so that management estimates are used.

In addition to direct fishermen-processor sales small volumes are handled by brokers, some being sold at the Chicago fish exchange where they are recorded by the NMFS. Once used extensively by the industry, prices from these transactions are not considered representative and are not reported, although volume data occasionally appear in the Boston "Blue Sheet" (Autin).

Breading and Retailing

Following filleting half the product is sold to breaders who handle a variety of other fish as well as agricultural products. The bulk of the remaining fillets are hand breaded in restaurants. Restaurants account for 94 percent of perch sales with the Friday fish fry in Wisconsin the single most important outlet (Follett, Spira).

Entry Barriers

Of the four entry barriers identified by Bain only the absolute cost barrier for the raw material, round perch, is important for perch processing. Product differentiation is non-important, operational size economies appear to be very modest,[6/] and the investment necessary to construct a plant should be

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[5/] Perch may be frozen whole, thawed and filleted and finally refrozen without a noticeable loss in quality making year around operation feasible.

[6/] Size economies have not been determined empirically. For hand filleting operations according to the five interviewed managers there are limited processing economies or diseconomies over the relevant range. Based on the estimate of an equipment manufacturer there are no operational economies for multiple machines except for the need to keep a trained mechanic fully employed in making frequent adjustments. Quantity discounts of up to 20 percent are available for these custom manufactured machines. In total the operational size economies are judged to be "shallow" following the classification developed by Bain, (pp. 100-01).

available to a favored potential entrant. The absolute cost barrier is important because the supply arrangements with fishermen acts in a similar manner to control over strategic raw materials (see below) and makes it difficult for a new entrant to purchase directly from fishermen. Some unprocessed perch is available in the secondary wholesale market from brokers and processors acting as brokers. Typically the margin is 20 percent making the absolute cost disadvantage of processors without direct access to fishermen "high" under Bain's classification (pp. 100-01).

Entrants could secure supplies by entering as an integrated firm. Ownership of fishing vessels, however, substantially increases the capital and management requirements of entry.[7/] Limited entry further restricts entry if rights are non-transferable or increases the cost of access if rights can be sold.

In a declining, excess capacity industry such as perch processing it is more relevant to discuss preservation of market share and exit barriers than entry barriers. Here too the interpersonal supply arrangements between fishermen and processors appear to restrict rationalization of the capacity. Personal allegiance means that exchange arrangements are not made solely on the basis of monetary returns and the opportunity for more efficient processors to bid away fishermen from the less efficient firms is limited. This delays exiting. Additionally, to the extent that excess profits exist in the industry, they form a "cost umbrella" over the less efficient firms enabling them to remain in operation.

[7/] The average investment in a 20-40 foot vessel in the Lake Erie fishery in 1978 was $9,550. Equipping each vessel with 10 trap nets at $1,410 each and 10 gill nets at $450 each brings the average total investment per vessel to $28,000 (Ontario Ministry of Natural Resources (OMNR)).

VERTICAL COORDINATION

Informal Arrangements

The exchange arrangements between independent fishermen and processors is entirely informal in the sense that no written agreements are used. These informal understandings, nevertheless, are generally of long standing and contain many of the arrangements typical of a written contract except that complicance is achieved through "moral obligation" rather than legal remedies. Specifically, the conditions under which the principles operate is a mutually recognized expectation that a fisherman will sell his entire catch from a vessel to a single dealer at the prevailing port price and that the dealer in turn will accept the entire catch at that price even if it exceeds "requirements." (Those with more than one vessel may have a separate understanding for each vessel).

These interpersonal exchange agreements often transcend purely economic factors. Typically fishermen and buyers are personal acquaintances (the fisherman generally delivers his catch in person directly to the buyer) and possibly friends in the small, close-knit fishing communities. The strength of the bond can be judged by the expressed (but unobserved) willingness of fishermen to withhold supplies by removing gear in an effort to get their customary buyer to match a higher price rather than switching buyers. The relationship between producers and processors also appears to be tempered by many fishermen's perceptions of "rights." This group sees access to the fishery as their right just as the processor has the right to a supply of unprocessed fish to keep his business operating; it is not the proper place for a fishermen to deny this right for a few cents a pound advantage. As the fishermen feel increasingly beleaguered by more stringent regulations and limited entry plans they may feel even closer bonds to processors as fellow victims of outside forces.

The use of informal exchange arrangements is typical of many small scale

near-shore fisheries in North America (Cf. Alvarez, Andrew and Prochaska, p. 10). A principal reason for not using formal contracts is the limited additional control over production and quality which the contractor could gain through contracts. Quality control is limited to stipulating on-board handling practices.[8/] The need for control in this area is limited for perch because of the short-duration of the voyage and the simple icing method used throughout the industry.[9/] Contracts could provide additional control over fishing effort, but not supplies which are highly stochastic in both the short and the long (interseasonal) run. However, price elasticity of effort may be quite high so that the same result could be accomplished through the price mechanism without contracting.[10/] Thus unlike the vegetable processor who in the post harvest period faces a perfectly inelastic supply, the perch buyer need not contract to assure and coordinate supplies (within the limitations of the stock).

The fishermen for their part are principally concerned with maintaining market access for their highly perishable product. For the independent perch fishermen who have no storage facilities it is important that a buyer be available at the end of the voyage. The uncertainty of supply can also mean that the price may change substantially from the first to the last boat in. Perch

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8/ The length of time the fish remains in the gill nets also influences their quality. (Gill nets suffocate the fish while trap nets keep them alive). Recently, however, the length of time between "lifts" has been established by regulatory authorities in some areas.

9/ Some fish houses do exercise control over quality by requiring that anyone selling to them ices their fish. Another means of achieving this objective is to give sufficient ice to the fishermen or require that they buy ice in some proportion to their expected catch. This latter practice may also be a means of extracting additional profits from the fishermen.

10/ No effort was made to estimate effort elasticity in the perch industry. In the larger term higher prices ceteris paribus would be expected to increase the investment in fishing gear while in the short run it is likely to induce fishermen to lift their nets more frequently, making them more effective at trapping additional fish (Ricker, p. 19).

fishermen find this instability difficult to accommodate and prefer a stable exchange relationship for transferring some of this supply and price risk. Both of these requirements can and are met through the existing informal supply agreements, and fishermen seem to feel no need to move to a more formal arrangement.

These informal agreements do have distinct limitations, especially for the fishermen. These understandings make exchange conditions less responsive to economic factors, shifting rivalry among buyers away from price to gaining and maintaining the "loyalty" of fishermen. In cases where the advantages of the agreement are insufficient to maintain the bond there is unverified testimony from the fishermen that other tactics are used, particularly by the dominant firm. This firm allegedly will secure loans for perch fishermen with local banks under the agreement that repayment will be deducted from the fish check. Although this arrangement does have some justification and benefits to the poorly secured fishermen it does serve to tie the borrower to the dominant firm for the duration of the loan unless refinancing can be arranged. Most perch fishermen in the vicinity of the dominant firm are said to have been engaged in such a loan agreement at some time in their fishing careers.

This same firm allegedly uses other kinds of coercive conduct which benefit the firm to the detriment of the fishermen. This conduct takes the form of withdrawing moorage privileges and black-balling fishermen who rent the firm's dockage but do not sell exclusively to it. With its almost complete control of facilities in a major port, explusion by the dominant firm would require a permanent change of fishing grounds which is somewhat restricted by the territorial restrictions of commercial fishing licenses in Ontario. Thus a defector from the dominant firm risks a lost livelihood, a strong disincentive. This conduct, if true, reduce short run competition by curtailing factor mobility and long term competition by erecting entry barriers.

Other Exchange Arrangements

Besides the two backward integrated processors the major alternative to the informal exchange relationships is the Kingsville Fishermen's Cooperative.[11/] Until 1976 when it began to fillet about half the member's catch, this co-op functioned solely as a bargaining cooperative. Buyers of round perch must be approved by the manager and agree to appear at the co-op every day fishing is carried out and accept a predetermined share of the catch. Price data for the co-op were not available, but there is no evidence that members received prices exceeding those of independent fishermen. The selling procedure also suggests a principal concern with maintaining outlets rather than using horizontal control over supplies to enhance prices. Some sensitivity to the bargaining power issue is, however, evidenced by the change from selling principally to the dominant firm to authorizing six to eight different buyers. Similarly, integration into processing appears to be a response to the recognition that profits are greater in the fillet market than the primary market for round perch. If the higher profits were realized and returned to the members giving them a higher effective price than non-members, additional fishermen would be attracted to join. In Ontario this process is limited by the number of licenses alloted to that area.

One wonders why there have not been further efforts in other areas to expand group action in this industry with its potential for oligopsony pricing by processors. Some contributory factors are present; the small size and geographic dispersion of ports makes effective and efficient group action difficult, and the control of available warfage in a major port by the dominant firm would

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[11/] The Red Lake Reservation does process and market its residents' perch catch as a group, but constitutes a minor production area. In all of Canada west of Ontario the Freshwater Fish Marketing Association has a federal monopoly over freshwater fish sales but the perch volume is very low, only 128,000 pounds in 1973-74 (Annual Report, 1976).

seem to prevent any organization there. The major reason, however, appears to be that many fishermen are satisfied with the existing system and see no need for an alternative. Low income is seen as a supply rather than a price problem. It is felt that the existing system provides good long term security and a price which is at least adequate. Studies in some developing countries have also found support among sellers for similar paternalistic arrangements even when there is evidence that sellers are being exploited (Cf. Wharton).

PRICING OF ROUND PERCH

The following information is based on interviews with managers of six major processing firms in Ontario, Illinois, Michigan, and Wisconsin. The dominant firm price leader model developed below is plausible and consistent with the available information, but represents supposition rather than documented evidence.

Prior to the beginning of the spring run the management of the dominant firm appraises cold storage holdings and expected supply[12/] and demand and establishes an offer price for round perch. According to the manager, he attempts to maintain this price through the entire season as a service to the fishermen who consider price stability to be very important. This price, transmitted from buyer to seller to buyer through an informal information network which many buyers feel keeps them well informed about prices and quantities, is adopted by buyers in other areas, making the dominant firm the price leader. Categorizing the form of price leadership, it would fall between barometric (smaller firms look to the major, better managed operation for pricing guidence) and dominate firm (based on this firm's control of about half the volume and the spread between its share and that of the next sized firm). The conduct allegedly employed by this firm stongly suggests that it is aggressive in maintaining its market

12/ The Ohio DNR makes an annual young-of-the-year sample which indicates the year class strength and can be used to project future supplies.

share and could be expected to have a role closer to dominant firm price leadership than barometric.

If this firm is operating as dominant firm price leader in an industry with consciously parallel prices then it would be expected to establish a price for round perch which maximizes its own returns - the simple monopsony price. The non-monetary ties this firm has with its suppliers limits or prevents the slow decline in market share predicted by theory (e.g., Scherer, pp. 164-66). Viewed from this perspective the price rigidity maintained by the domiant firm places fewer demands on the information system, thus facilitating parallel action among dealers.

The emphasis by the fishermen on the non-monetary aspects of the exchange relationship also aids parallel pricing. This is facilitated by fishermen withholding gear when dissatisfied with the price rather than switching to a buyer paying a higher price. As a result of this action, prices in a port either all return to the original low level or all move up to a higher price. In either case there is little incentive for a buyer to offer a higher price as a means of attracting additional suppliers and pricing is likely to remain in parallel. An example of marketing practices in a small port on Green Bay will emphasize this point. In this area there were (as of June 1977) two buyers, an active second tier processor (1 1/2 - 2 M lbs. annually) and a retired third tier one (1/2 M lbs. annually). The retired processor continues to buy from the same fishermen suppliers but now trucks the fish a few blocks and resells at a premium to the active firm. The active firm could out-bid the retired one but would have to be prepared to pay that price for all its locally purchased fish (part of the supply is imported round from Canada and its price would presumably be unaffected) for an unknown period. Alternatively it could refuse to buy from the other firm but would risk loosing this supply to another more distant buyer. An ob-

vious choice and the one which appears to have been followed is to tolerate price discrimination at the wholesale level while the fishermen receive a uniform price.

PERFORMANCE

When analyzing performance in the yellow perch industry, the equity issue between fishermen and processors shall be emphasized. Other performance measures (e.g., progressiveness, employment, food safety) are important but of limited relevance in this small industry which supplies what has become a luxury good in terms of cost per gram of protein. Equity between fillet buyers and processors is also an appropriate measure of performance, but there are several factors not present in this market which exist in the producer--processor market and appear to reduce the bargaining power of the fishermen. These factors are the higher effective concentration ratio and the alleged conduct used by the dominant firm which raises entry barriers. Additionally, Wharton, writing about similar potential oligopsony situations, suggests looking also at the number of economic services provide by the dealers; the greater the number of service, such as combining buying, moneylending and input supply, the more likely is oligopsony (p. 40). In the port market for perch the dominant firms acts as a buyer, guarantor of loans and as a supplier of warfage and gear. This fits Wharton's scenario. Thus there are substantial and more compelling a priori grounds for assuming that the perch fishermen are receiving sub-competitive prices.

To test this hypothesis an approximate test procedure is developed below which draws inferences about the competitiveness of the price based on different rates of price adjustment during periods of relative surplus and deficit supply. Prices which adjust downward faster than upward are considered to provide one source of excess profits for the dealers. This method does not pro-

vide unambiguous results because other interpretations such as an underlying charge in demand conditions between the two periods can also explain the empirical results. This method nevertheless provides results which are consistent with the hypothesis and the forms of industry conduct discussed above.

Other means of testing the hypothesis of sub-competitive port market prices are not applicable in this case. The "yardstick" approach involving a comparison of prices in the study area with a "competitive" price in another market is not usuable because no such independently determined price exists.[13/] Alternatively, structure-performance analysis (Cf. Weiss, Clevenger and Campbell) are not possible for several reasons. First, profit data are not available from the privately held firms. Second, even with the necessary data, excess profits if any could be partially or totally a result of seller concentration in the fillet market causing ambiguity in interpreting the empirical results.

Model Development

During periods of relative surplus supply such as characterized the perch fishery in 1968-69[14/] it is to be expected that the buyer is in a strong bargaining position while negotiating a lower price.[15/] Prices should move down rapidly to the competitive level as the supply function is observed to shift outward under the impact of good stocks and favorable weather. During periods of relative shortfalls such as occurred in 1974-76 when scarce supplies were allocated to

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13/ Restaurants discontinuing yellow perch typically substitute cod or ocean perch for the fish fry. These products are, however, quite different in taste and appearance, and their supply and demand situations are vastly divergent.

14/ During these years commercial storage space was completely filled and the Canadian government began buying supplies from dealers under the stipulation that they be bought back at cost and the fishermen be offered a minimum price (Canadian Fisheries Price Support Board).

15/ The terms "bargaining" and "negotiating" are used here to refer to the all- or non offer/acceptance system used by price taking fishermen.

restaurants (Spria), the situation should be reversed with fishermen effectively negotiating higher prices. Prices should move up to equilibrate supply and demand as the supply function is perceived to be shifting to the left. The fishermen may, however, be hesitant to establish too high a reserve price during periods of relative scarce supply for fear of being cut-off when the supply balance tips back the other way again. McKie put it this way, "... sellers hesitate to give buyers their own medicine [during tight supply periods], fearing the imminent return of a buyers' market." (p. 25). Thus perch prices may equilibrate more rapidly during periods of relatively abundant supply than tight supply with the lag constituting one source of excess profits for the dealers.

To quantify this hypothesis that price adjustments are non-symmetrical across periods, the theoretical literature on price dynamics is used which is based on the concept that price changes depend on excess demand $E(P_t)$.[16/] This relationship can be expressed as:

$$(1) \quad dP/dt = \phi \ (D(P_t) - Q(P_t)) = \phi \ (E(P_t)).$$

In practice, the excess demand relationship must be redefined in discrete time periods. Assuming ϕ to be linear and letting P_t represent price and E_t excess demand, t time and k a positive constant, the relationship is:

$$(2) \quad P_t - P_{t-1} = kE_t.$$

Excess demand is unobservable, however, and estimable expressions must be based on appropriate specifications for the commodity under study. For perch, for reasons to be discussed below, demand is:

[16/] This section is based on McCallum, pp. 56-65.

(3) $D_t = \alpha_1 + \alpha_2 P_t + \alpha_3 S_t$ $\qquad \alpha_2 < 0, \alpha_3\ 0$

and supply is:

(4) $Q_t = \beta_1 + \beta_2 P_t + \beta_3 C_t$ $\qquad \beta_2 > 0, \beta_3 < 0.$

where P_t is the price of yellow perch, S_t the price of substitute products and C_t represents costs. Then excess demand is:

(5) $E_t = \alpha_1 - \beta_1 + (\alpha_2 - \beta_2) P_t + {}_3\ {}_3 S_t + \beta_3 C_t$

Substituting (5) into (2) and solving P_t,

(6) $$P_t = \frac{\alpha_1 - \beta_1 + \Phi P_{t-1} + \alpha_3 S_t - \beta_3 C_t}{\alpha_2 - B_2}$$

with: $\alpha_i, B_i > 0$, $i = 1, 2, 3$, and $\Phi > 0$.

Φ represents the coefficient of the lagged price term incorporating the constant k which dropped out of the remaining terms.

This specification, however, assumes symmetric price adjustments; by construction, for a given charge in E_t prices will fall by the same amount and at the same rate when supply is excessive as they will rise when supply is deficit. Thus, this may not be a valid description of price responses in the yellow perch port market where prices are hypothesised to adjust downward faster than upward following a unit change in E_t. Allowing for different rates of price adjustment is possible in equation (6) by defining μ as the "adjustment coefficient" which indicates the rate of adjustment of P_t, the actual price, to P_t^*, the true equilibrium price. The actual price and the equilibrium price are assumed to be related as follows (Kmenta, p. 476):

$$(7)\quad P_t - P_{t-1} = \mu(P_t^* - P_{t-1}) \qquad 0 < \mu < 1.$$

Substituting (7) into (6) where P_t is replaced by the true equilibrium price P_t^* and adding random disturbances $\varepsilon_{t\,1}$, $\varepsilon_{t\,2}$, and $\varepsilon_{t\,3}$ for the supply, demand and adjustment equations respectively gives

$$(8)\quad P_t = \gamma(\beta_0 - \alpha_0) + \gamma\beta_2 C_t + \gamma\alpha_2 S_t + (1 - \mu) P_{t-1} + \theta_t$$

where $\gamma = \alpha/(\alpha_1 - \beta_1)$, $\theta_t = \varepsilon_{t\,3} + \frac{\mu\varepsilon_{t\,2}}{(\alpha_1-\beta_1)} - \frac{\varepsilon_{t\,1}}{(\alpha_1-\beta_1)}$

Equation (8) has the same variables as (6), but differs in interpretation.[17/]

The proposed test consists of comparing the μ's estimated for periods of relative excess demand and excess supply. The coefficient of the lagged price term for the excess demand period is expected to exceed the coefficient for the excess supply period, indicating a lag in equilibrating prices during periods of excess demand. This suggestion of a disequilibrium situation during periods of excess demand leads to additional predictions about the estimated coefficients from the models when applied to the two periods. With the market in disequilibrium during deficit supply periods the coefficients of the cost and substitute product terms should be less significant than for the period of abundant supplies and rapid price adjustments. The coefficient of the lagged price term, however, is expected to have a larger t ratio for the excess demand period since the current period price is hypothesized to reflect to a greater degree the price of the preceeding period than underlying changes in supply or demand. If there

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17/ Since prices are sometimes different for different size perch a change in the size mix would change the imputed price. The size of fish caught in an area, however, tends to be very uniform and dependent on available nutrients and fishing pressure (e.g., age frequency in catch). See Leach and Nepsey.

is market power on the sellers side or if the market is perfectly competitive the coefficient of the cost term will be positive and significant. If buyers' market power dominates (the hypothesized situation), the cost coefficient may have a smaller t ratio and even be negative, signifying that sellers do not always recover costs.

Application to the Perch Fishery

The demand for yellow perch given in (3) is considered to be a function of its price (P_t) in dollars per pound (Ontario Ministry of Natural Resources (OMNR), unpublished data) and the price index of substitutes (S_t) (index of dock prices, edible fish, National Marine Fisheries Service (NMFS)). Income was found to be unrelated and probably is unimportant for the short sample period used. For supply (equation (4)) the function is a positive factor of the yellow perch price (P_t). In addition the equation must reflect important aspects of the short run marginal cost function. This does not include labor since crew members receive a lay, or share of the profit. Limited investment data show little change in amount or technology over the period and are excluded. This leaves fuel as the principal cost component (CPI for gasoline, Statistics Canada). The unit cost of fuel varies with the catch since fuel consumption is independent of the catch level. The effective fuel cost per fish landed ($AFPI_t$) is then calculated by dividing the fuel cost index by the average catch per unit effort for the area and multiplying by 100 (OMNR, unpublished data). With this change in terminology the supply equation is:

$$(4') \quad Q_t = \beta_1 + \beta_2 P_t + \beta_2 AFPI_t.$$

Seasonal adjustments are not used because most of the product is purchased for frozen storage so that seasonality is not as important as in many fisheries with

a distinct fresh market.

This approximate test is applied to the model in equation (8) for two periods representing relative surplus (1968-69)[18/] and relative deficit (1974-76). The data consists of 16 and 24 monthly observations repsectively for the eight month major fishing season.

The ordinary least squares estimates (OLS) of equation (8) for the two time periods are reported in Table 3. In both cases the hypothesis of zero serial correlation cannot be rejected at the 5% level for either a one or two tailed test using the Durbin-Watson statistic.[19/]

The results agree with expectations. The adjustment coefficient for the excess supply period (.571) is larger than for the excess demand period (.018) and the coefficient for the lagged price term in the latter period is significantly larger than for the earlier period.[20/] The coefficients for the remaining terms have larger t ratios for the excess supply period than for the excess demand period. One factor which may reduce reported significance for 1974-76 is the high collinearity between P_{t-1} and S_t ($r^2 = .89$). The limited significance and negative sign of the cost term in the later periods suggests the fishermen

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[18/] It is during this period that the Price Support Board intervened in the perch market by providing storage space at cost on the condition that fishermen were paid at least a prescribed minimum price. To the extent this minimum price became the effective price (a plausible situation), the round perch price would be stabilized and the coefficient of the lagged price term biased toward one.

[19/] This test may be inaccurate in an autoregressive model estimated with OLS (Kmenta, p. 295).

[20/] With $P_t = \phi_0 + \phi_1 P_{t-1} + \phi_2 S_t + \phi_3 C_t$ (ω_1) (1974-76)

$P_t = \beta_0 + \beta_1 P_{t-1} + \beta_2 S_t + \beta_3 C_t + \beta_4 D \cdot P_{t-1}$ (ω_2)

where D is a dummy variable for 1968-69,

then $F_{16, 35} = \dfrac{(SSE_{\omega_1} - SSE_{\omega_2})/16}{SSE_{\omega_2}/35} = \dfrac{(12.279 - .042)/16}{.043/35} = 622.47$

$F_{16,35}(.05) = 2.31.$

TABLE 3: ESTIMATES OF THE PRICE ADJUSTMENT MODELS FOR 1968-69 AND 1974-76

Period	Int.	P_{t-1}	S_t	$AFPI_t$	$\bar{R}^2$	D.W.	n
1968-69	-.0864	.4285	.1064	.0581	.68	2.02	16
(excess supply)	(-1.64)	(1.68)	(1.96)	(1.72)			
1974-76	-.0943	.9818	.0423	-.00010	.96	2.32	24
(excess demand)	(-0.56)	(10.05)	(0.59)	(-0.18)			

Note: t-statistics are in parenthesis

were unable to bargain for a price which covered increased unit fuel cost resulting from higher gasoline prices and lower catches.

These results are consistent with the hypothesis of a non-symmetric price response and thus with the expectation that buyers are paying sub-competitive prices.

CONCLUDING COMMENTS

The predominant vertical coordination mechanism in the yellow perch industry is noteworthy because it consists entirely of informal agreements, a sharp contrast to the written contracts used for many perishable agricultural products. These agreements provide two principal advantages for the fishermen - assuring market access and shifting to the processor some short run price risk caused by unexpected heavy landings - while giving processors access to a share of the catch determined by the number and skill of the fishermen supplying them.

Although these agreements provide important coordinating functions they do have the potential of reducing factor mobility and interfering with the efficiency of the market. These problems come about primarily because the agreements are similar to long term full supply contracts while the personal association which underlies them reduces the responsiveness to economic incentives, thus raising substantial entry barriers. As a result there are strong indications but insufficient empirical documentation that the producers are receiving sub-competitive prices. More research is needed to better document this hypothesis and to evaluate the long term effects of these agreements on industry structure and risk. Additionally, further research is needed to evaluate alternative coordination forms which could enhance equity and economic efficiency. Part of this research should be directed to better understanding the coordination mechanisms used in other near-shore fisheries in North America and how they influence equity, performance and competition.

As a shorter term response the alleged coersive conduct by the dominant firm could be halted through an antitrust suit. This conduct by the dominant firm in the industry may be construed as "monopolization" and thus be in violation of section 2 of the Sherman Act or alternatively as conduct which has been found to violate section 3 of the Clayton Act. These changes can be brought against a Canadian firm since they affect the industry in the U.S., but as a practical matter such a case is unlikely to be brought in this minor industry. And even if this conduct were successfully enjoined it would likely lead, at best, to a slow decline in the dominant firm's share. A more direct and immediate approach would be to use public means to provide an alternative outlet for fishermen. This could take the form of a self-supporting purchase and buy-back frozen storage system for round perch which would give the fishermen greater leverage in making sales arrangements at the dock while also allowing them to assemble trucksized loads for sales to more distant buyers. Further analysis is needed to determine the feasibility of this proposal. Finally, the mobility of the fishermen and hence their access to alternative markets would be enhanced in Ontario if the restrictions on fishing in the southeast counties were eliminated. This policy should not be followed without a thorough analysis of the effect on fishing pressure and the stock. However, to the extent that these traditional limitations are intended to insure adequate incomes for the fishermen, one of the objectives, the current regulations are partially inhibiting rather than advancing this goal.

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