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Assessing the Importance of Oligopsony Power in Agricultural Markets

Richard T. Rogers and Richard J. Sexton

Oligopoly, competition among few sellers, is the cornerstone of industrial organization (IO). Conversely, its sister concept, oligopsony, competition among few buyers, is scarcely mentioned. For example, oligopsony is not discussed in the entire two volume *Handbook of Industrial Organization*, and monopsony is mentioned only in the context of incentives to integrate vertically.

Two reasons apparently account for IO economists' lack of interest in buyer market power: (*i*) they don't think it's very important, and (*ii*) they don't believe it presents any unique modeling issues relative to seller market power. Scherer and Ross illustrate this first viewpoint, arguing that "average concentration on the buyers' side in manufacturing is undoubtedly lower than seller concentration" (p. 519). Tirole, in his masterful treatise on IO theory, illustrates the second, dispatching monopsony power in one sentence: "Naturally the conclusions [regarding monopoly power] would also hold as well for monopsony power..." (p. 65).

We argue that this dismissive treatment of buyer market power is not reasonable for economists interested in agriculture and agricultural markets. The Scherer and Ross viewpoint may apply when considering generic inputs such as labor, capital, and energy. Competition for these inputs is apt to exceed competition for the outputs they produce because firms cross product market boundaries to compete for these inputs, and there is essentially no "branding" among input buyers to diminish price competition among them. Moreover, these inputs are typically mobile, hence, in elastic supply to individual buyers, limiting the exercise of oligopsony power even in geographic settings where relatively few buyers prevail.

This view of input markets does not apply, however, to first-handler markets for the raw agricultural commodities that are inputs into the processed or fresh-packed food products.[1] We identify the following distinctive structural characteristics of these markets:

C1: The products are often bulky and/or perishable, causing shipping costs to be high, restricting the products' geographic mobility, and limiting farmers' access to only those buyers located close to the production site.

C2: Processors' needs for agricultural products are highly specialized. Other inputs cannot normally be substituted for a given farm product, nor can the given farm product substitute readily for agricultural product inputs in alternative production processes.

C3: Farmers are specialized to the supply of particular commodities through extensive investments in sunk assets. These assets represent exit barriers for farmers and cause raw product supply to be inelastic.

C4: Marketing cooperatives or bargaining associations, institutions of seller power, are present or potentially present in the market.

Analyses of market power must begin with definitions of the relevant markets. C1 and C2 are crucial to defining input markets for agricultural products. Collectively, they assert that the relevant markets for raw agricultural products will typically be narrower with respect to both product class and geography than the markets for the finished products they produce. Thus, C1 and C2 contradict the general Scherer and Ross proposition that buyer concentration will be less than

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[1] We focus on the first handler markets where oligopsony structures are most pervasive and public policy issues concerning buyer market power are most acute, given ongoing concerns about low farm prices and incomes.

seller concentration. High buyer concentration in the relevant market coupled with inelastic supply of the farm commodity (C3) jointly constitute compelling structural evidence of buyer market power.

The prototype agricultural market characteristics also call into question Tirole's assessment that monopsony power can be analyzed readily using the tools of monopoly power analysis. For example, markets with costly product transport (C1) are by definition spatial markets. Yet, the classic IO models ignore the spatial dimension. Also, the institutions of countervailing power (C4) that are endemic to agriculture are largely absent from other sectors of the economy. In fact, without the protection afforded exclusively to farmer organizations through the Capper-Volstead Act, coalitions of sellers represent a per se violation of the Sherman Act.

These factors combine to generate the key premises of this paper. First, buyer market power is a significant issue in many first-handler markets. Second, understanding buyer market power in agriculture requires use of models that incorporate the unique structural characteristics of agricultural markets rather than models adapted routinely from the analysis of seller market power. We pursue these themes in the subsequent two sections of the paper.

Evidence on Buyer Concentration in Food Markets

Thirty-four years ago in a similar forum, Lanzillotti concluded from data assembled for fifty-one farm-related industries that "farmers, as sellers, have found themselves at the mercy of oligopsonies, collusion, and monopsony" (p. 1240). Two great merger waves have since reshaped the U.S. economy. Although trends in farm production include decreasing farm numbers and increasing farm size, the imbalance between the number and size distribution of farmers and that of the firms they sell to has worsened since 1960. In this section we provide an updated view of structure in the food and tobacco processing industries.

Buyer concentration is difficult to assess because there are no statistical series analogous to the abundant data available on seller concentration. The Census of Manufacturing provides most of the public data available to study food processing.[2] The data for the fifty-three food and tobacco industries identified by four-digit SIC code in the 1987 Census show that most industries have experienced decreasing firm numbers and increasing seller concentration over time. In total, the sector lost 11,000 firms, leaving just over 16,000 by 1987. Moreover, the sector's largest 100 firms accounted for two-thirds of its value added. Even without adjusting for proper market definitions, the data indicate that sellers to the processing industries now face fewer and more dominant firms.

Most of the fifty-three food and tobacco industries contained in the Census do not define relevant input markets because (*a*) input markets are often local or regional in geographic scope (C1), and (*b*) the four-digit industry categories are too broad (C2). Table 1, part of a special Census tabulation, addresses this first problem for nine industries by moving to the SIC five-digit product class data or even to more narrow classifications. The average four-digit four-firm concentration ratio (CR4) is 37.8, and four of the nine industries have CR4 $\leq$ 30. However, their five- and seven-digit classifications have an average CR4 of 61.3, with twenty-four of the thirty-eight national product markets having CR4 $\geq$ 50, a commonly used benchmark for separating markets into workable competition and noncompetitive groups.

Consider, for example, the meat and poultry industries. Plants in these product categories are highly specialized and, even though the finished products may be good substitutes, the raw agricultural products are not substitutes into production. In these cases the five-digit product class data provide a basis for meaningful assessments of the input market structure. Similar conclusions hold for the flour and other grain mills and vegetable oil mills categories. Table 1 documents that, generally, the number of firms and plants falls and CR4 rises when one moves from industry data (four-digit) to product class data (five or more digits). In canned fruits, the relevant input markets are often so narrow that the seven-digit level of detail is necessary to attain the proper market definition. To illustrate, note that, although eighty-one firms canned fruits in 1987, only five and eleven processed cranberries and olives, respectively. Thus, whereas canned fruits may represent a relevant output market class, it is far too broad for analysis of competition in the raw product markets because the vast majority of fruit processors do not compete, for example, for

[2] We focus on market structure in food processing in this section. Relevant market structure data on fresh market sales are practically nonexistent. However, oligopsony power issues may be important in this market due to increasing consolidation among the grocery retailers, the major buyers of food for fresh market sales.

Table 1. Selected SICs to Highlight Increased Concentration of Input Markets, 1987

		All Companies				Top 100 Co-ops			
SIC	Name	Co	Est	VS	CR4	Co-op	Est	VS	Share
2011	Meat packing plant products	1328	1434	41227	39	1	2		0.1
20111	Beef, not canned or made into sausage	218	265	21684	58	0	0		0.0
20112	Veal, not canned or made into sausage	52	53	379	64	0	0		0.0
20113	Lamb and mutton, not canned or made into sausage	38	51	380	73	0	0		0.0
20114	Pork, fresh and frozen	132	161	8,406	38	0	0		0.0
2015	Poultry and egg processing	284	463	14,371	29	3	16		5.0
20151	Young chickens	72	161	7,452	42	2	12		7.1
20153	Turkeys, incl. frozen, whole and parts	41	57	1,645	38	1	3		2.5
20159	Liquid, dried and frozen eggs	39	47	495	41	0	0		0.0
2033	Canned fruits and vegetables	462	647	12,244	28	26	63		13.7
20331	Canned fruits, except baby foods	81	120	2,085	49	9	25		38.6
2033128	Canned cranberries and sauce	5	10	107	>96	1	6		(D)
2033136	Canned olives, incl. stuffed	11	11	280	87	3	3		56.5
2033190	Other canned fruits, excl. olives, cranberries	69	101	1,698	55	6	16		32.5
20332	Canned vegetables, except hominy and mushrooms	99	214	2,298	42	3	10		8.8
20333	Canned hominy and mushrooms	21	26	166	66	1	1		1.5
20335	Canned vegetable juices	37	49	310	78	3	4		18.8
20336	Catsup and other tomato sauces, pastes, etc.	94	148	3,024	55	1	6		5.0
20338	Jams, jellies, and preserves	55	77	664	57	4	7		10.6
2033A	Canned fruit juices, nectars, and concentrates	95	133	2,344	48	9	18		14.4
2033B	Fresh fruit juices and nectars, single strength	188	295	951	35	14	25		16.3
20866	Noncarbonated soft drinks, including fruit drinks	286	504	2,427	54	15	40		32.8
2034	Dehydrated fruits, vegetables, and soups	107	132	2,079	37	3	4		14.2
20343	Dried and dehydrated fruits and vegetables	52	82	1,544	41	3	4		19.1
2034313	Raisins	11	13	334	80	1	1		(D)
2034315	Prunes	10	24	265	88	1	1		(D)
2034330	Dehydrated potatoes	8	11	173	90	0	0		0.0
2035	Pickles, sauces, and salad dressings	344	382	4,479	40	3	3		1.8
20352	Pickles and other pickled products	78	102	1,000	48	0	0		0.0
2037	Frozen fruits and vegetables	194	258	6,254	30	7	13		8.4
20371	Frozen fruits, juices, ades, drinks, cocktails	89	114	2,482	41	6	10		13.3
20372	Frozen vegetables	86	147	3,645	42	3	9		5.4
2037248	French-fried potatoes, incl. other potatoes	31	50	1,853	77	1	1		(D)
2037290	Other frozen vegetables	69	110	1,792	27	2	8		(D)
2041	Flour and other grain mill products	237	358	4,690	44	1	1		1.0
20411	Wheat flour, except flour mixes	75	185	3,219	54	1	1		1.4
20413	Corn mill products	55	98	561	59	0	0		0.0
2076	Vegetable oil mill products, n.e.c.	20	23	490	70	3	3		4.3
20761	Linseed oil	6	7	105	98	1	1		15.0
20762	Vegetable oils	29	39	218	67	2	2		1.4
2099	Food preparations, n.e.c.	1,510	1,658	10,671	23	7	12		0.6
2099761	Dried, dehydrated potatoes, packed w/other ingred.	8	11	(D)	99	0	0		0.0
2099771	Head rice packaged w/other ingredients	12	17	225	91	2	4		(D)
2099921	Perishable prepared salads	84	86	359	46	1	1		(D)
2099935	Vegetables, peeled or cut for the trade	22	25	78	61	0	0		0.0
2099F	Peanut butter	41	48	848	70	1	1		0.6
2099G25	Honey, blended and churned	14	16	79	74	0	0		0.0

Note: Co = number of companies; Est = number of establishments; VS = value of shipments in $millions. If the number of cooperatives was less than 5, the VS Share was estimated if possible, else (D); (D) = Census cannot disclose the value.

olives or for cranberries.

The problem of using Census data to make inferences about local/regional markets is even more vexing. The national data will typically represent lower bounds on the relevant geographic input market concentration.[3] Two examples illustrate the general problem. In 1987, twenty sweet corn canners and twenty-four frozen sweet corn processors operated with production scattered across much of the country, contributing collectively to a relatively unconcentrated market for processed sweet corn. However, the relevant raw product input markets may be highly concentrated, given the geographic immobility of raw sweet corn (Jesse and Johnson). Similarly seventy-two broiler processors operated in 1987 with CR4 = 42. These firms are located predominantly in the "broiler belt" that stretches from the Midatlantic to eastern Texas. Shipping of refrigerated and "super chilled" chickens has allowed the output market to continually enlarge in geographic scope, but the input markets remain local, often a fifty-mile radius around a processor. The Census data are relatively impotent to overcome the problem of geographic market definition. Data available at the state level are limited to the four-digit level and give only establishment counts, employment, and sales data. In the more concentrated industries even this information is withheld for confidentiality reasons.

Cooperatives are directly relevant to market conduct in agriculture because they enable their members to integrate around oligopsony processors. They may also influence oligopsonists' behavior by acting as "yardsticks of competition," an issue addressed in the next section. For the 100 largest marketing cooperatives, table 1 lists the number of co-ops and establishments in the product-class categories and their combined market shares. The co-op share is positively related to the importance of the agricultural input in the production process and negatively related to the industry's ratio of value added to shipments. Much of cooperatives' involvement in food marketing is missed, however, when only food processing industries are examined because cooperatives have a major presence in the first-handler markets that are classified outside of food processing.

[3] Differences between concentration in national markets and local input markets will be minimized if companies operate establishments in each local market. Table 1 demonstrates, however, that this tends not to be the case. For the nine four-digit industries depicted in the table, the ratio of establishments to companies is only 1.20.

Modeling Oligopsony in Agricultural Markets

Not surprisingly, the data limitations we have described have limited the scope for empirical study of oligopsony power in agriculture, thereby placing a premium on theoretical modeling as a guide to understanding the dimensions and potential significance of the problem. In this section we develop a prototype model of oligopsony competition in agricultural markets, explore its implications, and discuss extensions of the basic model. Consistent with the prior discussion, the model incorporates the impacts of (*a*) concentrated market structures, (*b*) costly product transportation, and (*c*) potential noncompetitive conduct among processor/handlers. We illustrate how these market conditions interact to determine the farm-retail price spread.

The basic model involves production and sale of a single product, r. Producers are assumed to be arrayed uniformly along a line of unit length. For the sake of mathematical tractability, an individual farmer's function for supplying r is assumed to be linear: $r = (1 / b)w$, where w is the net price received by the farmer.[4] Under a system of free-on-board (FOB) pricing $w = W - tU$, where W is the processor's "mill" price, t is the shipping cost per unit distance, and U is the distance from farm to processor.

Processors are assumed to convert raw product into the processed product q according to the quasi-fixed production function $q = \min\{R / \lambda, h(\mathbf{Z})\}$, where R is the aggregate raw product volume procured by the processor, $\mathbf{Z}$ is a vector of processing inputs, and $\lambda = R / q$ is the fixed conversion rate between raw and processed product. This function incorporates the notion of limited substitution between farm and processing inputs expressed in C2. Without loss of generality, we can set $\lambda = 1.0$ through choice of measurement units.

Firm market areas do not overlap under FOB pricing, and, thus, supply to a processor is found by integrating over his market radius, L

$$(1) \qquad R = 2\int_0^L r\,dU = 2\int_0^L \frac{1}{b}(W - tU)\,dU = \frac{L}{b}(2W - tL).$$

[4] This function derives from a Cobb-Douglas technology of the form $r = AX^{0.5}Y^{0.5}$, where X and Y are inputs and A is a constant. We consider the short-run case where Y is fixed at the level $Y = Y^o$. Then, from producer profit maximization it follows that $(1 / b) = A^2Y^o / 2v$, where v is the price of the variable input X.

The cost function associated with the production function for q is $c(R) = W(R)R + m(R) + f$, where $R = q$ is the total volume processed, $W(R)$ is, from (1), the inverse supply function facing the processor, $m(R)$ is the cost associated with the processing inputs **Z**, and $f > 0$ represents a fixed cost. It will be convenient to assume processors operate with constant marginal costs and, hence, that $m(R) = mR$. Furthermore, to focus on issues of oligopsony power, we assume that processors are perfect competitors in the sale of q and take output price P as given. We define a price level $P = P^o$ and scale money units so that $P^o - m = 1.0$. A processor's profit function is thus

$$(2) \qquad \pi(R) = (1 - W)R(W) - f.$$

The first-order condition for maximizing (2) can be expressed as follows (see Sexton):

$$(3) \qquad \Phi = \frac{1 - W}{W} = \frac{1}{\eta},$$

$$\eta = \frac{dR}{dW}\frac{W}{R} = \frac{\partial R}{\partial W}\frac{W}{R} + \frac{\partial R}{\partial L}\frac{L}{R} \cdot \frac{dL}{dW}\frac{W}{L}.$$

Equation (3) expresses the appealing notion that the spatial competitor must consider both the direct effect of its price change on producer supply, $\partial R / \partial W$, and the indirect effect on its market area based on rivals' reactions, $\partial R / \partial L(dL / dW)$. The relative farm-retail price spread, Φ, provides a convenient metric of performance in the raw product market. Its lower bound is zero under competitive behavior and for the model considered here its upper bound under pure monopsony is 1.0. Thus, $\Phi \in [0, 1]$.

We model a short-run industry equilibrium where the number, n, of processors in the market area is given. Moreover, we assume that the processors are symmetric and are arrayed equidistantly along the unit interval.[5] Distance between processors is then $1 / n$. Given this specification, the equation defining the market boundary between a representative processor and its rival is the condition of equality of net prices $W - tL = W^* - t[(1 / n) - L]$, where W^* is the mill price of an adjacent rival. Solving for L and differentiating with respect to W obtains

$$(4) \qquad L = \left(W - W^* + \frac{t}{n}\right)\frac{1}{2t},$$

$$\frac{dL}{dW} = \left(1 - \frac{dW^*}{dW}\right)\frac{1}{2t} = \frac{\alpha}{2t}.$$

Here $\alpha = 1 - (dW^* / dW)$ specifies producer conduct. Under competitive Bertrand/Hotelling behavior $dW^* / dW = 0$ and $\alpha = 1$, whereas under collusive/Loschian behavior $dW^* / dW = 1$ and $\alpha = 0$. Thus, it is convenient to consider α to lie in the unit interval, $\alpha \in [0, 1]$, with higher values of α denoting increasingly less competitive conduct. The index α may be interpreted in "conjectural variations" parlance, but, more generically, it can be treated simply as an index of processor conduct.

Given the specification for dL / dW in (4), the remaining steps in formulating the relative price spread in (3) involve specifications for the partial derivatives, $\partial R / \partial W$ and $\partial R / \partial L$. The first expression is obtained simply by differentiating the supply function (1): $\partial R / \partial W = 2L / b$, and the second expression is obtained by noting that the gain in supply from expanding market area is simply the amounts supplied by the farmers at either border: $\partial R / \partial L = (2 / b)(W - tL)$. Setting $L = 1 / 2n$ and substituting these various expressions into (3) yields a reduced-form expression for the relative farm-retail price spread as a function of the market concentration measured by $n \geq 1$, processor conduct measured by $\alpha \in [0, 1]$, and the spatial dimension of the market measured in terms of t

$$(5) \qquad \Phi(t, n, \alpha) = \frac{1 - w}{w}$$

$$= \frac{2n\alpha - t\left[\alpha - 4 + 2n\sqrt{(\alpha^2 / t^2)(1 - t / n)) + (1 / 2n)(\alpha^2 - 4\alpha + 16)}\right]}{2n\alpha + t\left[\alpha - 4 + 2n\sqrt{(\alpha^2 / t^2)(1 - t / n)) + (1 / 2n)(\alpha^2 - 4\alpha + 16)}\right]}.$$

Because the expression for Φ in (5) is rather complex, it is convenient to simulate the behavior of the price spread for alternative values of t, n, and α. To determine reasonable bounds for t, consider that total farm-to-processor shipping costs, tU, in the range of

[5] Processors' locations, once chosen, are fixed. Equal separation among processors minimizes the total cost of transporting a given volume of raw product. We do not invoke a long-run equilibrium assumption of zero profit and treat n as endogenous (e.g., Beckman and Capozza and Van Order) for two reasons. First, profits are driven to zero by free entry, which most analysts agree does not hold generally in food processing. Second, treating n as exogenous enables us to illustrate how concentrated market structures interact with firm conduct and spatial market parameters to influence the farm-retail price spread.

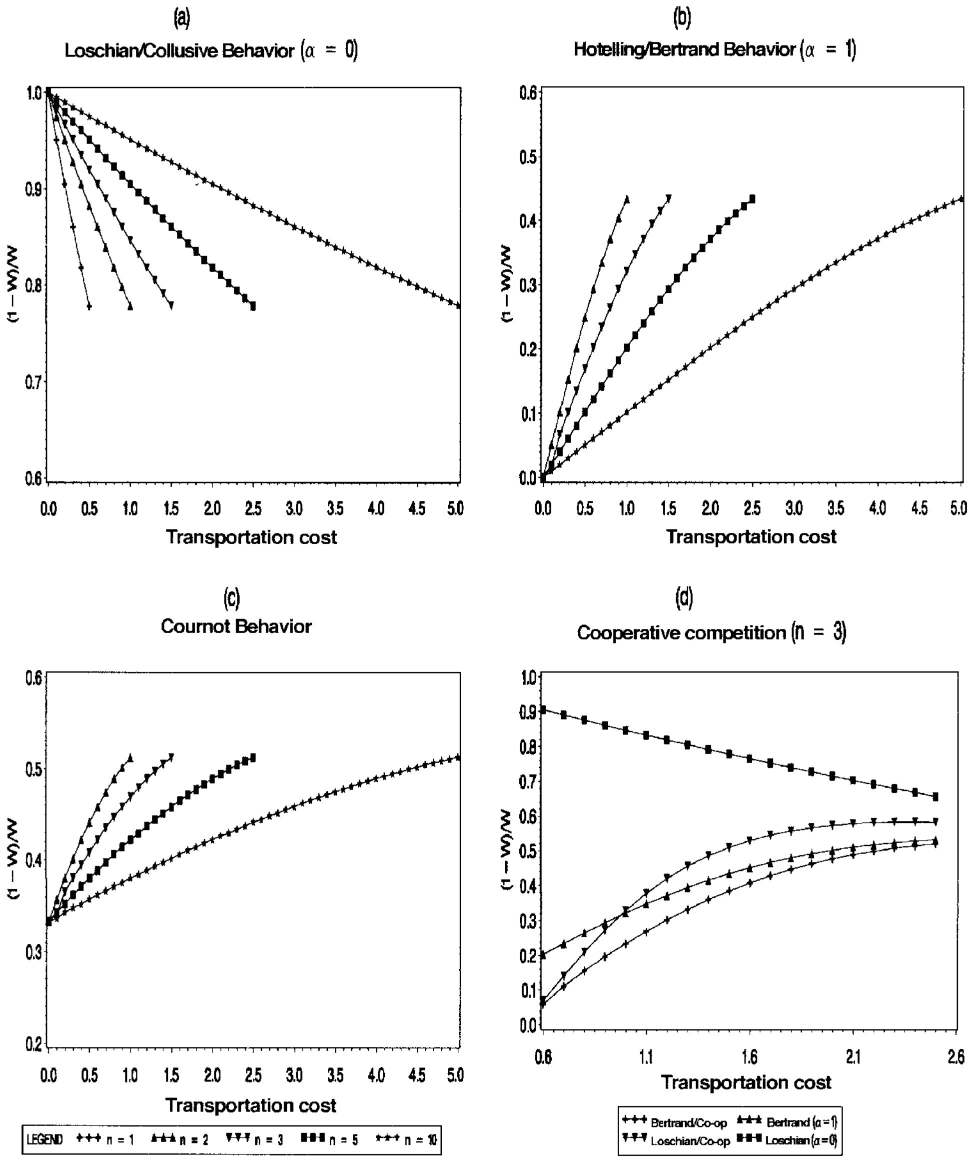

Figure 1. Farm-retail price spreads for alternative forms of market behavior

25% of raw product value are not uncommon (Durham and Sexton). Using the competitive mill price $W = 1.0$, this benchmark yields a maximum $t = t^*$ based on the formula $t^* / 2n = 0.25W = 0.25$, or $t^*(n) = 0.5n$, where $U = 1 / 2n$ defines the longest haul, given n.

Figures 1a–1c summarize the results for values of $t \in [0, t^*]$ (e.g., $t^* = 1.0$ implies haulage costs of 0.25 for the boundary producer, given $n = 2$) and $n = 1, 2, 3, 5, 10$. Figure 1a represents the case of Loschian or collusive behavior among processors, where $\alpha = 0$ and, hence $dL / dW = 0$. In this case each firm acts as a monopsonist within its market area. Higher transportation costs reduce the price spread under Loschian competition because they diminish farmers' net price, $W - tU$, causing supply facing the processor to become more elastic and processors to react by raising W. Conversely, increasing the number of buyers n increases the relative margin because more buyers cause smaller market areas for each buyer, thereby mitigating the effect transportation costs have in increasing processor prices.[6]

Figure 1b depicts behavior under Bertrand/Hotelling competition, $dW^* / dW = 0$ and $\alpha = 1$. In nonspatial models this behavior induces the competitive market outcome as reflected in $\Phi(t = 0) = 0$ for all n. However, costly transportation and small n interact to produce rather large relative price spreads even under this form of aggressive processor competition.[7]

Figure 1c depicts Φ under Cournot behavior, generally considered to be an appealing alternative to the extremes of Bertrand or Collusive behavior. In the Cournot case, the price spread ranges from a low of $\Phi(t = 0) = 1/3$ for all n to $\Phi > 0.5$ for small numbers of sellers and high relative transportation costs.

Finally, we extend the basic model to include marketing cooperatives operating in conjunction with ordinary for-profit processors. As table 1 illustrates, this situation is common. Two market performance implications follow. First, members of the cooperative do not face oligopsony pricing, as the cooperative seeks to maximize member welfare. Second, as noted by Sexton, the presence of a cooperative may improve market performance by competing rivals. From (4) the rational conjecture of a cooperative's price response to a noncooperative rival's price increase, dW^c / dW, is negative whenever the cooperative faces an upward sloping net average revenue product curve for its members' production. Given $f > 0$, this condition prevails in the present model. Thus from (4), $\alpha > 1$ when facing a cooperative rival, and a cooperative stimulates even more competitive market conduct than Bertrand competitors.[8]

Figure 1d illustrates how a cooperative presence improves market performance of for-profit rivals for the model developed in this section. The figure is based on $n = 3$, and evaluates the equilibrium price spread generated by a representative firm who competes either with two for-profit rivals (either Loschian or Bertrand competitors) versus when one of the rivals is a cooperative. The cooperative's impact on performance is especially significant when it replaces a Loschian competitor and when transportation costs are relatively low. High transportation costs vitiate the competitive impact of even a cooperative rival.

Conclusions

This paper has argued that markets for raw agricultural products are likely to be structural oligopsonies. Concentration in the these first-handler markets will often exceed concentration in the affiliated finished product markets. We developed a simple theoretical model to illustrate how high buyer concentration, costly product transport, and noncompetitive buyer conduct may interact to produce large farm-retail price spreads.

The analysis suggests that monopsony/oligopsony issues deserve strong consideration in food industry policy debates, but to date this has not been the situation. Even in the meat industry where consolidation and increased concentration issues have been most dramatic, the courts did not address input market concerns (Purcell). Absent public intervention to promote competition in raw product markets, farmers' main opportunities to foster competitive behavior in their selling markets are through developing means of countervailing power. Given the size disparities between farmers and their buyers, countervailing power must often be attained jointly through bargaining associations or marketing cooperatives. The potency of even this tool may be diminished, however, by powerful buyers who, as Innes and Sexton have shown, may be able to "divide-and-conquer" farmers through discriminatory practices.

[6] Farmers' elasticity of supply with respect to the mill price W for the linear supply case is $E_{r,W} = W / (W - tU)$, i.e., elasticity is increasing in t and U. These paradoxical results for Loschian competition hold for all supply function specifications that share this property.

[7] All competition measured by $\alpha \in (0, 1)$ is qualitatively similar to the $\alpha = 1$ case in the sense that it implies less than full matching of a price change by rivals. $\Phi(t = 0) = 0$ for all $\alpha \in (0, 1]$. However, for all $t > 0$, Φ is decreasing in α over the interval $(0, 1]$.

[8] Because a cooperative's optimal behavior must include achieving zero profit, its net price to members is a function of its fixed costs, f, which, of course, do not affect for-profit firms' short-run pricing decisions. An increase in a rival's raw product price diminishes sales to the cooperative, raising its average fixed costs, and diminishing the net price it can pay members. Derivation of optimal behavior for a cooperative and its rivals is provided in Sexton.

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