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## MONOPSONISTIC FOOD PROCESSING AND FARM PRICES: THE CASE OF THE WEST ALABAMA CATFISH INDUSTRY

Henry Kinnucan and Gregory Sullivan

### Abstract

Increasing concentration in food processing has important economic implications for agricultural producers and consumers. This paper addresses the issue by focusing on a case where pure monopsony conditions appear to hold—catfish processing in West Alabama. Farm-level impacts of the market power imbalance are described via a six equation theoretical model. Results show price elasticity of farm supply governing the economic incentive to the processor for exploiting its market power: less (more) elastic supply implies greater (lesser) divergence between competitive and monopsony price. The theoretical model is operationalized using an indirect procedure recently suggested by Houck for estimating farm level supply elasticities. Based on these supply elasticities and historical prices, the model predicts a 12-35 percent potential reduction in prices received by West Alabama producers as a result of market power imbalance.

*Key words:* monopsony, price exploitation, price discrimination, supply elasticity, welfare loss, catfish.

A farm enterprise gaining importance in the South is the pond culture of catfish. Since 1963, the number of acres devoted to commercial catfish production has increased from 2,400 to 23,000 (Russell; USDA). Fish processed by commercial-sized plants (those with over 2,000 lb./day capacity) more than tripled in volume between 1980 and 1984

(USDA, 1982 and 1985). Farm revenues obtained from sales of the fish to commercial processing plants have increased steadily since 1976, exceeding \$100 million in 1984 (USDA, 1985). In early 1985, a national fast food chain contracted with the industry to purchase 54 million pounds of processed fish over a 15-month period (Jensen). Based on a 1984 industry base of 154 million pounds (USDA, 1985), this action alone represented a 28 percent increase in annual processor purchases.

A potential problem facing this emerging industry is an apparent imbalance of market power between catfish producers and the processing sector. Currently, some 14 commercial sized processors service the industry's 1,000 producers (USDA, 1982 and 1985). A 1981 study of catfish processors concluded that the industry "is characterized structurally by a high degree of market concentration" (p. v) with five of the nine reporting firms handling 98 percent of the total pounds processed (Miller et al.). Further evidence of the oligopsonistic nature of the industry was the existence of a "... high degree of mutual interdependence..." among the firms in their pricing and other business policies (Miller et al., p. 18). Finally, a chronic problem of excess processing capacity (Russell; Miller et al.) coupled with the apparent existence of "... major economies of size in [catfish] processing..." (Fuller and Dillard, p. 18) suggest even greater industry concentration over time.<sup>1</sup>

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<sup>1</sup>Using an economic-engineering approach to estimate investment requirements and processing costs associated with different sized catfish processing plants, Fuller and Dillard found operating costs (on a per pound basis) declining 29 percent when plant capacity was increased from 32,000 pounds per day (one shift capacity) to 160,000.

The degree of competitiveness in the processing sector is important to the catfish producer because historically about 80 percent of the farm output is sold to local processing plants (USDA, 1982). Two other market options typically available to the catfish producer are direct sales to specialty restaurants and fee fishing. Although these outlets are attractive in that the farmer receives a higher price, volume is generally insufficient to make these alternatives economically viable in the long run for the individual producer.

The primary objective of this paper is to quantify the potential economic impact of market power imbalance on catfish producers. The problem is approached by applying a mathematical model of monopsony behavior to a segment of the catfish industry located in West Alabama. This portion of the industry is chosen for study because the market recently became monopsonistic with 225 producers in a five county area being dependent on a single processor to market their fish (Mims and Sullivan). Hence, a pure monopsony model is appropriate and the analysis is simplified.<sup>2</sup> Because supply elasticities are a key component of the economic model and empirical estimates of such parameters at the farm level are unavailable, a secondary objective is to show how neoclassical theory can be used to obtain insights into the nature of supply response characteristic of an industry when elaborate econometric analysis is either not warranted or inappropriate due to data limitations or other reasons.

The economic model yields three essential results, each dependent upon the magnitude of the farm level supply elasticity: (1) the price exploitation potential of the monopsonist increases (decreases) as the farm level supply elasticity gets smaller (larger), (2) producers selling to a monopsonistic buyer receive less than the value of the marginal product of their output, i.e., the monopsonist's price is lower than the perfectly competitive price, and (3) the quantity exchanged

in the market under monopsony is less than under perfect competition, implying higher prices to consumers and a social welfare loss due to reduced trade.<sup>3</sup> The paper proceeds by first developing these implications of the model. An attempt is then made to quantify the price exploitation potential of monopsonistic catfish processing by using neoclassical economic theory to indirectly derive the needed supply elasticities. An expression is derived to quantify the potential welfare losses of monopsony to West Alabama producers. The paper concludes with a brief discussion of limitations and implications of the analysis.

## THE MODEL

The nature of the supply response in catfish production plays a key role in determining the degree to which the processor in West Alabama can profit by exploiting its market advantage. This finding can be expressed mathematically with a simple six equation model.<sup>4</sup> First, the catfish processing industry may be viewed as using two inputs: farm-raised catfish (a) and other purchased inputs (b) necessary for the production of fresh and frozen market-ready fish (x). The production function for the processing industry is:

$$(1) x = f(a, b).$$

The (inverse) supply functions for these inputs are:

$$(2) P_a = g(a, Z)$$

for the equation for catfish supply, and

$$(3) P_b = h(b, T)$$

as the supply function to the processing firm of inputs other than catfish. The variables Z and T represent exogenous supply shifters of the respective functions. Specifically, Z may be thought of as disease problems affecting catfish supply and T as a specific tax on one or more of the inputs embodied in b (say

<sup>2</sup>Actually, a potential complication exists because the West Alabama processing plant is owned by a national food manufacturer which has larger plants located in Mississippi (the major catfish production area in the United States). The extent to which the Alabama plant is autonomous with respect to pricing and procurement policies or is considered by the parent company as part of a multi-plant corporate strategy (Scherer et al., 1975) is unknown. For the purposes of this paper, it is assumed that the plant will behave as a pure monopsonist. Support for this assumption is derived from Willard F. Mueller's 1983 address to the American Agricultural Economic Association in which he stated (pp. 856-60) . . . "our case studies and cross-sectional analysis in food manufacturing and grocery retailing reveal that the possession of great power invites its use."

<sup>3</sup>A fourth implication, not developed in this paper because of space considerations, is an incentive for the processor to practice price discrimination if catfish supply elasticities vary seasonally. A good reference for developing this implication is Hadar, pp. 107-8. (Also, see footnote 6.)

<sup>4</sup>This model is adapted from the one developed by Gardner to explain marketing margin behavior in the food industry. Although approaching the problem of monopsony pricing in this manner adds to the complexity of the analysis, it has the didactic virtue of clarifying variable definition and other more subtle, but important, aspects of the problem.

taxes on labor) that makes the input more expensive to the firm.

The demand equation for processed catfish is:

$$(4) x = D(P_x, N),$$

where  $P_x$  is the price the processor receives for the fish it sells and  $N$  is an exogenous demand shifter such as population growth.

If perfect competition prevailed in both product and factor markets, the processor would maximize profits by buying quantities of  $a$  and  $b$  that result in price equaling the value of marginal product of both, i.e.,

$$(5) P_a = P_x \cdot f_a$$

and

$$(6) P_b = P_x \cdot f_b$$

where  $f_a$  and  $f_b$  are the partial derivatives of  $x$  with respect to  $a$  and  $b$ . In this case, the above system represents six equations with six endogenous variables ( $x, b, a, P_x, P_b, P_a$ ). Assuming downward sloping demand curves and supply curves with non-negative slopes, a unique equilibrium exists for given values of the exogenous variables.

However, as indicated previously, in West Alabama perfect competition does not prevail in the factor market for catfish. Although the processing plant faces competition in the product (processed catfish) market, it is the sole effective buyer of local pond output of the raw fish. For this reason, equation (5) is no longer valid. Before making the necessary modification of the model to accommodate imperfect competition, first note that competition does exist in the market for factor  $b$ . In fact, because labor comprises the major component of  $b$  for the West Alabama plant, and labor is paid the minimum wage (Jensen), it is reasonable to assume that the supply function for  $b$  is perfectly elastic, i.e., the plant can purchase all the  $b$  it wishes without affecting  $P_b$ . Thus, equation (3) may be rewritten as:

$$(3') P_b = P_b^0,$$

to indicate that the supply price of  $b$  to the plant is a parameter rather than a variable. Similarly, because competition is keen in the product market, it is reasonable to assume that the firm must take  $P_x$  as given, i.e.,

$$(4') P_x = P_x^0$$

The assumption of fixed prices in the product and  $b$  factor markets simplifies the differential calculus necessary to show the new equilibrium under monopsony. Because the West Alabama catfish processing plant is buying a large quantity of catfish exchanged in the local market, it must expect a change in the price per unit of fish when the quantity exchanged varies. In other words, the processing firm faces an upward sloping supply curve for catfish (catfish producers are assumed to be pure competitors). Under these conditions, the profit function of the processing plant is:

$$(7) \pi = P_x^0 \cdot f(a, b) - g(a, Z) a - P_b^0 \cdot b - c,$$

where the as yet undefined variables  $\pi$  and  $c$  represent profit and fixed cost, respectively. The first-order conditions for profit maximization are:

$$(8) \frac{\partial \pi}{\partial a} = P_x^0 \cdot f_a - g_a \cdot a - g(a, Z) = 0$$

and

$$(9) \frac{\partial \pi}{\partial b} = P_x^0 \cdot f_b - P_b^0 = 0,$$

where the as yet undefined term  $g_a$  is the partial derivative of  $p_a$  with respect to  $a$  (see equation (2)). With fixed prices for output and factor  $b$ , equation (9) is identical to equation (6), meaning that factor  $b$  is paid the value of its marginal product even though the firm is a monopsonist in the live fish market. Thus, if  $b$  is defined as labor, theory predicts that labor in the processing plant will continue to be paid a competitive wage even though the firm has monopsony power in the live catfish ( $a$ ) market.

Comparing equations (5) and (8), a different picture emerges with respect to factor  $a$ . In particular, under monopsony, catfish producers are no longer paid the value of the marginal product of the input they supply to the processing firm. Letting  $P_x^0 f_a = VMP_a$  (value of marginal product of  $a$ ) and making use of equation (2), it can be seen from equation (8) that:

$$(10) P_a = VMP_a - g_a \cdot a.$$

Since by assumption the supply curve of catfish producers has a positive slope, the quan-

<sup>5</sup>Historically, Alabama contributes about 12 percent to the national production of catfish (Jensen). Thus, in a sense Alabama may be viewed as a residual supplier of processed fish, taking the retail (and by implication, the wholesale) price as given.

tity  $g_a \cdot a$  is positive, meaning that catfish producers are likely to receive a lower price when the processor is a monopolist.

That the farm supply elasticity plays a key role in determining the extent to which prices are lowered can be seen by first defining the supply elasticity as:

$$\varepsilon = \frac{\partial a}{\partial P_a} \frac{P_a}{a} = \frac{1}{g_a} \frac{P_a}{a}$$

Substituting  $\varepsilon$  into equation (10) yields:

$$(11) P_a = \frac{VMP_a}{1 + 1/\varepsilon}$$

Denoting  $VMP_a = P_a^c$ , where  $P_a^c$  is the price catfish farmers receive when processing is a purely competitive industry, equation (11) can be rewritten as:

$$(12) \frac{P_a^c - P_a}{P_a} = \frac{1}{\varepsilon}$$

Equation (12) shows that the price catfish farmers receive under monopsony varies inversely with the magnitude of the supply elasticity of their output: the less price elastic the catfish supply response, the lower the farm price relative to the price received when the processing industry is competitive. In other words, divergence between the perfectly competitive and actual price grows as the ability of farmers to adjust production to output price changes diminishes.

This result is illustrated graphically in Figure 1. In this diagram,  $S_a$  represents the farm supply schedule for fish,  $D_a$  is the processor demand function for fish under competitive conditions, and  $MFC_a$  is the marginal factor cost of fish to the processor (the derivative of the supply function after multiplying by  $a$ ).

The price farmers receive under perfect competition is determined by the intersection of  $S_a$  and  $D_a$  which yields  $P_a$  in Figure 1. At competitive equilibrium,  $a^*$  fish are exchanged in the market. Under monopsony, the monopolist will maximize profits by purchasing fish at the point where buying one more unit of fish adds more to cost than

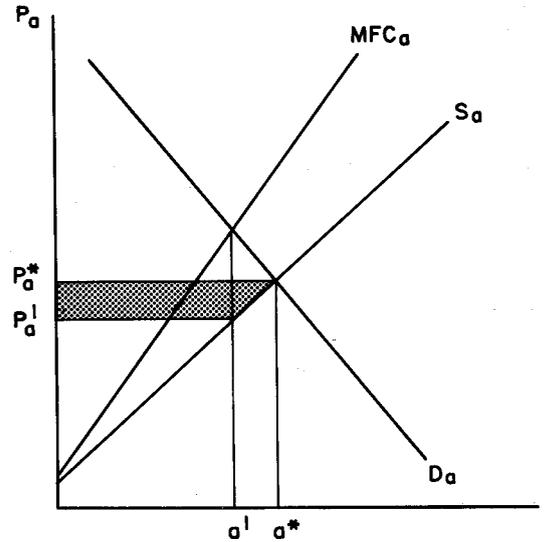


Figure 1. Price Determination Under Monopsony.

it does to revenue. This point is determined by the intersection of the marginal factor cost curve ( $MFC_a$ ) and the marginal benefit curve ( $D_a$ ). In Figure 1, the quantity of fish corresponding to this profit maximizing point is  $a'$ , which is less than the amount of fish purchased when processing is competitive. The price farmers receive for this reduced quantity of fish is determined from the supply curve and is  $P_a'$  in the diagram. Because the supply curve is upward sloping, the monopsony equilibrium price is lower than the competitive equilibrium price by virtue of the fact that less fish are exchanged in the market under monopsony. It is apparent from the diagram that as catfish supply becomes less price elastic (the relative slope of the supply curve increases), the divergence between the price that farmers receive for fish and the perfectly competitive price becomes greater.<sup>6</sup>

## AN APPLICATION OF THE THEORY

Empirical measures of supply response to output price are needed to operationalize the theoretical model and provide predictions of the extent to which producers might

<sup>6</sup>An interesting aspect of the model (not developed because of space considerations) is the revelation that an incentive may exist for the processing plant to practice price discrimination by varying the price paid to producers seasonally. Briefly, the argument is as follows: because feed conversion of catfish differs seasonally due to changes in water temperature (Lovell and Sirikul), production elasticities and hence supply elasticities (Houck) for catfish are likely to also differ seasonally (being more elastic in warm water seasons than cold water seasons). Theory says that the monopolist will vary the price paid for affected inputs in response to changes in the supply elasticity of those inputs: offering a higher price when supply elasticities are relatively large and less when elasticities are smaller (Hadar). Thus, seasonally varying catfish supply elasticities would imply a seasonally varying price under monopsony conditions; i.e., price discrimination would occur. This potential for price discrimination in catfish processing represents another important research issue to address as data become available. In this connection, a crucial hypothesis to be tested is whether catfish supply elasticities are uniform across seasons.

find prices falling under the new monopsonistic market environment in West Alabama. The newness of the industry and the consequent paucity of data make conventional econometric measurements of supply elasticity impractical at this juncture. However, neoclassical production theory provides an avenue for obtaining insights into supply response providing certain assumptions regarding producer behavior and catfish production technology are accepted. An indirect method for estimating the supply elasticity is outlined in the following discussion and is applied to the West Alabama catfish industry.

### A Derived Supply Elasticity for Catfish

Supply response is ultimately governed by production technology and the ability of the firm to adjust input use in response to changes in relative prices. This fact was illustrated by Griliches who showed that under conditions of competitive equilibrium and constant factor prices, the supply elasticity (assuming profit maximization) is a weighted sum of factor demand elasticities with weights corresponding to production elasticities. Specifically, the aggregate supply elasticity can be written as:

$$(13) \quad \varepsilon = \sum_i^N k_i \eta_{ip_a}$$

where  $\Sigma$  is the supply elasticity of output with respect to product price,  $k$  is the production elasticity corresponding to the  $i$ th input which tells how output changes as the  $i$ th input is varied,  $\eta_{ip_a}$  is the elasticity of demand for input  $i$  with respect to product price ( $p_a$ ), and  $N$  is the number of inputs employed by the firm. If inputs are paid the value of their marginal product, it can be shown that in equilibrium:

$$(14) \quad k_i = \frac{r_i}{P_a \cdot a}$$

where the numerator represents expenditure on the  $i$ th input and the denominator represents total revenue to the firm or industry. In other words, equation (14) says that factor shares can be used as an estimate of respective production elasticities under specified conditions. Griliches and others after him (e.g., Tweeten and Quance; Rayner) used equations (13) and (14) along with empirical estimates of input demand elasticities to

obtain estimates of aggregate supply elasticities. Griliches termed supply elasticities obtained in this way as "derived" elasticities because they were derived from information regarding production technology (as measured by production elasticities) and factor demands.

A disadvantage of the Griliches approach is that estimates of factor demand elasticities are needed. Thus, unless data or estimation problems associated with estimating factor demand equations are less severe than those of estimating the supply equation directly, one may be no better off from an empirical standpoint with the indirect approach. A recent paper by Houck overcomes this limitation. In that paper, Houck showed that the own price elasticity of product supply can be expressed strictly in terms of production elasticities (i.e., without regard to input demands) if the following conditions are met: (1) producers are profit maximizers, (2) production elasticities are constant throughout the relevant range of the production surface, (3) the production process is characterized by non-increasing returns to scale, and (4) all relevant prices (output and factor) are given. In this case, factor demand elasticities (the  $\eta_{ip_a}$  in equation (13)) become equal to one another and to the output supply elasticity plus one, i.e.,

$$(15) \quad \eta_{ip_a} = 1 + \varepsilon \quad i = 1, 2, \dots, N.$$

Substituting equation (15) into equation (13) yields:

$$(16) \quad \varepsilon = \frac{v}{1-v},$$

where  $v = \sum_i k_i$ . Note that under the specified conditions, production elasticities become the sole determinant of the supply elasticity; factor demands no longer enter into the calculation of  $\varepsilon$ .

Application of equation (16) requires satisfaction of model assumptions. A critical assumption is the one of constant production elasticities. In examining the effects of relaxing this assumption, Houck showed that equation (16) yields an upward bias in the estimated supply elasticity if the assumption fails to hold, but argued that under general conditions the bias would likely be small or nonexistent. Evidence relating to the applicability of the non-increasing returns to scale assumption to catfish production is scant but suggests that the assumption is valid (Lace-

well et al.). Moreover, the catfish enterprise is management intensive and involves substantial risk (Hansen et al.), lending credence to the notion that average costs are likely to increase with size. Finally, the assumption of fixed prices appears valid because Alabama supplies less than 12 percent of the nation's output of catfish (Jensen).

Significance of equation (16) for empirical work in supply analysis is summarized by Houck (p. 15): *If information about actual costs in a sector is available and if individual profit maximization is assumed, estimates of the various production elasticities can be calculated easily from equation (14). In profit maximizing equilibrium, each production elasticity is equal to the ratio of that input's cost to the total revenue obtained from the product. With empirical estimates of this kind . . . calculation of the supply elasticity is possible. In fact, all that is needed is an estimate of the ratio of total costs of the relevant variable factors to total revenue. This latter ratio is an estimate of  $v$ , which can then be used in equation (16)*<sup>7</sup>.

To apply this procedure, budget data generated by the Alabama Cooperative Extension Service (Crews and Jensen) were used to compute factor shares for the variable inputs used in catfish production.<sup>8</sup> Because factor shares are sensitive to changes in factor/product price ratios and may be influenced by economies of size, computations were made for the most recent four year time period and for a variety of pond sizes. Results show computed factor shares ranging from .65 to .89 (Table 1), suggesting that in any given year between 65 and 89 percent of total Alabama catfish farm revenues are consumed by variable costs. These estimates, although based on synthetic budgets rather than actual farm data, are consistent with "hard data"

TABLE 1. ESTIMATED FACTOR SHARES FOR VARIABLE INPUTS USED IN CATFISH PRODUCTION BY POND SIZE, ALABAMA, 1981-84

Year	Pond size (acres) <sup>a</sup>			
	1	5	10	20
1981	.80	.77	.77	.72
1982	.89	.86	.85	.82
1983	.83	.80	.80	.75
1984	.70	.67	.67	.65

<sup>a</sup>Assumes a stocking rate of 3,500 fish per acre.

Source: Crews and Jensen.

<sup>7</sup>Numbers in parentheses were added and they refer to equations in the text.

<sup>8</sup>Variable inputs are defined to include the following factors: fingerlings, feed, chemicals, hired labor, electricity, fuel, lubricants, equipment repair, and interest on operating capital.

<sup>9</sup>The average value is based on the 10- and 20-acre pond figures only because these appear to represent the most economically viable pond sizes in the long run for West Alabama producers (Hansen et al.).

TABLE 2. DERIVED SUPPLY ELASTICITIES FOR CATFISH BASED ON ALTERNATIVE FACTOR SHARES FOR VARIABLE INPUTS, ALABAMA, 1981-84

Factor share values	Supply elasticity
.65	1.86
.75	3.00
.89	8.10

cost estimates showing the same variable factors representing about 69 percent of total production costs in Mississippi catfish operations (Giachelli et al.).

Following Houck's suggestion, these factor share values are used as an estimate of production elasticities ( $v$ ). Supply elasticities corresponding to the minimum, average, and maximum factor share values in Table 1 were computed using equation (16).<sup>9</sup> They range from 1.86 to 8.10, Table 2. Although these elasticities appear large, several points should be considered. First, the elasticities are computed under the assumption that the supply of inputs is perfectly elastic to the industry; i.e., input prices are fixed. Should this assumption not hold, i.e., should input prices rise with increases in factor demands, equation (16) overstates the supply elasticity. Thus, these elasticities may be regarded as representing an upper bound on the true supply elasticity. Second, very little is known about supply response in aquaculture. The rapid expansion in pond acreage over the past 10 years suggests that output may indeed be quite responsive to price changes. Third, previous work shows some tendency for derived supply elasticities to exceed conventional estimates (Wipf and Bowden). However, for the purpose of this analysis, an overestimate of the supply elasticity is rather innocuous in that estimates of the price exploitation potential of the monopsonist will be conservative in this case. Thus, if in fact the indirect procedure provides a measure of the supply elasticity that is "too large", the resulting estimated impact of monopsony on farm prices and producer welfare will represent a lower bound.

### The Monopsony Price

With estimates of the supply elasticity for catfish in hand, it is now possible to quantify the extent of the market power held by the

West Alabama catfish processing plant. Rewriting equation (12) as:

$$(12') P_a = \frac{P_a^c}{1 + 1/\varepsilon}$$

and taking \$.60 (the 1983 average price received by Alabama farmers) as a measure of  $P_a^c$ , the monopsony price consistent with the derived supply elasticities of Table 2 can be computed. The difference between the competitive price ( $P_a^c$ ) and the monopsony price measures both the incentive for the monopsonist to exercise its market power and the extent to which producers may need to be concerned about the new market environment.

Results indicate significant incentive for the monopsonist to exploit its market power, Table 3. Depending upon the supply elasticity, the potential monopsony price is 11.7 to 35.0 percent below the competitive equilibrium price. The average amount is 25 percent below. Note that deviations from the competitive price widen as the supply elasticity becomes smaller. Hence, as indicated, if the derived supply elasticities are "too large," the price exploitation potential is even greater than indicated by these calculations.

### Producer Impacts

In addition to a lower price to relevant input suppliers, monopsony also implies reduced marketings relative to competitive equilibrium (see Figure 1). Thus, monopsony-induced losses to producers must consider quantity as well as price effects. One way to measure this loss is to study the change in producers' surplus (defined as total revenue minus total variable costs or quasi-rent)

as monopsony replaces competition. In Figure 1, monopsony diminishes producers' surplus by an amount equal to the shaded portion of the diagram.

To approximate the potential loss to West Alabama catfish producers of selling in a monopsonistic catfish processing market, the following formula was used:

$$(17) L(PS) \approx P^*Q^*T[1 - \frac{1}{2}T\varepsilon]$$

where  $L(PS)$  stands for loss in producer's surplus,  $T$  is the percentage decrease in price from competitive equilibrium associated with monopsony,  $P^*$  is the competitive equilibrium price ( $P_a^c$  in Figure 1),  $Q^*$  is the competitive equilibrium quantity ( $a^*$  in Figure 1) and  $\varepsilon$  is the price elasticity of supply.<sup>10</sup> Note that from this formula it appears that the loss in producers' surplus becomes greater as supply becomes less price elastic, *ceteris paribus*.

During 1983 (the year immediately preceding the switch to monopsony), West Alabama producers sold 16.9 million pounds (liveweight equivalent) of fish to processors (Jensen). The average price paid to producers was \$.60 per pound. Hence, a value of \$10.1 million was used for  $P^*Q^*$  in applying expression (17). Based on these data, the derived supply elasticities, and the associated values for  $T$  (based on equation 12'), results show potential losses in producers' surplus ranging from \$.6 million to \$2.4 million, depending on the value of the supply elasticity, Table 3. In relation to revenues received by Alabama producers during 1983 (\$10.1 million), these estimated losses are not unimportant and further support the contention raised previously that monopsony in catfish processing has important implications for catfish producers.<sup>11</sup>

<sup>10</sup>The method and algebra used to derive expression (17) is presented in the Appendix. As noted by Wallace (p. 582), formulas such as expression (17) become more accurate as the difference between competitive and monopsony equilibrium is reduced. However, if the supply function is linear and  $\varepsilon$  is an arc elasticity, the formula is exact.

<sup>11</sup>Evidence to date is not inconsistent with these estimates. Consider the following recent data relative to the catfish industry, keeping in mind that in May, 1984 catfish processing became a monopsony in West Alabama (where most of the catfish production in the State occurs):

Year	Farm Prices		Farm Revenues	
	U.S.	Ala.	U.S.	Ala.
	----(¢/lb.)----		----(mil. \$)----	
1981	63.8	63.8	38.5	4.7
1982	55.0	55.0	54.7	6.6
1983	61.0	59.7	83.8	10.1
1984	69.3	61.0	106.9	7.8

Sources: U.S. data—USDA (1985); Ala. data—Jensen.

Two points are noteworthy: (1) between 1969 and 1982 Alabama farmers received the same price for fish as the national average; in 1984, a 13.6 percent price spread occurred. (Annualizing this figure to correspond to a 12-month period of monopsony rather than the observed 8-month period produces a 20.4 percent price spread—not too different from the predictions of the theoretical model, see Table 3), (2) 1984 revenues to Alabama producers declined \$2.3 million (29.5 percent) from the previous year; a period in which revenues for the industry as a whole expanded 27.6 percent. This revenue loss, especially if annualized, is consistent with the estimated figures for producers' surplus loss presented in Table 3.

TABLE 3. MONOPSONY VERSUS COMPETITIVE FARM PRICES FOR CATFISH AND PRODUCER WELFARE LOSS UNDER ALTERNATIVE SUPPLY ELASTICITIES, ALABAMA, 1983

Supply elasticity (E)	Competitive price (P <sub>c</sub> )	Monopsony price (P <sub>m</sub> )	Percent difference (T)	Estimated loss in producers' surplus due to monopsony (L(PS))
	\$ /lb			mil. \$
1.86	.60	.39	-35.0	2.4
3.00	.60	.45	-25.0	1.6
8.10	.60	.53	-11.7	.6

### CONCLUDING REMARKS

In May 1984, the catfish processing industry in West Alabama became a monopsony, restricting the 225 producers in the area to effectively a single outlet in which to market fish. The theoretical model and analytical results presented in this paper provide predictions that are in close agreement with actual market behavior. In 1984, the average price received by Alabama catfish producers was 13.6 percent below the national average price: a divergence that is unprecedented in the history (beginning in 1969) of these two price series. Moreover, Alabama marketings of catfish and associated farm revenues declined in 1984 from previous year levels by 24.7 percent and 23.0 percent, respectively, a period in which the total industry realized *expansions* in marketings and revenues of 12.4 percent and 27.6 percent, respectively. When allowance is made for the fact that the West Alabama market was not monopsonistic for the entire 1984 calendar year and not all catfish production is located in the western portion of the State, the degree of congruence between model predictions and actual market behavior is impressive. This consistency should increase confidence in the model and procedures used in this paper to analyze potential farm impacts of monopsonistic food processing.

Although the results are somewhat *ex ante* in nature and relate specifically to only a small segment of the catfish industry, they

may have more general implications. The existence of significant scale economies and excess capacity in catfish processing portends increasing, not decreasing, concentration as the industry expands over time. Moreover, even in production areas where processing plants are more numerous, locational monopsonies may exist because transporting live fish beyond 50 miles may be uneconomical under normal cost/price relationships.<sup>12</sup> These facts, combined with the recent empirical evidence showing substantial concentration in catfish processing (Miller et al.) suggest that issues relating to industrial organization are likely to continue to be important to the overall development of the industry. The model developed in this paper and attendant methodology may prove a useful starting point for attacking some of these issues.

The paper points to significant gaps in knowledge regarding fundamental relationships affecting the farm-raised catfish industry. Empirical studies designed to shed light on the nature of supply response in catfish production are needed. Hypotheses regarding seasonality in catfish supply elasticities need to be tested to determine whether an incentive exists for price discrimination. Because issues relating to industrial organization have especially important implications for catfish producers, these issues will need to be carefully examined as the industry matures over time.

### APPENDIX

Derivation of the equation to represent loss in producer surplus associated with mo-

nopsony pricing can be facilitated by the use of the following diagram:

<sup>12</sup>Recent estimates show hauling costs increasing from \$ .47 to \$1.16 per pound of liveweight fish when distance traveled increases from 10 to 50 miles one way (Keenum and Dillard). An industry survey conducted in 1979 found that 94 percent of the fish processed came from farms located within 50 miles of the plant (Miller et al.).

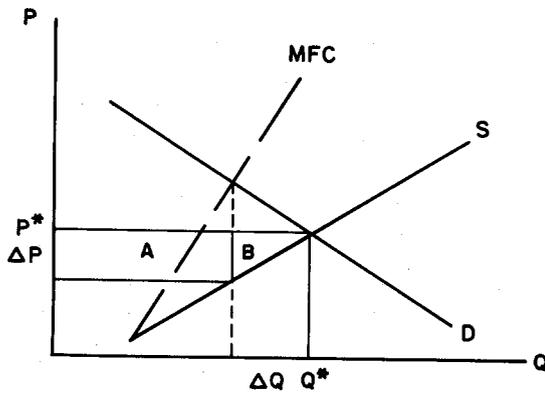


Figure 2. Loss in Producers' Surplus Associated with Monopsony Pricing.

In this diagram, loss in producers' surplus is represented by the areas of rectangle A and triangle B; i.e.,

$$(18) L(PS) = \text{area A} + \text{area B}.$$

The area of rectangle A is:

$$(19) \text{area A} = \Delta P (Q^* - \Delta Q),$$

where  $\Delta P$  is the difference between the competitive equilibrium price ( $P^*$ ) and the monopsony price and  $\Delta Q$  is the difference between the equilibrium quantity ( $Q^*$ ) under perfect competition and the monopsony quantity.

The area of triangle B is:

$$(20) \text{area B} = \frac{1}{2} \Delta P \Delta Q.$$

Substituting equations (19) and (20) into equation (18) yields:

$$(21) L(PS) = P (Q^* - \Delta Q) + \frac{1}{2} \Delta P \Delta Q.$$

Letting  $T$  represent the percent decrease in the monopsony price from the competitive equilibrium price, define:

$$(22) \Delta P = P^* T.$$

The change in quantity associated with monopsony pricing can be approximated from the supply elasticity:

$$(23) \varepsilon \approx \frac{\Delta Q P^*}{\Delta P Q^*}$$

or

$$\Delta Q \approx \varepsilon \Delta P Q^* / P^*.$$

Substituting equation (22) into equation (23) yields:

$$(24) \Delta Q \approx \varepsilon T Q^*.$$

Substituting equation (22) and expression (24) into equation (21) yields an expression which approximates the desired loss function:

$$(25) L(PS) \approx P^* T (Q^* - \varepsilon T Q^*) + \frac{1}{2} P^* T \varepsilon T Q^*$$

which, upon simplification, yields:

$$(25') L(PS) \approx P^* Q^* T [1 - \frac{1}{2} T \varepsilon].$$

A caveat in using equation (25') is that it is an approximation formula for which its accuracy is greatest for small deviations from competitive equilibrium. A precise formula to measure loss involves the use of integrals but this requires a complete specification of the supply equation. Wallace argues that because of difficulties associated with attempting to completely specify a supply equation, the approximation formula (25') may do no worse than the integral approach. Moreover, as indicated in footnote 10, if the supply equation is linear and an arc elasticity is used to represent  $\varepsilon$ , expression (25') is exact.

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