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An Empirical Bargaining Model of Price Discovery: An Application to the Washington/Oregon Asparagus Industry

ABSTRACT: The bargaining process and its role in price discovery within the Pacific Northwest asparagus industry is analyzed using a general empirical bargaining model. Growers' and processors' inverse supply and demand functions define boundaries for the negotiated prices. OLS and Heckman's two-stage estimation procedures are used to estimate a stochastic bargaining model of price determination. The results indicate that basic supply and demand forces exert substantial influences on the bargaining process. In particular, expected levels of supply play a paramount role in the level of prices offered, while past prices also influence current offers. The general framework of analysis used in relation to asparagus can be generalized to other commodities where bargaining plays a role in price discovery. The model can be used to investigate the extent to which major economic forces impact bargaining behavior.

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INTRODUCTION

Increasing concentration in food processing has led to fewer buyers of raw agricultural commodities and heightened interest in grower bargaining associations. Ignoring the dairy sector, the number of grower cooperatives involved in bargaining has increased from 40 in 1987 to 54 in 1996 (USDA, 1998).

A case in point is the asparagus industry. Asparagus is sold by growers for either fresh or processed uses. The price of fresh asparagus is determined by the concurrent interaction of market supply and demand forces on an on-going basis. On the other hand, price discovery for most processing asparagus in the United States is through micro-level negotiation of contract prices between growers' bargaining associations and processors. The bargaining process is completed prior to harvest each crop year to establish the price and expected volume of processing asparagus for the coming season.

The characteristics of the bargaining process suggest that the processed asparagus market operates within a monopoly/monopsony-like context. The typical price equilibrium, where supply equals demand, breaks down under such behavior, as is well-known. In particular, price equilibrium under bargaining not only depends upon supply and demand forces, but also on the relative bargaining power of the sellers and buyers.

In the case of the Washington/Oregon asparagus industry, negotiations establish both the price and the expected volume of processing asparagus for the upcoming season. At the beginning of each year, the grower's bargaining association announces an opening selling price offer based on the growers' perceptions of asparagus market conditions. Processors provide a response within three days following the growers' announcement. The opening price offer becomes the final price for processing asparagus if the majority of processors agree to accept it. If not, the growers' bargaining association must make a second price offer within five days. The second price offer may or may not be the same as the first. If the second offer is accepted, it becomes the price for processing asparagus in the coming season. If not, the price of processing asparagus is finally determined by an arbitration board. The arbitration board is composed of representatives of the growers and processors, as well as other members who are appointed by the states' departments of agriculture. In practice, either the first or second price offer has always become the final price of processing asparagus. There have been only two years in which the final price of processing asparagus was determined by the arbitration board during the past 30 years, and in both of these cases, the second price offer of the growers was adopted by the board.

A number of models of the asparagus industry have been analyzed in the literature. In 1971, French and Matthews formulated a demand-supply equilibrium model of the U.S. asparagus industry. Grossman (1973) developed a structural model of the asparagus industry at a regional level. Hoos and Runsten

(1977) constructed a linear and logarithmic multiple regression model to predict grower prices for processing asparagus in California. In 1982, a structural econometric model for the U.S. asparagus industry was developed by Bbuyemusoke, et al. (1982), and still another econometric model of the U.S. asparagus industry was developed by French and Willett (1989). However, none of these past models contained an explicit analysis of the bargaining component of processed price determination.

Previous studies relating to bargaining may be broadly classified into two categories: the general economic theory of bargaining and models of bargaining in specific industry contexts. Bowley (1928) was one of the first researchers to analyze the economic theoretic underpinnings of bargaining, and based his analysis on the theoretical model of bilateral monopoly. Bowley separated the bargaining process into two steps. The quantity traded that would maximize profit was determined first. Then the bargained price determined the distribution of the maximized joint profits. This same theoretical theme appeared in the much more recent work of Blair and Kaserman (1987), and thus would appear to have withstood the test of time. Fuller (1963) made theoretical comparisons and contrasts between bargaining in agriculture and general labor industry markets in terms of the bargaining nature, type, tactics, and outcomes. He indicated a relative lack of market power in most agricultural situations.

A number of bargaining models and analyses have been developed that are related to a number of (non-asparagus) agricultural industries. Helmberger and Hoos (1963) outlined the essential characteristics of the bargaining participants, the bargaining environment, and various alternative approaches to bargaining in agriculture. Hill's (1966) bargaining model for predicting price adjustments to technological change established an absolute limit of the bargaining range by using minimum profits acceptable to the firms engaged in bargaining. The result of bargaining within this range was determined in terms of the distribution of bargaining power between the sellers and the buyers. Babb, Belden, and Saathoff (1969) analyzed factors affecting the bargaining process and outcome of negotiations for the processing tomato industry in Indiana and Ohio during the 1966 growing season. They found that processors were primarily concerned about quality factors and growers with price. Ladd (1974) developed a model of a cooperative that bargains with processors either for maximization of price received by producers or maximization of quantity of raw materials to be traded. This led to a representation of a bargaining solution in terms of first order conditions for optimizing the two objectives. A relatively recent bargaining model was analyzed by French (1987) who developed a framework for farm price estimation under bargaining applied to the California cling peach industry.

Previous studies of market power have received increasing attention in both agricultural and food industries in recent years. Market power is here defined as

a firm's ability to advantageously influence market behavior or market results such as levels of prices or quantities in a transaction. Various structure-conduct-performance (SCP) studies have been conducted to determine the source of market power, or the major factors affecting market power, and their relationships. A classic example is Brandow (1969), who identified more than a dozen sources of market power in the food industry. He also pointed out that profits and market power were not necessarily associated with each other. Besides SCP studies, a number of studies developed measures of the degree of market power in an industry or a market. Of particular interest is the work of Love and Murniningtyas (1992), who used the principle of profit maximization to define an equilibrium condition for noncompetitive markets and provided explicit parametric tests for measuring the existence of market power. Market power parameters were jointly estimated based on cost and demand parameters.

The principal objective of this paper is to develop an empirical model for investigating the extent to which primary market factors affect price offers and ultimately the final price in a bargaining context, and apply the model to the processed asparagus in the Washington/Oregon asparagus industry. To accomplish this objective, an empirical model of the bargaining process that leads to price offers, and ultimately a final negotiated price, is specified and then estimated. While the final estimated equations apply only to the asparagus industry, the general bargaining model that leads to the specification of the equations can be applied to other industries in which final commodity prices are determined via a bargaining process.

EMPIRICAL MODEL OF THE BARGAINING PROCESS

Various market equilibrium and disequilibrium situations are possible within the bargaining context. A standard market equilibrium model can be conceptualized as containing four essential equations, consisting of a demand equation, a supply equation, a price equilibrium equation, and a quantity equilibrium equation (Table 1, entry 1). Given the demand and supply equations, if either or both of the price and quantity equilibrium conditions are violated, market disequilibrium results. Bargaining can lead to a solution under market disequilibrium, which can be classified into three types: 1) quantity bargaining; 2) price bargaining; and 3) bargaining for both price and quantity (see Table 1, entries 2, 3, and 4, respectively). This study deals with price bargaining for a given quantity to be traded, which coincides with the context in which processed asparagus prices are determined (Table 1, entry 3).

The equilibrium quantity of processing asparagus to be traded is agreed upon before pricing is established in the processed asparagus industry. Neither the growers nor the processors are price takers, and both parties have some market or bargaining power with which to attempt to influence the price. The growers

Table 1. Market Equilibrium and Disequilibrium Situations

1. Market Equilibrium		2. Quantity Disequilibrium	
$D = D(P_d, Z_d)$	Demand	$D = D(P_d, Z_d)$	Demand
$S = S(P_s, Z_s)$	Supply	$S = S(P_s, Z_s)$	Supply
$D = S = Q^*$	Quantity Equilibrium	$D \neq S$	Quantity Bargaining
$P_d = P_s = P^*$	Price Equilibrium	$P_d = P_s = P^*$	Price Equilibrium
3. Price Disequilibrium		**4. Price and Quantity Disequilibrium**	
$D = D(P_d, Z_d)$	Demand	$D = D(P_d, Z_d)$	Demand
$S = S(P_s, Z_s)$	Supply	$S = S(P_s, Z_s)$	Supply
$D = S = Q^*$	Quantity Equilibrium	$D \neq S$	Quantity Bargaining
$P_d \neq P_s$	Price Bargaining	$P_d \neq P_s$	Price Bargaining

P_d = the buyers' price; P_s = the sellers' price; S = the quantity supplied; D = the quantity demanded; P^* = the bargained or equilibrium price; Q^* = the bargained or equilibrium quantity; Z_d = demand shifters; and Z_s = supply shifters.

cannot set a price on the processors' demand curve and the processors cannot set a price on the growers' supply curve.

There are two basic features of price determination under bargaining that distinguish it from the typical market equilibrium analysis. First, the equilibrium price under bargaining cannot be determined by supply and demand equations alone because the bargaining activities play a role in price determination. Second, estimation of the usual neoclassical demand and supply equations will be biased and inconsistent since actual price observations are generally not located on either the demand or supply curves.

The supply and demand curves can be considered as defining the lower and upper price boundaries for the price bargaining process, respectively. The equilibrium price under bargaining for a given quantity to be traded can be defined as a convex combination of the inverse supply and demand functions evaluated at the given equilibrium quantity, Q^*. We refer to the parameter defining the convex combination weights as the relative bargaining power coefficient, α, which takes a value between 0 and 1. Hence, an economic model of price discovery under bargaining under the current market assumptions can be represented by:

$$P_d = P_d(Q_d, Z_d) \qquad \text{Buyer's Inverse Demand} \qquad (1)$$

$$P_s = P_s(Q_s, Z_s) \qquad \text{Seller's Inverse Supply} \qquad (2)$$

$$Q_d = Q_s = Q^* \qquad \text{Quantity Equilibrium} \qquad (3)$$

$$P^* = (1 - \alpha)P_s + \alpha P_d \qquad \text{Price Equilibrium under Bargaining} \qquad (4)$$

where: Q^* = the agreed quantity to be traded; P^* = the equilibrium price under bargaining; Z_d = inverse demand shifters; Z_s = inverse supply shifters; and α = coefficient of relative bargaining power. Some implications of various values of α are as follows:

under monopoly: $\alpha = 1$ $P^* = P_d$
under monopsony: $\alpha = 0$ $P^* = P_s$
under competition: indeterminate $P^* = P_d = P_s$
under bargaining: $\alpha \in (0,1)$ $P_s < P^* < P_d$

Solving this market equilibrium bargaining model for the final bargained price yields:

$$P^* = (1 - \alpha)P_s (Q^*, Z_s) + \alpha P_d (Q^*, Z_d) = f(Q^*, \alpha, Z_s, Z_d) \qquad (5)$$

For purposes of estimation, represent both the sellers' inverse supply function and the buyers' inverse demand functions in stochastic form as follows:

$$P_s = P_s (Q_s, Z_s) + \epsilon_s = f_s(X) + \epsilon_s \qquad \text{Sellers' inverse supply} \qquad (6)$$

$$P_d = P_d (Q_d, Z_d) + \epsilon_d = f_d(X) + \epsilon_d \qquad \text{Buyers' inverse demand} \qquad (7)$$

$$E(\epsilon_s) = E(\epsilon_d) = 0 \qquad \text{Zero mean of error terms} \qquad (8)$$

where ϵ_s and ϵ_d are the disturbance terms for the inverse supply and demand functions, respectively. Henceforth to simplify notation we let X represent a universal set of explanatory variables affecting supply and demand and we treat the parameters as being implicit in the representation of these functions and in other functions below. Some of the entries in X will then be ghosts in either the demand or supply functions. All other variables retain their earlier definitions.

First-Round Bargaining

Since the sellers' opening offer will be above their supply curve if they are not price-takers, the sellers' opening or first price offer, say $P_{s,1}$, can be represented as the inverse supply function plus some positive increment $\Delta P_{s,1}$ which is related to the sellers' perceptions of market conditions and bargaining strength, as:

$$P_{s,1} = [P_s + \Delta P_{s,1}] + \epsilon_{s,1} \qquad (9)$$

$$= [f_s(X) + \epsilon_s] + [\Delta f_{s,1}(X) + \Delta \epsilon_{s,1}] + \epsilon_{s,1}$$

$$= [f_s(X) + \Delta f_{s,1} (X)] + [\epsilon_s + \Delta \epsilon_{s,1} + \epsilon_{s,1}]$$

$$= f_{s,1}(X) + \epsilon^*_{s,1}$$

where $E[\epsilon^*_{s,1}] = 0$, and $f_{s,1}(X)$ represents the expectation of the sellers' first price offer.

In making a decision regarding the acceptability of any price offer, buyers must have a threshold price in mind. If the sellers' offer is less than or equal to this threshold, the buyers will accept the price offer. If the offer is higher, the buyers will reject it. The buyers' threshold price, $P_{d,1}$, can be defined as the buyers' inverse demand, P_d, less an increment, $\Delta P_{d,1}$, that is a function of the buyers' perceptions about market conditions and bargaining strength, as:

$$P_{d,1} = [P_d - \Delta P_{d,1}] + \epsilon_{d,1} \tag{10}$$

$$= [f_d(X) + \epsilon_d] - [\Delta f_{d,1}(X) + \Delta\epsilon_{d,1}] + \epsilon_{d,1}$$

$$= [f_d(X) - \Delta f_{d,1}(X) + [\epsilon_d - \Delta\epsilon_{d,1} + \epsilon_{d,1}]$$

$$= f_{d,1}(X) + \epsilon^*_{d,1}$$

where $E[\epsilon^*_{d,1}] = 0$, and $f_{d,1}(X)$ is the expectation of the buyers' threshold price.

The difference between the sellers' first price offer and the buyers' threshold price, Y^*_1 can be used to characterize the outcome of price bargaining at the first stage. The criterion function for the bargaining outcome will be:

$$Y^*_1 = P_{s,1} - P_{d,1} = [f_{s,1}(X) - f_{d,1}(X)] + [\epsilon_{s,1} - \epsilon_{d,1}] = f_1(X) + \epsilon^*_1 \tag{11}$$

where $E(\epsilon^*_1) = 0$. If $Y^*_1 \leq 0$, which implies $P_{s,1} \leq P_{d,1}$, then the buyers accept the sellers' opening price offer and the bargaining process ends with a bargained price of $P^* = P_{s,1}$. The final price, P^*, can then be represented as:

$$P^* = P_{s,1} = f_{s,1}(X) + \epsilon^*_{s,1} \tag{12}$$

The criterion variable Y^*_1 is unobservable since the buyers' threshold price is not made public. However, information about the buyers' decision during the bargaining process is available in terms of the growers' price offers, the buyers' acceptance or rejection decision, and the final bargained price. Thus, whether the final price equals $P_{s,1}$ or not can be modeled via a limited dependent variable procedure by defining an observed indicator variable Y as:

$$Y = 0 \qquad \text{if } Y^*_1 \leq 0 \Rightarrow \text{the offer } P_{s,1} \text{ was accepted} \tag{13}$$

$$Y = 1 \qquad \text{if } Y^*_1 > 0 \Rightarrow \text{the offer } P_{s,1} \text{ was rejected.}$$

Second-Round Bargaining

If $Y_1^* > 0$, so that $P_{s,1} > P_{d,1}$, then the buyers will reject the sellers' opening price offer. In this case, the bargaining process will continue and the seller must make a second price offer in order to reach a price agreement. Viewing the sellers' second price offer as an adjustment to his or her first price offer, it can be expressed as the sellers' supply price plus an adjustment increment that is assumed to be less than or equal to the increment added to P_s in the previous offer.

$$P_{s,2} = [P_s + \Delta P_{s,2}] + \epsilon_{s,2} \tag{14}$$

$$= [f_s(X) + \epsilon_s] + [\Delta f_{s,2}(X) + \Delta \epsilon_{s,2}] + \epsilon_{s,2}$$

$$= [f_s(X) + \Delta f_{s,2}(X) + [\epsilon_s + \Delta \epsilon_{s,2} + \epsilon_{s,2}]$$

$$= f_{s,2}(X) + \epsilon_{s,2}^*$$

where $E[\epsilon_{s,2}^*] = 0$ and $Y_1^* > 0$.

Similarly, the buyers' second threshold price can be defined as an adjustment of the first-round threshold price. It can be represented as the buyers' demand price less an increment that is assumed to be greater than or equal to the increment in the previous threshold price function, as:

$$P_{d,2} = [P_d - \Delta P_{d.2}] + \epsilon_{d,2} \tag{15}$$

$$= [f_d(X) + \epsilon_d] - [\Delta f_{d,2}(X) + \Delta \epsilon_{d,2}] + \epsilon_{d,2}$$

$$= [f_d(X) - \Delta f_{d,2}(X) + [\epsilon_d - \Delta \epsilon_{d,2} + \epsilon_{d,2}]$$

$$= f_{d,2}(X) + \epsilon_{d,2}^*$$

where $E[\epsilon_{d,2}^*] = 0$ and $Y_1^* > 0$.

While it is impossible to know if there is any change in the buyers' threshold price during the bargaining process since the threshold price cannot be observed, it is reasonable to assume that the buyers will consider adjusting their threshold price based on previous bargaining outcomes. If the buyers' second threshold price is the same as the first in the bargaining process, then $\Delta P_{d,2} = \Delta P_{d,1}$, and the threshold price will be:

$$P_{d,2} = P_{d,1} = f_{d,1}(X) + \epsilon_{d,1}^* \tag{16}$$

The criterion function for the second round price negotiation can be defined as the difference between the sellers' second price offer and the buyers' second threshold price:

$$Y_2^* = P_{s,2} - P_{d,2} = f_2(X) + \epsilon_2^* \tag{17}$$

If $Y_2^* > 0$, so that $P_{s,2} > P_{d,2}$, then the buyer will reject the sellers' second price offer. In this case, the price discovery process continues. In the particular case of the Washington/Oregon asparagus industry, a final price will be determined by an arbitration board based on the sellers' second price offer, the buyers' response to that offer, and perceptions of market conditions. If $Y_2^* \leq 0$, then the sellers' second price offer will be accepted and the final price will be the sellers' second price offer, given by equation (14).

In the empirical application of the bargaining model in this study, it can be assumed that the final price resulting from the bargaining process is either the sellers' first or second price offer in view of the fact that the bargaining process for processing asparagus has always resulted in at most two different price possibilities in each year. Based on this assumption, the particular specification of the empirical bargaining model of price discovery for the processing asparagus situation is given by

$$P_{s,1} = f_{s,1}(X) + \epsilon_{s,1}^* \qquad E(\epsilon_{s,1}^*) = 0 \tag{18}$$

$$P_{s,2} = f_{s,2}(X) + \epsilon_{s,2}^* \qquad E(\epsilon_{s,2}^*) = 0, \text{ given } Y_1^* = f_1(X) + \epsilon_1^* > 0$$

$$P_f^* = (1 - \delta) P_{s,1} + \delta P_{s,2}$$

where δ is an indicator variable defined so that $\delta = 0$ when the sellers' first price offer is accepted and $\delta = 1$ if the second offer is accepted.

EMPIRICAL ESTIMATION OF THE BARGAINING MODEL

The sellers' first offer equation can be estimated by ordinary least squares (OLS) using all of the available observations on growers' first offers. The second offer equation violates standard OLS assumptions because of the obvious censoring problem that underlies its specification. On the other hand, the sellers' second price offer equation meets the general conditions of Heckman's (1976) two-stage estimation procedure. In particular, assuming multivariate normality of disturbances, the expected value of the seller's second offer can be represented as (recall equation (11))

$$E(P_{s,2}|(Y_1^* > 0) = f_{s,2}(X) + E(\epsilon_{s,2}^*|\epsilon_1^* > -f_1(X))$$

$$= f_{s,2}(X) + \tau(\phi/\Phi)$$

where ϕ and Φ are the probability density and cumulative distribution function of the standard normal distribution evaluated at the point $-f_1(X)/\sigma$, and τ is the covariance between ϵ_1^* and $\epsilon_{s,2}^*$. The estimation of the seller's second offer equation then proceeds in two steps. In the first step, a probit model is fit to dichotomous observations indicating whether or not the first offer was accepted, and is based on the full universal set of explanatory variables, X. Then the predicted Mill's ratios (ϕ/Φ) from the probit model are used as an additional explanatory variable in estimating the seller's second offer equation via least squares. Thus, Heckman's two-step procedure is implemented in estimating the seller's second offer equation.

Based on annual time series data from 1960 to 1994 on price offers and acceptances, the estimated equations for the asparagus growers' first and second price offers are (t-ratios are in parentheses):

$$PPW_{1t} = 5.9 - 0.1\,AW_t - 0.02\,SPU_{t-1} + 0.13\,PFU_{t-1} + 0.72\,PPU_{t-1} \qquad (20)$$

$$\phantom{PPW_{1t} = 5.9}\;(-2.7)\qquad(-1.7)\qquad\qquad(2.7)\qquad\qquad(3.5)$$

$R^2 = 0.93$, Durbin Watson (d) = 1.8, Std. Error of the Estimate = 1.4

$$PPW_{2t} = 35.0 - 1.03\,AW_t - 0.12\,SPU_{t-1} + 0.17\,PFU_{t-1} - 0.88\,PPU_{t-1} \qquad (21)$$

$$\phantom{PPW_{2t} = 35.0}\;(-3.2)\qquad(-2.1)\qquad\qquad(2.5)\qquad\qquad(-3.9)$$

$$-12.2\,Mills_t$$

$$(-2.0)$$

$R^2 = 0.89$, Durbin Watson (d) = 1.7, Std. Error of the Estimate = 1.0

where,

AW_t	=	Bearing acreage of asparagus for the coming season in Washington/Oregon;
SPU_{t-1}	=	Previous year's ending stock of U.S. processed asparagus;
PFU_{t-1}	=	Previous year's U.S. price of fresh asparagus;
PPU_{t-1}	=	Previous year's U.S. price of processing asparagus;
PPW_t	=	The final price of processing asparagus in Washington/Oregon; and
$Mills_t$	=	Mills ratio correction term in the Heckman two-step procedure.

The probit equation underlying the generation of the Mills' ratio correction in the seller's second offer equation is given by:

$$Y_1^* = -4.13 + .15\, AW_t + .032\, SPU_{t-1} + .012\, PFU_{t-1} - .05\, PPU_{t-1}$$

$$(1.3) \qquad (1.5) \qquad (.22) \qquad (-.5)$$

LRT (4 df) = 6.84, Craig-Uhler R^2 = .25, Correct Predictions = 67%

DISCUSSION

The signs of the coefficients on AW_t and SPU_{t-1} are negative in the first price offer equation estimated, indicating that the larger the current bearing acreage and carry-in stocks, the lower the price offer for processing asparagus will be. This is consistent with the notion that the bargaining strength of growers is eroded when supplies for the current market period are expected to be high. The perception of a diminished bargaining position is translated into a reduction in the initial price offer issued by growers. A positive sign is associated with the effects of both PPU_{t-1} and PFU_{t-1}. This is consistent with the notion that growers' expectations of current period prices for fresh and processed asparagus are extrapolated from their most recent experience. Higher price expectations for either fresh or processed asparagus induce growers to issue higher initial price offers.

The interpretations of the signs of the effects of AW_t, SPU_{t-1}, and PFI_{t-1} on the level of the second price offer by growers is analogous to the preceding interpretations in the case of the first price offer. Namely, expectations of higher asparagus supplies lead to lower levels of second price offers, while expectations of higher fresh market prices lead to higher second price offers. The negative sign on PPU_{t-1} was not anticipated, and indicates that at the second stage of the bargaining process, higher processed asparagus prices in the previous year induces lower values for growers' second price offer. The mills ratio is significant and has a negative effect, suggesting that the self-selection correction is relevant and that the relationship between disturbances in the probit and second price offer equations is negative, which makes intuitive sense.

Based on one-sided t tests, all of the t values for the explanatory variables in the econometric model are statistically significant at the level of $\alpha = 0.05$. Thus, the variables in the model can be considered as having significant influences on the offer prices for processing asparagus formulated during the bargaining process.

The estimated coefficients of the probit model indicate that the probability of the bargaining process going beyond the first round increases as expected supplies increase, which relates to increasing values of AW_t and SPU_{t-1}. This is consistent with the bargaining process between growers and processors becoming more contentious when high expected supplies place downward pressure on asparagus prices. The coefficient on lagged prices are notably insignificant, although the signs of the estimated coefficients themselves suggest that it is more likely that the

bargaining process will exceed one round if expectations of fresh asparagus prices are high and processed asparagus prices are low, which is sensible.

While the implications of the estimated probit equation are consistent with expectations, the model fit is considerably less than desirable. The likelihood ratio test (LRT) on the significance of the explanatory variables has a probability value of .13, which is not significant by the conventional .05 or .10 significance level standards and the ability of the model to predict an extended bargaining situation is disappointing. It is evident that factors beyond those included in the model exert important influences on the bargaining process.

CONCLUSIONS

The empirical bargaining model of price discovery applied to the Washington/ Oregon Asparagus Industry identified a number of broad market indicators that exerted important influences on the bargaining process leading to an equilibrium processed asparagus price. Expected levels of supplies played a notable role in the levels of price offers throughout the bargaining process, and also appeared to influence whether the bargaining process required more than one round to complete. Past prices of asparagus in the fresh and processed markets also influenced price offers, but their affect on extending the bargaining process was unclear.

Overall, it was found that broad market indicators explained a substantial amount of the variation in both price offers and final bargained price. The results of the model also suggest that other factors beyond broad market indicators influence the bargaining process, the most notable deficiency being in the explanation of the process leading to an extension of the bargaining process beyond the first round of negotiations.

While the estimated equation presented in this research are applicable only to the asparagus industry, the general model can be applied to other commodities where bargaining plays a dominant role in price discovery. The major economic factors that influence the behavior of the participants would be the basis of the specification of the price offer equations.

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