BEEF PACKER CONDUCT, ALTERNATIVE APPROACHES TO PRICE DISCOVERY, AND SUCCESS FACTORS FOR NEW GENERATION COOPERATIVES

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PREFACE

This dissertation is organized into three main chapters. The first, "Industry Conduct and Supergame Strategies in a Dynamic Oligopsony", uses concepts from game theory to determine the patterns of behavior in an experimental market for fed cattle, designed to closely resemble its real world counterpart. Evidence of collusive behavior in fed cattle procurement is discovered, and it is concluded that further investigation employing real market data is warranted. To this point, regulators are unwilling to reveal that data to researchers. It is hoped that the evidence discovered here will help convince them that this data should be shared.

The second chapter is entitled "Alternative Approaches to Livestock Price Discovery: Theory and Empirical Estimates." It proposes two separate theoretical frameworks for estimation of livestock price discovery models, and tests the models empirically using data from the experimental fed cattle market. It is found that alternative theoretical bases and model structures yield different estimates of the impacts of some key variables. As such, it is argued that researchers should base choice of model on predetermined goals, but that alternative methods should be considered.

The third and final chapter of the dissertation is entitled "Success Factors for Value-Added New Generation Cooperatives." It details the results of a survey of fifty New Generation Cooperatives managers regarding the factors most important to their success, and discusses the differences among responses from NGCs operating in various industries. It is found that the factors most important to the success of NGCs depend on the industry in which they operate, but that overall, the planning stage is critically important to these enterprises, as is control of cost factors. It is hoped that results of the survey can be used by managers of existing and new NGCs to enhance their chances of long-term sustainability.

Though my name appears beneath the title of this dissertation, I could not have completed this journey on my own. I want to thank Dr. Clement E. Ward, my major advisor, for guiding me through not just this dissertation, but through my Ph.D. program, and in some ways, the past three years of my life. No words can express, sir, the admiration and respect I have for you. From the bottom of my heart, I thank you for your patience, kindness, and support during my time here.

Dr. Daniel S. Tilley served as a member of my graduate committee, but his role in my training as an agricultural economist was far broader than that. I took three courses from Dr. Tilley, and consider him to be among the best teachers I have ever known. I hope that my skills in the classroom can someday approach those he possesses. Thank you, Dr. Tilley, for everything you have taught me, and for the time you have taken to advise me in my research.

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Dr. Joseph M. Jadlow of the Department of Economics at OSU was my external member. His comments on the research topics strengthened it greatly. Thank you, sir, for the assistance you provided.

Many members of the faculty and staff of the Department of Agricultural Economics have helped make my experience an enjoyable one. I would especially like to thank Dr. B. Wade Brorsen, whose counsel I often sought on a variety of matters, for the guidance he gave me and for the role he played in my economic training. I also want to thank Dr. Conrad P. Lyford, who gave me the opportunity to co-teach his agribusiness course. I am a better instructor as a result of the experience he provided for me.

I shall never forget the friends I made during my time at OSU. Space does not permit me to mention all those whose names I will remember years hence and smile, but I do want to thank The Big Feller, Rob Hogan, in particular. I could never have survived the excruciating task of passing my qualifying exams without his aid in studying, and I could not have completed my degree this quickly without his help on a variety of problems.

My family provided me with the foundation upon which this accomplishment is built. My mother, the greatest person I have ever known, always advised me of the importance of education. My father, whose intelligence far supersedes my own, taught me that only 110% will do in any endeavor. My sister Miranda has been my role model in many ways, and it was she who showed me what it means to persevere.

I have leaned too heavily on my wife Monica during the completion of my Ph.D. No one has sacrificed as much as she on my behalf, and that I could not have succeeded without her is beyond any question. Her unwavering love and support as I struggled through all the difficulties associated with this degree is the greatest gift I have ever received. I will never be able to repay the debt I owe her, but I will spend the rest of my days trying. Thank you, Honey. I love you.

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Introduction

Perceived anti-competitive behavior of beef packers is an ongoing cause of concern for those stakeholders in the earlier stages of the beef supply chain. Cattle producers and feeders have long argued that large packing firms take advantage of limited competition in their industry to earn excessive profit. With the national four-firm concentration ratio exceeding 80% (Grain Inspection, Packers and Stockyards Administration), and being even higher in some procurement regions, these allegations of market power abuse do not seem completely unfounded. Nevertheless, as Ward (2002) notes, there has been little attempt on the part of regulators and no rewards to the efforts of litigators to rectify this situation. Part of the reason for this is that the conduct of individual firms is difficult to discover, given data limitations. Often, only market prices and quantities are observable. These data do not suffice for studying individual firm behavior.

Concerns about packer concentration date to the turn of the 20th century when the "Big 5" of that era (Armour, Cudahy, Morris, Swift, and Wilson) controlled a large share of the industry (Azzam and Anderson). Regulatory intervention, combined with technological advances that lowered barriers to entry, effectively decreased concentration levels. These lower levels prevailed until the 1970s and 1980s, when a series of acquisitions and mergers created the new "Big 3": IBP, ConAgra, and Excel. As concentration in the industry continues to increase, so do attempts to measure the effects of thereof on industry stakeholders, and by a variety of methods.

Many early studies of market power in beef packing employed the Structure-Conduct-Performance (SCP) paradigm. These studies, based on the application of Bain's ideas (and Mason's and Chamberlin's before that), attempt to relate levels of concentration in an industry to firm profitability or price levels. According to the SCP paradigm, the "structure" of an industry, which is defined by the number of firms, affects how firms may "conduct" themselves, as measured by their ability to move away from the competitive price. In turn, the industry's "performance", which may be described in terms of prices (or a number of other measures) compared to those that would prevail under perfect competition, will depend on the conduct of firms. A thorough review of studies that have applied the SCP paradigm to the beef industry can be found in Azzam and Anderson.

The SCP approach has fallen somewhat out of favor due to its theoretical shortcomings. Variable measurement problems, concerns about direction of causality between prices/profitability and concentration, poorly specified (ad-hoc) models, and uncertainty about the nature of pricing conduct in SCP studies have all been cited as reasons for this. In its place has arisen the New Empirical Industrial Organization (NEIO) approach, in which firm behavior is more explicitly developed. Most NEIO research involves the estimation of a "conjectural variation", the estimated value of which is then linked to a specific type of firm conduct. This approach was first used to model the beef packing industry by Schroeter, and is now the one most often taken in studies of packer conduct. NEIO has been extended to include concepts from game theory by Koontz, Garcia, and Hudson and Koontz and Garcia. This allows the repeated strategic interaction of packers to be modeled more fully, and provides a theoretical basis for much observed behavior.

The objective of the research reported in this paper is to develop and estimate a game theoretic model of industry conduct and supergame strategies in a dynamic oligopsony. Data from an experimental fed cattle market, designed to resemble a real market procurement region, are used. Though a few previous attempts have been made to apply concepts from game theory to agricultural markets, these studies have been limited by their use of aggregated data and lack of firm cost data. Additionally, little effort has been made to model individual firm behavior, because individual transaction data have not been available. This research is therefore unique in that firm level price and cost data allow a more complete analysis of industry conduct and underlying firm strategies to be undertaken. As well, the use of game theory, which explicitly considers strategic interactions among packers, is an improvement over most conventional methods used to study the behavior of those firms.

Theory

Friedman's (1971) specification can be adapted to packer behavior in a fed cattle region. We begin with the single period, non-cooperative ordinary procurement game played by a fixed, finite set of packers $N = (1, 2, \ldots, n)$ in a given region.[1] A game is non-cooperative if players are forbidden from making binding agreements; this is the case for the procurement game in the United States because of antitrust legislation. The information structure of the game is assumed to be one of complete but imperfect information. Complete information implies that each player is aware of the strategy sets and payoff functions that apply to all participants, and imperfect information means that players are not completely able to observe the strategic decisions made by others. For instance, each packer is not aware of the exact prices paid or quantities purchased by all other packers for each trading period. They are merely aware of the prevailing market price and quantity.

Quantity of fed cattle purchased is the strategic variable in the procurement game. Each player chooses a (quantity) strategy s_i from the available set of strategies S_i, a compact, convex subset of Euclidean space of finite dimension. The strategy set of the overall game, S, which consists of all possible quantities procured for all packers in a single period, is the Cartesian product of the individual S_i strategy sets:

(1) $S = S_1 \times S_2 \times \ldots \times S_n$.

The vector of strategies chosen in the single period ordinary game is then

(2) $s = (s_1, s_2, \ldots , s_n)$,

where each s_i denotes a procurement volume chosen by packer $i \in N$. The payoff to the i^{th} player, in this case the profit from processing fed cattle into boxed beef, is a function of its own strategy as well as the strategies of all other players and is denoted $\pi_i(s)$. It is clear that the volume of cattle procured by each packer affects the volume available to the remaining packers, which in turn affects their payoff. As such, the vector of industry payoffs associated with strategy vector s can be written as

(3) $\pi(s) = (\pi_1(s), \pi_2(s), \ldots , \pi_n(s))$.

An equilibrium point of the ordinary game is a strategy vector s^e which satisfies the condition

(4) $\pi_i(s^e) \geq \pi_i(s)$

for all $s \in S$ and all $i \in N$. That is, an equilibrium point exists where each packer maximizes its payoff with respect to its own choice of strategy, given the strategy choices of other players in the game. This equilibrium point is often called the Nash equilibrium of the game.

Friedman (1971) notes that when the payoff functions are profit functions, the players are firms, and the strategy choices are quantities (or prices), the game is a single period oligopoly and the non-cooperative (Nash) equilibrium is the same as the Cournot solution.[2] Packers in a single period game would then choose this quantity to achieve static profit maximization. This strategy may not hold for a repeated game, however, in which the same ordinary game is played at each iteration (Friedman, 1986). If players are able to tacitly collude in a multiperiod game, they may be able to achieve profits in excess of those which would be generated in a single period game. It is well-established that the Nash equilibrium of a single period game can differ substantially from that which will prevail in a repeated game, because alternate strategies can produce higher payoffs than in the single period game. An *infinitely* repeated game will not necessarily be repeated for an infinite period of time, but a game may be correctly termed infinite if the players cannot conceive of a definite ending point, and thus do not choose strategies with such a definite ending period in mind.[3]

A sequence of ordinary games with individual player strategy sets S_{i1}, S_{i2}, ... , S_{it},... and attached payoff functions $\pi_{it}(s_t)$ is a *supergame* in extensive form, with the t^{th} move in the game being the playing of the t^{th} ordinary game in the infinite sequence. This formulation allows for the association of strategies and payoffs across time. The strategy set for the t^{th} ordinary constituent game of the supergame is then

(5) $S_t = S_{1t} \times S_{2t} \times ... \times S_{nt}$,

where the strategy sets may now differ across time, and the associated payoff vector is

(6) $\pi(s_t) = (\pi_{1t}(s_t), \pi_{2t}(s_t), ..., \pi_{nt}(s_t))$.

In the supergame, players do not seek to maximize their single period payoffs, but rather their payoffs over time. Given a discount parameter for the i^{th} player in the t^{th} time period of $\delta_{it} = 1 / (1+d_{it})$ where $d_{it} > 0$ is the discount rate, the payoff to player i at the outset of the supergame is

(7) $$\Pi_i = \sum_{t=1}^{\infty} \delta_{it}\, \pi_{it}(s_t).$$

Since all players' past strategies form part of the information set available to each player, supergame strategies take the form

(8) $s_{it} = g_{it}(s_1, s_2, ... , s_{t-1})$,

which says that the strategy chosen by player i in the current period is some mapping of the strategy vectors of all players in all previous periods.[4] In the beef packing industry, past fed cattle purchase prices and volumes of rivals are taken into account when setting quantity in the current procurement period. Further, static profit maximization is not necessarily the packers' goal, as found by Driscoll, Kamphampaty, and Purcell. Rather, packers seek to maximize a discounted profit stream.

The concept of a *trigger strategy equilibrium* (Friedman 1986) is central to the idea that beef packers can tacitly collude to keep fed cattle prices from approaching those that would prevail in a competitive market. Trigger strategy equilibria facilitate cooperation between players that allows them to achieve cooperative (cartel) outcomes in games that have a noncooperative structure. A trigger strategy is a tacit agreement to choose in each period a strategy vector $s^* = (s_1^*, s_2^*, \ldots, s_n^*)$ which results in lower fed cattle prices than those which would come about in the ordinary game. The strategy vector in an ordinary game would see each player choosing a Cournot strategy $s^c = (s_1^c, s_2^c, \ldots, s_n^c)$. It is important to note that

$$(9) \quad \sum_{t=1}^{\infty} \delta_{it}\, \pi_{it}(s^*_t) > \sum_{t=1}^{\infty} \delta_{it}\, \pi_{it}(s^c_t)$$

for all $i \in N$, otherwise a trigger strategy would not be chosen. Such a strategy would not be a noncooperative equilibrium in a single period game, because it would not be the single period profit maximizing strategy of any player.

Any player can increase its single period payoff for any iteration within the supergame by choosing a defection strategy s_i^d. In the beef packing procurement game, such a strategy would see player i pay slightly higher than the collusive price for fed cattle, thus increasing its processing volume, and earning payoff $\pi_{it}(s_i^d) > \pi_{it}(s_i^*)$. If any player defects from the tacitly collusive strategy vector s* by choosing s_i^d, it "triggers" a reversionary (noncooperative) episode in which the other players, who observe that market prices have risen above some trigger level, must follow suit, and all players will choose s_j^c $(j \neq i)$ for each remaining time period. This is often referred to as a *punishment period* for the game, so named because defection by one player results in punishment of that player (and all others, if that player cannot be singled out) for some period of time. But because (9) holds for all players across each ordinary constituent game of the supergame, there is no incentive for any player to ever defect, as long as the following holds:

$$(10)\quad \sum_{t=\tau}^{\infty} \delta_{it}\, \pi_{it}(s^*_t) \;>\; \pi_{i1}(s_i^d) + \sum_{t=\tau+1}^{\infty} \delta_{it}\, \pi_{it}(s^c_t),$$

where τ is the period in which defection occurs. If (10) holds, there is no benefit to defection during any iteration of the supergame.

It is clear that defections would never occur in such a scenario, if players are rational profit maximizing firms. Nevertheless, most markets—including the fed cattle market—exhibit patterns that are consistent with periodic reversionary episodes. The Green and Porter model can be used to show why such episodes can occur in the fed cattle market due to cattle supply fluctuations not directly observed by firms, rather than due to defection of any of the cartel members.[5] They assert that the punishment period does not necessarily last for the remainder of the game after defection, but rather is T ordinary game periods in length. They further suggest that T may depend, among other possibilities, upon the amount by which the trigger price and market price differ in the first reversionary period.

Denote the observable market price as p and the trigger price, which suggests that one or more players has defected and chosen s_i^d , as p^d. The fed cattle market then enters a reversionary period when $p > p^d$. Packer i's expected aggregate procurement volume for all other packers $i \neq j$ in normal periods is defined as

$$(11)\ Q_i = \sum_{j \neq i}^{N} s_j^*.$$

Suppose that in normal periods, packer i follows some strategy s_i^h, which may or may not be the same as s_i^*. The expected payoff to choosing s_i^h is

$$(12)\ E[\pi_i(s_i^h)] = E_\varphi \pi_i(s_i^h, \varphi p(s_i^h + Q_i)),$$

where φ is a vector of i.i.d. random unobservable supply shocks with cumulative distribution function F and probability density function f such that $p_t = \varphi \sum_{i=1}^{n} s_{it}$. Each packer's expected payoff in reversionary periods is then

$$(13)\ E[\pi_i(s_i^c)] = E_\varphi \pi_i[s_i^c, \varphi p[\sum_{j \le n} s_j^c]],$$

and it is assumed that $E[\pi_i(s_i^h)] > E[\pi_i(s_i^c)]$ for all i. Then Π_i from (7) satisfies

$$(14)\ \Pi_i(s_i^h) = E[\pi_i(s_i^h)] + \delta_i \Pr(p^d \ge \varphi p(s_i^h + Q_i))\ \Pi_i(s_i^h) + \Pr(\varphi p(s_i^h + Q_i) > p^d)$$

$$\times [\sum_{t=1}^{T-1} \delta_i^t\, E[\pi_i(s_i^c)] + \delta_i^T\, \Pi_i(s_i^h)],$$

where $\Pr(\cdot)$ represents probability with respect to the distribution of φ. Since $(\Pr(\varphi p(s_i^h + Q_i) > p^d) = F(p^d / p(s_i^h + Q_i))$, (14) can be rewritten as

$$(15)\ \Pi_i(s_i^h) = \frac{E[\pi_i(s_i^h)] + F(p^d / p(s_i^h + Q_i))((\delta_i - \delta_i^T) / (1 - \delta_i))\, E[\pi_i(s_i^c)]}{1 - \delta_i + (\delta_i - \delta_i^T)\, F(p^d / p(s_i^h + Q_i))}$$

which in turn equals

$$(16)\ \Pi_i(s_i^h) = \frac{E[\pi_i(s_i^h)] - E[\pi_i(s_i^c)]}{1 - \delta_i + (\delta_i - \delta_i^T)\, F(p^d / p(s_i^h + Q_i))} + \frac{E[\pi_i(s_i^c)]}{1 - \delta_i}$$

Thus, the expected discounted value of packer i equals what it would be in a single period Cournot environment, plus the discounted gain in returns due to participation in the cartel. Then the Nash equilibrium (4), stated as a trigger strategy equilibrium s_i^* and incorporated into (7) can be rewritten as

$$(17)\ \Pi_i(s_i^h) \le \Pi_i(s_i^*)$$

for all s_i^h and i. This means that no strategy can produce a higher payoff for players than the trigger strategy. The associated first order condition for (17) is

(18) $\Pi_i'(s_i^*) = 0$

for all players i. From the quotient rule, (a / b)′ = 0 if and only if a′b – ab′ = 0, so (18) is the same as

$$(19)\ 0 = [1 - \delta_i + (\delta_i - \delta_i^T)\, F(p^d / p(\sum_{j \le n} s_j^*))]\, E[\Pi_i(s_i^*)]' + (\delta_i - \delta_i^T)\, f((p^d / p(\sum_{j \le n} s_j^*))$$

$$\times [p^d p'(\sum_{j \le n} s_j^*) / (p(\sum_{j \le n} s_j^*))^2)] \times (E[\Pi_i(s_i^*)] - E[\pi_i(s_i^c)]),$$

which says that the marginal return to defecting from collusive output levels must be exactly offset by the risk of suffering a loss in returns by triggering a reversionary episode of length T.

An implication of this result is that the observed market price reveals information about supply only, and does not cause players to revise their interpretations of what their competitors have procured. The frequency of industry reversion from collusive states will be given by $F(p^d / p(\sum_{j \le n} s_j^*))$, and these reversions occur *regardless* of actual intentional defections by cartel members. The critical extension of this result is that even though participants are aware reversionary episodes occur as a result of supply conditions rather than intentional defections, it is rational for them to participate in the episodes anyway. As Green and Porter note, such episodes are temporary switches to a Nash equilibrium in noncontingent strategies, specifically the single period Cournot procurement levels. Further, no firm can improve its payoff by unilaterally changing its strategy once a reversionary episode has begun. If firms did not participate in the reversionary episodes when high prices prevailed due to low fed cattle supply conditions, the first order condition (18) would not hold during normal game periods, and collusive behavior would not be individually optimal for packers.

It can therefore be seen how the beef packing industry can be expected to exhibit both reversionary and collusive periods. Reversionary periods may be caused by either fluctuations in the supply of fed cattle, which cause high prices that appear as defections, or actual choice of a defection strategy by any of the packing firms. If plant shutdown costs are sufficiently high, firms may purposely choose s_i^d as their optimal strategy. If fed cattle supply is particularly low, players will understand this and punishment period length T will be very short. Allowing for such defections under certain circumstances does not change the theoretical basis of the procurement game in any important way.

Data

Plant-level fed cattle procurement data are not available for the real fed cattle market. Although such data are collected by the Grain Inspection, Packers and Stockyards Administration (GIPSA), they are protected for proprietary reasons and hence not available to researchers except in unique cases. For this and other reasons, the Fed Cattle Market Simulator (FCMS) was developed at Oklahoma State University (OSU) to function as an experimental market for fed cattle. The FCMS closely resembles a real market fed cattle procurement region, in which there are typically several cattle feeders and not more than a few fed cattle purchasers (Ward et al. 1996). The FCMS has been used extensively for teaching, extension, and research experiments. Ward et al. (2001) provide a history of these experiments and other applications of the experimental market.

A detailed explanation of the experimental market can be found in Ward et al. (1996). Thus, only the fundamentals are presented here.

In the experimental market, four beef packing firms of different sizes and eight feedlots trade paper pens of one hundred head of fed cattle in open negotiation trading sessions that last approximately seven minutes. Players may participate in cash or forward transactions, and may also hedge or speculate in the futures market. Packing firms are aware of their efficient (minimum cost) procurement volumes, which are 8, 9, 11, and 12 pens per trading period for packers 1 through 4, respectively. Average total processing cost curves for the four packers are shown in Figure 1. Output (boxed beef) price is determined by the volume of fed cattle processed, i.e. number of pens and weights of cattle. Packing firms use the most recent boxed beef price to determine their bids in order to maintain certain margins. Cattle feeders are also aware of their minimum breakeven weights and usually prefer to sell their cattle at 1150 pounds. Cattle are placed on the showlist at 1100 pounds and gain 25 pounds per week until they are sold.[6] The number of new placements on the showlist follows a cyclical pattern, similar to that found in the continuously adjusting real market. At certain times, supplies are plentiful and each packer can reach its minimum cost volume relatively easily, with little competition with the other packers over price. At other times, however, fed cattle stocks can be quite tight, and packers are forced to bid up fed cattle prices in an effort to reach their minimum cost volumes.

Several types of information are provided to the players during and following each trading session, and end of week summary information is provided to the market after each trading period closes. Details for the most recent transactions are continuously scrolled across an electronic information display during and between the trading periods. Financial statements are provided to each packer and feedlot in the short interval between sessions, and the players then have a limited amount of time to calculate new bid/ask prices. Players are also informed periodically of which packing firm and which feedlot are most and least financially successful. This may influence other firms in their dealings with the "winners" or "losers".

Data used in this paper were generated during in-class use of the FCMS during the spring semesters of 1994, 1995, and 1996. Summary statistics for the three years' data are presented in Table 1. Participants were undergraduate agriculture majors at OSU. The first year's data consist of 2,664 observations collected over 72 trading periods. In 1995, 3,450 observations were collected over 92 sessions. An experiment carried out that year saw a marketing agreement imposed between the largest beef packer and two specific feedlots for a portion of the semester. Such a marketing agreement might be expected to decrease the level of collusion in the industry, since it would decrease the bargaining power possessed by the largest fed cattle buyer. The 1996 semester, which had 60 trading sessions with 2,197 observations, also involved a classroom experiment. In that year, public information available to the participants was limited for intermittent periods of time. The electronic displays which provide current cash market and futures market information were disconnected, leaving firms unable to base bid/ask price decisions on market data. Expected results of this information constraint upon industry performance are uncertain: it is often argued that providing extra information to members of a cartel allows them to coordinate their pricing (i.e. trigger strategy) behavior more easily, resulting in more collusive conduct. On the other hand, current market information on boxed beef prices may strengthen the bargaining position of feedlots if they know what packers can afford to pay.

For each of the three years, missing observations are encountered in the data sets used to estimate firms' reaction functions. At times, beef packing firms who encounter particularly tight supply conditions are unable to procure fed cattle at a price they are willing to pay, and so a single period plant shutdown occurs. During such a shutdown, no cattle are procured, processed, or sold, but the firm still has fixed costs and as a result an operating loss is incurred. Rather than omitting the entire trading session as an observation, the firm's procurement price and volume are calculated as the average of the values for the previous and next period. The losses in precision of doing are not believed to be serious. For the 1994 data, 4.86% of the observations are averaged in this way, for 1995 the number is 2.72%, and for 1996 it is 7.08%.

Procedure

Beef packing at the industry level is examined first in an attempt to discover evidence that firms tacitly collude when procuring fed cattle. The methodology uses firm processing margins similar to the work of Richards, Patterson, and Acharya, and Schroeter and Azzam. Recall that the ordinary constituent game of the supergame is one where profit maximization is the objective function for packer i. As such, the packer's problem can be written

(20) $\max \pi_i = pq_i - w(X,z)x_i - c(q_i)$,

where p is the price of boxed beef sold in the wholesale market, q_i is the quantity of boxed beef sold, w(X,z) is the price of fed cattle, X is the total quantity of fed cattle available for sale, z is a vector of supply shifting exogenous variables, and $c(q_i)$ is the i^{th}

firm's cost as a function of the quantity of cattle processed. The input transformation function of the i^{th} firm, which describes how fed cattle are processed into boxed beef, is

(21) $q_i = \gamma x_i$,

where γ is the dressing percentage. Incorporating the input transformation function (21), the firm's objective function (20) can be restated as

(22) $\max \pi_i = p\gamma x_i - w(X,z)x_i - c(\gamma x_i)$,

and then the first order condition for profit maximization is

(23) $\partial\pi_i / \partial x_i = \gamma(p-c_q^i) - w_i(X,z) - [(\partial w_i / \partial X) \times (\partial X / \partial x_i)] = 0$,

where c_q^i is the marginal cost of firm i.

The conjectural variation of a firm describes its response to changes in output by other firms, and is denoted $\phi = \sum_{i \neq j}^{N} dx_i / dx_j$. The industry conduct parameter, which includes the conjectural variation, can be written as

(24) $\theta = 1 + \phi$,

and it is constrained to take on a value between 0 and 2.[7] Since conduct at the industry level is the variable of interest for the time being, it is the industry average conjecture that is contained in θ. The processing margin for packer i is given as

(25) $m_i = (p\gamma - w_i(X,z))$,

which merely states that the processing margin is the difference between the marginal value product and the fed cattle price.

The supply function for fed cattle provided to packers by feedlots is

(26) $Q_t / X_t = \alpha_0 + \alpha_1(w(X,z) / z_j) + \alpha_2 L_t + e_t$,

where $Q_t = \sum_{i=1}^{N} q_{it}$ is the total quantity of fed cattle purchased in period t, z_j is the cost of gain, L_t is the average weight of cattle sold in period t, and e_t is the disturbance term. As in Schroeter and Azzam, the proportion of marketings to available supply is used as the dependent variable because it is a more precise measure of supply response than marketings alone. Average weight of cattle procured in time period t can be specified as

(27) $L_t = \eta_0 + \eta_1 X_t$

where η_1 is expected to have a positive sign. As the quantity of fed cattle available for sale increases, the average weight of cattle sold should increase as well. This is because packers prefer to purchase heavier cattle, whereas feedlots prefer to sell cattle at 1150 pounds.[8]

Given the supply function (26), (25) can be rewritten as an industry average margin

(28) $m_t = c_q^t \gamma + \alpha^{-1} \theta X_t$,

where α^{-1} is the inverse slope of the supply function, and m_t is the average margin earned in period t and is the same as in (25), except that the industry average procurement price is used for w(X,z). Similarly, c_q^t is the marginal cost for the industry as a whole, calculated as

(29) $c_q^t = \sum_{i=1}^{N} \omega_i c_q^i$,

where ω_i is firm i's share of procurement and c_q^i is firm i's marginal cost at the industry's minimum cost volume.[9]

The three equation system (26) – (28) is estimated simultaneously for each data set using the MODEL procedure in SAS. Only (26) and (28) are fit in the estimation; (27) is modeled but not fit because its purpose is merely to ensure that the average weight variable is considered endogenous in the estimation procedure. The estimation method is nonlinear two-stage least squares (N2SLS), with market price specified as an endogenous variable in the system. Equations (26) and (27) are estimated in log-linear form, but (28) is estimated without logs since it contains negative values for some margin observations.

Dickey-Fuller unit root tests are carried out to test for stationarity of each of the dependent variables. In all three years, the supply and margin variables are found to be stationary, but not the average weight variable. This is not a concern because, as noted above, that equation is not fit in the estimation procedure. Godfrey's test reveals serial correlation in the margin equation (28) for 1994 and 1995; this is dealt with by employing a second-order moving average [MA(2)] error process for each, which successfully corrects the problem. White's test and a Breusch-Pagan test fail to reject the null hypothesis of homoskedastic residuals for those two years. No evidence of autocorrelation or heteroskedasticity in the supply equation are found for 1994 or 1995. The system for 1996 exhibits autocorrelation in the margin equation and heteroskedasticity in the supply equation. An MA(1) correction is successfully employed to address the first problem, and a reweighting of the residuals is carried out in an attempt to rectify the second. After the reweighting, the heteroskedasticity is improved but not eliminated.

Chow tests for structural change are carried out at five period intervals for each data set. Evidence of structural change would support the hypothesis that industry behavior alternates between collusive and reversionary periods. Interestingly, frequent structural changes were evident in the 1994 data, fewer in the 1995 data, and almost none in the 1996 data. As such, a dual regime model is necessary.

Switching regressions may be used when it is suspected that observations on the dependent variable are not generated according to the usual formulation

(30) $Y = X\beta + e$,

but rather are generated by one of two regimes

(31) $Y_t = \sum_{j=1}^{k} \beta_{1j}X_{jt} + e_{1t}$ [denoted regime 1], or

$Y_t = \sum_{j=1}^{k} \beta_{2j}X_{jt} + e_{2t}$ [denoted regime 2].

If $\beta_1 \neq \beta_2$, the regression system is said to be "switching" between two regimes. Since which regime has generated a particular observation is usually unknown, the problem is how to assign each observation to one regime or another.[10] This can be addressed using Goldfeld and Quandt's D-method for switching regressions (SAS Institute, Inc.).

Assume that a given observation t's inclusion in one regime or the other is determined by some vector of variables $z = (z_1, z_2, \ldots, z_n)$. Then

(32) $\sum_{j=1}^{p} \psi_j z_{jt} \leq 0$

if Y_t was generated by regime 1, otherwise

$\sum_{j=1}^{p} \psi_j z_{jt} > 0$,

and Y_t was generated by regime 2, where ψ_j are coefficients to be estimated. If

$$(33)\ d(z_i) = (1 / \sqrt{2\pi\sigma}) \int_{-\infty}^{\Psi z} \exp[-1/2(\xi^2/\sigma^2)d\xi$$

is defined as a continuous approximation to a step function, then D is the diagonal matrix with $d(z_i)$, i = 1,2, ... ,n on the diagonal, and the parameters to be estimated are the k β_1 and k β_2 parameters from (31), the p ψ parameters from (32), and the variances of each regime. The equation to be estimated for the switching regression then becomes

$$(34)\ Y = (I - D)X\beta_1 + DX\beta_2 + \Omega,$$

where $\Omega = (I - D)e_1 + De_2$, a vector of heteroskedastic disturbance terms, with covariance matrix Φ. The log-likelihood function is then

$$(35)\ \ln L = -n/2\ \ln 2\pi\ -1/2 \ln |\Phi|\ -\ 1/2\{[Y - (I - D)X\beta_1 - DX\beta_2]'\ \Phi^{-1}$$
$$[Y - (I - D)X\beta_1 - DX\beta_2]\},$$

which produces maximum likelihood parameter estimates.

The model for z_i is

$$(36)\ z_i = a(L_t - L_{t-1}),$$

where 'a' is a scale parameter. Equation (36) hypothesizes that there will be different parameters for the model based on whether the average weight of fed cattle sold is increasing or decreasing. It is expected that as supplies increase, packers are able to "back up" the showlist (although feeders may play a role in this if they try to hold out for better prices as their breakeven prices increase), and procure heavier cattle, which provides them with greater profit. This will be reflected in increasing average weight in fed cattle transactions, which indicate that packers may be exerting market power and behaving in a more collusive fashion. Conversely, if supplies are shrinking, packers must behave more competitively to reach their minimum cost volume. This will be reflected in decreasing average weights of fed cattle purchased, and may indicate when reversionary periods are occurring.

The margin equation (28) can therefore be estimated by using a switching regressions model with the log-likelihood equation (35). The margin equation under a dual-regime specification becomes

(37) $m_t = c_q^t\gamma + \alpha^{-1}\theta_1 X$ when $(L_t - L_{t-1}) < 0$, and

$m_t = c_q^t\gamma + \alpha^{-1}\theta_2 X$ when $(L_t - L_{t-1}) \geq 0$.

Equation (37) is estimated using the MODEL procedure in SAS for each data set using N2SLS. Likelihood ratio tests are carried out for parameter constancy between regimes.

Having modeled conduct at the industry level, it is now appropriate to attempt to discover individual firm behavior. *Reaction functions* show how packers in the procurement game respond to the strategic decisions of other players. Slade shows how the strategic interaction between players can be inferred from prices

(38) $$p_{it} = p_t^* + R_t \sum_{j \neq i}^{N} (p_{jt-1} - p_t^*),$$

where p_t^* is the "equilibrium" price at time t and R_t is the slope of the intertemporal reaction function. If (38) is rewritten to allow reaction functions to each other player j individually, and the strategy selection is stated in terms of price change responses to other strategic price changes, we have

(39) $$\Delta p_{it} = \sum_{j=1}^{N} R_{ij}\Delta p_{jt-1} + e_t.$$

Equation (39) asserts that firm i reacts to only those strategies chosen by other players in the immediately preceding period. However, it may be appropriate to make two revisions to this formulation. First, the reaction functions should be allowed to take strategies beyond the previous period into account. Second, there is no clear reason why (38) should not be specified with an intercept. Estimation results will determine whether either or both restrictions imposed by Slade are true. The new formulation of the reaction function equation is then

$$(40)\ \Delta p_{it} = \eta_i + \sum_{j=1}^{N} R_{ij}\Delta p_{jt-\chi} + e_t,$$

where χ is the number of past strategy choices of the other j packers taken into account by packer i when making strategy decisions. Packer i's own past strategy choices are also included, as in Slade. This seems appropriate since past strategy choices for a given packer are likely to influence current strategic decisions. Packers are likely to assess the success of past choices in meeting firm goals, and update decisions accordingly.

If packers behave competitively when purchasing fed cattle, then the reaction functions R_{ij} will be close to zero. This would be an indication that firms do not respond to others' choice of strategy when deciding upon their own. Conversely, reaction functions equal to 1 would be evidence of perfectly monopsonistic individual firm behavior, indicating that firm's strategies were set collusively. Positive values for the reaction functions can be associated with successful tacit collusion by the beef packing firms.

Equation (40) is estimated for each data set with ordinary least squares using the AUTOREG procedure in SAS. The final model lag length of rival strategy choices estimated for the reaction functions of each packer is based on statistical significance. For instance, if estimation reveals that packer i reacts significantly to packer j's t^{th} period lagged strategy choice, then the model is estimated for strategic reactions to *all* packers' past t strategy choices. Durbin-Watson statistics indicate that no autocorrelation exists in the residuals; this is not surprising given that the data employed are all in first-difference form. Q-statistic and Lagrange Multiplier tests for ARCH (autoregressive conditional heteroskedastic) disturbances are carried out, and the null hypothesis of homoskedastic error terms is not rejected for the majority of the reaction function equations. Those models that do exhibit heteroskedasticity are re-estimated using a GARCH (1,1) (generalized autoregressive conditional heteroskedasticity) model, which improves the efficiency of the estimates.

Results

Results for the estimation of the system (26) – (28) are presented in Table 2 for each of the three data sets. All of the parameter estimates except for the slope on the supply fucntion for 1996 are significant at the five percent level. Supply response to price varies across the three years. In 1995, the marketing agreement year, supply is more inelastic than in the other two years. Imposition of the marketing agreement resulted in fewer cattle remaining to supply the three packers that were not involved in the agreement. Also, the negotiating strength of the largest packer was altered because it was constrained for a period of time to purchase most of its cattle only from certain feedlots. In 1996, when information was limited during part of the experiment, fed cattle supply was more elastic. This implies that cattle feeders are adversely affected by a lack of information, as they are unable to use market data to better negotiate with packing firms. Anderson et al. find that market efficiency suffers when less information is available. The model for 1994 has a slope parameter that lies between those of the other two years, indicating that supply is more inelastic than when information is limited, but less so than when marketing agreements are imposed.

Negative and significant coefficients on the average weight variables indicate that price decreases as the average weight of fed cattle traded increases. This may reflect the attempts of the feeders, who are aware that heavier cattle are more profitable for packers, to hold out for better prices. These attempts are usually doomed. For the most part, packers are able to avoid paying higher prices for heavier cattle, thus contributing to extra profitability.

The market conduct parameters are significant for each of the three years. The values are all greater than zero, which is the value that would prevail in a perfectly competitive market. Estimation of the model for the 1994 data produces a market conduct parameter of 1.655, which is considerably higher than the Cournot value of 1.0 and approaches the monopsonistic value of 2.0. This indicates that beef packers were able to tacitly collude as if to form an effective cartel that paid prices lower than the competitive levels. The impact of the marketing agreement in 1995 reduced the ability of packing firms to behave collusively relative to the other two years. This is contrary to many captive supply scenarios, but consistent with the results of Ward et al. (1998) and Ward et al.(1999), who found that transaction prices were higher but more variable during marketing agreement periods. A conduct parameter for that year of 1.025 suggests that packer behavior was very close to Cournot conduct. This implies that packers were not able to achieve payoffs in the repeated game that were significantly different than those which would have come about in the single period game.

The effects upon industry conduct of restricting market information in the 1996 experiment are less clear. The market conduct parameter is 1.579, which is closer to the perfectly monopsonistic level than to the Cournot level. Although feedlots appear to be adversely affected by limited market information, packers collude less effectively than in 1994, which may indicate that limited market information also hindered their ability to exert market power. Evidence has been found that certain types of market information can foster market power. Albaek, Mollgaard, and Overgaard find that collusion in the Danish concrete industry increased after specific transactions prices began to be published. Wachenheim and DeVuyst hypothesize that the same may happen if mandatory price reporting is fully implemented in the U.S. fed cattle industry. Bastian, Koontz, and Menkhaus find that price levels and dispersion were reduced when mandatory pricing was introduced into the FCMS. For the 1996 experiment, it seems that neither the packers nor the feedlots benefited substantially from limiting market information. This may indicate that calls for mandatory price reporting in the real market are unfounded. It is generally assumed that more market information will enhance efficiency, but that hypothesis is not supported by the evidence discovered here.

Table 3 shows the results of the switching regression margin equation (37) incorporating the log-likelihood function (35). Market conduct parameters are significant for both regimes for each of the three years. The results for 1994 imply that during collusive regimes, in which the parameter is 1.891, packers are able to act in a manner that is close to perfectly monopsonistic. During reversionary periods, the parameter is lower at 1.448, but this is still much higher than the Cournot, and especially the competitive value. A likelihood ratio (LR) test indicates that the values for the parameter in collusive and reversionary periods are statistically different. In 1995, when collusion is hampered by the imposition of a marketing agreement, the collusive and reversionary period parameters are 1.209 and 1.033, respectively. They are not found to be significantly different; nevertheless, the results support the hypothesis that packers are able to behave more collusively as average weights increase.

The results for 1996 are different from the other two years. It is found that conduct actually is *less* collusive when average weights are rising (1.270) than when they are falling (1.624). This, too, may be a result of limiting the information available to market participants, creating a market which functions less efficiently. Packers use (imperfect) market information to infer the conduct of their rivals in the repeated game. If this already imperfect information is withheld, the ability of packers to assess whether the cartel is in a collusive or reversionary stage is hampered. Given that the LR test fails to reject the hypothesis that the market conduct parameters are equal, it may be that information to packers is too imperfect for them to infer their rivals' strategies.[11] It may also be that with less information, feedlots do not behave as expected. Anderson et al. found this to be the case. This, too, could cause packer reactions to vary from those that would be expected. Nevertheless, the estimated parameters are well above those that would be expected in a competitive or Cournot market, and provide further evidence that beef packers are able to successfully collude in the fed cattle market.

Reaction function coefficients for 1994, 1995, and 1996 are given in Tables 4, 5, and 6, respectively. Several significant reaction function parameters are evident in Table 4. Each of packers 1, 2, and 4 react to the strategy choices of packer 3. This may indicate that packer 3 is a dominant firm price leader in the Stackelberg sense. Packer 3 itself reacts to the pricing decisions of each of the other three players at either one or two lags, and packer 4 has significant reaction functions for all the other packers at one lag. Each of the smallest two packers reacts only to packer 3. These results taken together provide evidence of collusive conduct in the experimental fed cattle market for that year. The largest two beef packing firms consider strategic choices of all the other firms, and even the smaller firms, which possess less market power, are able to do so. These results support the evidence of collusion presented in Tables 2 and 3 for the 1994 data.

Inspection of Table 5 reveals evidence of collusive behavior by packers in the 1995 experiment, although it is not as widespread as in 1994. Packer 2 shows the most evidence of collusion; it has significant responses to strategy decisions by both packers 3 and 4. The two largest packers appear to react to each others' pricing strategies. The smallest packer does not appear to be able to exert much market power; this is not surprising given its smaller size. Interestingly, it neither behaves collusively nor does any other firm appear to take its strategies into account when making their own decisions. It is not surprising, then, that packer 1 experiences an operating loss over the course of the experiment.[12] Overall, packer 3 strategic decisions are, as in 1994, again the ones which are most frequently considered by other firms, and packer 3 again emerges as the Stackelberg leader in the game.

The reaction functions shown in Table 6 exhibit less evidence of collusive conduct than did those for the previous two years. Packer 1 has a significant response to packer 2, and packer 4 is found to react to packers 1 and 3. This reaffirms the hypothesis that collusive behavior is more difficult to undertake when market information is limited. A natural question arises over the apparent contradiction between Table 2 and Table 6 results for 1996: why is the industry conduct parameter nearly as high as for 1994, whereas the individual reaction functions indicate decidedly less evidence of collusion? It may be that limiting information available to market participants seriously affects packers' ability to respond to each others' strategic decisions, but is less harmful to the ability of the overall cartel to behave collusively. A second possibility is that it does not take as much individually collusive behavior to achieve overall industry collusion as may be presumed. That is, overall industry conduct may discover and maintain price and quantity *levels* that are not reflected in significant individual conduct *changes* for packers.

Summary and Conclusions

The goal at the outset of this paper was to develop and estimate a game theoretic model of industry conduct and supergame strategies in a dynamic oligopsony. Data from an experimental market for fed cattle for three different years were used because real market data were not made available to researchers. A non-cooperative, infinitely repeated game of beef packer procurement was developed in which players were hypothesized to behave differently depending on fed cattle supply conditions and strategic considerations within the game. Player goals were assumed to be maximization of a discounted stream of processing profits.

Estimation of a three equation system for fed cattle supply, average procurement weight, and processing margin revealed that beef packing firms are able to achieve various levels of successful tacit collusion, as measured by an industry conduct parameter. Using a switching regressions approach, it was further discovered that the level of collusive behavior in such a framework varies according to supply conditions for fed cattle. Even at its most competitive, however, industry conduct is still substantially more collusive than would be the case under perfect competition. The most competitive behavior discovered followed a Cournot pattern. Packer conduct was also modeled at the firm level using a reaction function framework. Results of that method displayed collusive behavior, which varied by year and by firm, at the individual packer level.

It was found that market conditions imposed by experimenters had important effects on the ability of packers to successfully collude. In the second year of the experiment, a marketing agreement imposed between the largest packer and two feedlots substantially reduced the collusiveness of that firm and of the industry as a whole. Firms were not able to exceed Cournot levels of collusiveness in that year. In the third year, limits were placed on the amount and types of market information made available to participants. It appears that this restriction weakened the bargaining position of both packers and feeders, and made it more difficult for packers to interpret whether their cartel was in a collusive or reversionary state. Levels of collusion as measured by industry conduct were still high, which may suggest that market information is more important to cattle feeders than cattle buyers. Overall, conduct of beef packers in the experimental market is consistent with what might be expected of cartel members following a trigger price strategy. Exertion of market power by packers is exhibited at both the industry and individual firm level.

Possession of individual transaction price and cost data are two major advantages of the experimental simulation approach, and allow for more precise estimation of industry and individual conduct than has been carried out in previous research. The structure of the experimental market closely resembles that of most real market procurement regions, so it is not unreasonable to suppose that given similar conditions, firms in the real market behave in similar ways. If this is the case, then the evidence discovered here supports the claims of those cattle industry stakeholders who assert that beef packers are able to extract excess rents from cattle feeders and in turn, from producers. The issue cannot be put to rest until regulators exhibit a willingness to provide the data they possess to researchers.

Notes

1. It is important to note that only packers participate in the game. The game is played among packers, *not* between packers and cattle feeders.

2. The Cournot solution is often referred to as the "quantity setting" solution, and is viewed as the intermediate result between perfectly competitive and perfectly monopsonistic behavior. In a perfectly competitive setting, changes in quantity purchased by one firm are offset perfectly by changes in quantity purchased by other firms, and net purchases are unchanged. In a perfectly monopsonistic setting, such a quantity change by one firm is matched perfectly by other firms, effectively restricting purchases to a higher or lower amount. In the Cournot setting, firms take each others' output as given, and a change in the quantity purchased by one firm has no effect on the quantities purchased by all other firms.

3. It can be shown that for some classes of games with finite planning horizons, equilibrium points, such as the trigger strategy equilibrium discussed in this paper, resemble those in a game with an infinite planning horizon.

4. Such games are sometimes referred to as having *strategic time dependence.*

5. Four features of an industry are required for the Green and Porter model to apply. First, the industry must be stable over time. Second, output quantity is the only decision variable firms can manipulate. They cannot divide the market regionally or differentiate their product. Third, information about the industry and its environment is public knowledge. Fourth, the information used by players to monitor whether the game is in a collusive or reversionary period (market price) must be imperfectly correlated with actual firm behavior (quantity procured).

6. If cattle are not sold during the week in which they appear on the showlist at 1200 lbs, they are automatically sold to a hypothetical fifth packer at a heavy price discount. The effective marketing window is therefore five weeks (1100, 1125, 1150, 1175, and 1200 lbs).

7. This is because $\phi = \sum_{j \neq i}^{N} dx_i / dx_j$, the conjectural variation of any firm, must fall between 1 and -1. If ϕ = -1, this implies perfectly competitive conjectural variations: each one unit reduction in output by a firm is compensated for by an increase in one unit of output by other firms. This is often referred to as the Bertrand solution. On the other hand, ϕ = 1 implies perfect collusion: firms match each others' quantity restrictions to achieve the monopsony solution. The intermediate case is the Cournot solution, where ϕ = 0. In such a scenario, firms do not respond at all to each others' quantity changes. The estimation methods employed here do not require the conduct parameter to fall between 0 and 2, it is a theoretical rather than empirical restriction.

8. Feedlots minimize breakeven costs for cattle feeding at 1150 lbs in the market simulator, and strive to sell their cattle at that weight. Packers, on the other hand, have lower per-pound slaughter and fabrication costs, the heavier the cattle they procure. As such, the average weight variable is an indication of supply conditions, and who is "winning" and "losing" in price discovery negotiations between packers and feeders. Packers win when supplies are plentiful, and they are able to drive up the average weight of cattle they buy. Feeders win when supplies are tight, and they are more able to keep sale weights in the range that is favorable to them (Lyford et al.).

9. Firm 1's share is 8/40, firm 2's is 9/40, firm 3's is 11/40, and firm 4's is 12/40.

10. Sometimes it is possible to observe changes between regimes. Porter's analysis of industry behavior in the Joint Executive Committee from 1880 to 1886, when collusion was overt, is an example.

11. It may also be the case that average weight, the variable chosen for z_i in equation (36) is not indicative of conduct for 1996. Other variables for z_i were tried, but the results did not change.

12. For the 1995 data, the average profit per head processed for packers 1 through 4 is ($1.34), $9.81, $11.28, and $15.96, respectively.

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Table 1. Summary Statistics, FCMS Data, 1994-1996

	1994	1995	1996
Trading Periods	72	92	60
Transactions	2,664	3,450	2,197
Average Price	78.42	78.66	78.31
Std. Dev.	3.77	3.34	3.62
Average Quantity	36.99	37.50	36.67
Std. Dev.	6.28	5.57	7.61

Table 2. Nonlinear Two-Stage Least Squares Estimates for Supply and Margin Equations, 1994-1996

Parameter	1994	1995	1996
Supply Intercept	69.795* (11.642)	69.919* (15.659)	94.382* (21.804)
Price/COG	0.661* (0.301)	0.425* (0.256)	0.746 (0.512)
Average Weight	-10.27* (1.567)	-10.666* (2.179)	-14.542* (2.787)
Market Conduct	1.655* (0.113)	1.025* (0.072)	1.579* (0.264)
MA(1)	-	-0.116 (0.401)	-0.566* (0.125)
MA(2)	-	-0.438* (0.012)	-

Notes: Standard errors are given in parentheses. Asterisks denote significance at the α = 0.05 level.

Table 3. Maximum Likelihood Estimates for Switching Regressions Margin Equations, 1994-1996

Parameter	1994	1995	1996
Market Conduct (reversionary)	1.448* (0.149)	1.033* (0.106)	1.624* (0.238)
Market Conduct (collusive)	1.891* (0.154)	1.209* (0.097)	1.270* (0.324)
χ^2 statistic (test $\theta_1 = \theta_2$)	4.07* (0.044)	0.91 (0.341)	0.69 (0.408)
χ^2 statistic (test $\sigma_1^2 = \sigma_2^2$)	1.54 (0.215)	1.62 (0.203)	0.29 (0.590)

Notes: Standard errors are given in parentheses for market conduct parameters. p-values are given in parentheses for test statistics. Asterisks denote significance at the $\alpha = 0.05$ level.

Table 4. Ordinary Least Squares or GARCH Estimates, Beef Packer Reaction Functions, 1994

Parameter (response to)	Packer 1	Packer 2	Packer 3	Packer 4
Intercept	0.053 (0.086)	0.034 (0.080)	0.038 (0.101)	0.065 (0.125)
Packer 1	-0.109 (0.132) -	0.326** (0.155) -	0.212 (0.136) 0.288** (0.125)	0.286* (0.149) -
Packer 2	0.136 (0.114) -	-0.204 (0.158) -	0.266** (0.117) -0.180 (0.126)	0.260** (0.130) -
Packer 3	0.497** (0.126) -	0.587** (0.165) -	0.015 (0.129) -0.268** (0.130)	0.340** (0.144) -
Packer 4	0.110 (0.113) -	0.071 (0.126) -	0.096 (0.117) 0.239** (0.112)	-0.306** (0.128) -
ARCH0	-	0.653** (0.148)	-	-
ARCH1	-	0.242 (0.190)	-	-
GARCH1	-	0 (0.00)	-	-

Notes: Two estimates are given for packer 3 because that was the lag length of rival strategies considered. Standard errors are given in parentheses. Single and double asterisks denote significance at the $\alpha = 0.10$ and $\alpha = 0.05$ levels, respectively.

Table 5. Ordinary Least Squares or GARCH Estimates, Beef Packer Reaction Functions, 1995

Parameter (response to)	Packer 1	Packer 2	Packer 3	Packer 4
Intercept	-0.022 (0.062)	-0.025 (0.139)	-0.024 (0.135)	-0.020 (0.080)
Packer 1	0.097 (0.237)	0.053 (0.144)	0.077 (0.141)	-0.090 (0.194)
Packer 2	0.122 (0.130)	-0.271* (0.140)	0.240 (0.137)	0.054 (0.136)
Packer 3	0.246 (0.178)	0.333** (0.160)	-0.333** (0.155)	0.397* (0.207)
Packer 4	0.180 (0.160)	0.367** (0.141)	0.262* (0.137)	0.272 (0.172)
ARCH0	0.601 (0.701)	-	-	1.427** (0.047)
ARCH1	0.235 (0.247)	-	-	0 (0.00)
GARCH1	0.345 (0.657)	-	-	0.028 (0.069)

Notes: Standard errors are given in parentheses. Single and double asterisks denote significance at the $\alpha = 0.10$ and $\alpha = 0.05$ levels, respectively.

Table 6. Ordinary Least Squares or GARCH Estimates, Beef Packer Reaction Functions, 1996

Parameter (response to)	Packer 1	Packer 2	Packer 3	Packer 4
Intercept	0.084	0.100	0.056	0.067
	(0.026)	(0.203)	(0.162)	(0.053)
Packer 1	-0.060**	0.033	0.077	0.289**
	(0.141)	(0.116)	(0.092)	(0.067)
	-	-	-	-0.027
				(0.082)
Packer 2	0.578**	0.159	0.189	0.065
	(0.142)	(0.162)	(0.129)	(0.095)
	-	-	-	0.037
				(0.100)
Packer 3	0.201	0.266	0.024	0.456**
	(0.241)	(0.174)	(0.139)	(0.139)
	-	-	-	0.028
				(0.063)
Packer 4	-0.123	-0.068	0.111	0.427**
	(0.184)	(0.198)	(0.158)	(0.161)
				-0.742**
				(0.127)
ARCH0	2.090**	-	-	0.062
	(0.067)			(0.110)
ARCH1	0	-	-	1.566**
	(0.00)			(0.726)
GARCH1	0.020	-	-	0
	(0.142)			(0.00)

Notes: Two estimates are given for packer 4 because that was the lag length of rival strategies considered. Standard errors are given in parentheses. Single and double asterisks denote significance at the $\alpha = 0.10$ and $\alpha = 0.05$ levels, respectively.

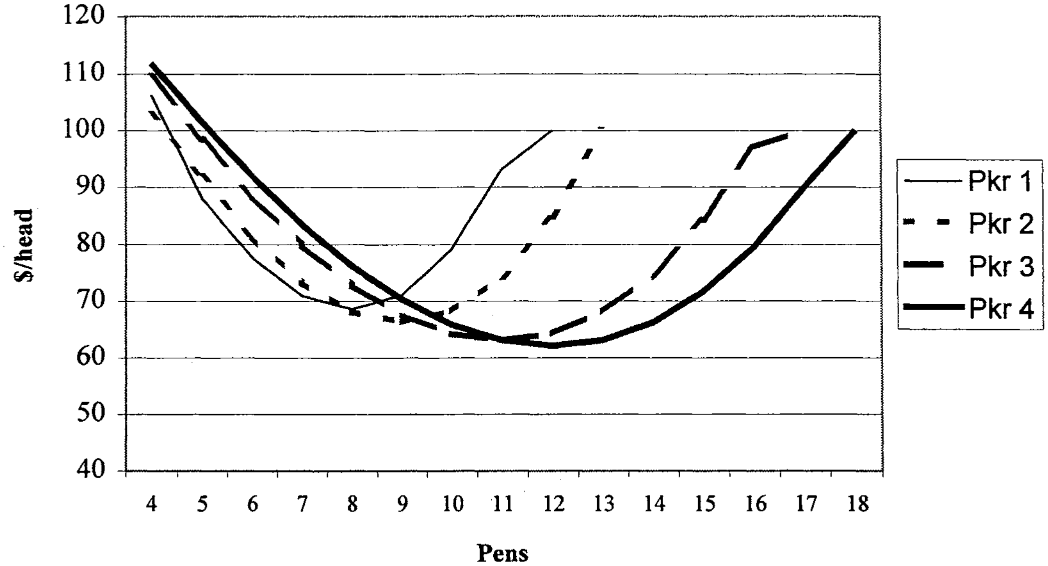

Figure 1. Average Total Processing Cost Curves, All Packers

II. Alternative Approaches to Livestock Price Discovery: Theory and Empirical Estimates

Introduction

Commodity prices have traditionally been an area of concern for those involved in the supply chain for such products. Allegations of unfair pricing practices via the use of market power in many markets for agricultural products have been particularly prevalent. As such, there are persistent calls for the calculation of a "fair" price: one which would presumably prevail in a market governed solely by competitive forces. Accordingly, researchers have long striven to better understand and describe the process by which market prices are obtained. The focus of this paper is upon issues surrounding the discovery of prices in livestock markets.

Much has been written about determining and discovering prices, but rarely is a specific distinction between the two explicitly noted. *Price determination* is the process in which the broad forces of supply and demand interact to clear the market and allow sellers and buyers to trade a given quantity of a specific good at the determined price (Thomsen and Foote). Textbook econometric theory focuses largely on this process. But given imperfect and asymmetric information, costly transactions, heterogeneous products, and thin, spatially dispersed markets, rarely is the process of price determination that simple. It is more likely, as Schroeder and Ward note, that due to these sources of variability, supply and demand "bands" exist, and the theoretical supply and demand curves may lie anywhere within these bands. As such it is possible that no one true equilibrium price exists across regional markets for a given time period due to the disequilibrating factors listed above. Figure 1 shows how supply and demand bands rather than curves might appear.

Price discovery differs from price determination, and is the process of market traders ascertaining a price for a certain quantity of a good with specific characteristics (Thomsen and Foote). Price determination creates a neighborhood of discoverable prices, for instance the area comprising the intersection of the demand and supply bands in Figure 1, and the price discovery process finds a price within this neighborhood. For example, the supply of and demand for beef interact to establish a general daily or weekly price level for fed cattle, but the quality characteristics of each animal or lot of animals cause a specific transaction price to be discovered. Price determination and price discovery are thus closely related, but distinct concepts.

Schroeder et al. (1998) note several reasons why research on livestock price discovery is critically important to industry stakeholders. One of the most important is that large numbers of animals are still priced on averages, rather than based on the value of each carcass. For example, a beef packer might purchase an entire showlist from a cattle feeder at a single, average liveweight price, although the value of each individual carcass cannot be determined until after an animal is slaughtered. The same price is thus paid for high quality animals as for low quality animals. This type of pricing, although economical from the standpoint of transaction cost minimization, introduces inefficiencies into the livestock pricing system and hinders transparency of the price signal received by livestock producers. Exacerbating the problem is the fact that once a price is established, there is a tendency for market participants to want to trade more animals at that price. The result is that a large number of animals are traded at an average price which may not accurately represent the value of each carcass to its end-use market. Since prices are relied upon as sources of considerable information (Stigler; Garbade, Pomrenze, and Silber), prices which do not fully reflect the value of the underlying commodity are providing misleading information to industry stakeholders about which characteristics are valued most in their commodities. Accordingly, considerable inefficiency can be introduced into any market in which price discovery is not well understood.

Although a good deal of empirical work for livestock price discovery has been carried out, no study has proposed alternative theoretical bases for price discovery and compared empirical results of such alternative theories using a common data set. That is the objective of this paper. First, a "derived demand" model, which hypothesizes that the transaction price is a function of supply and demand factors as well as attributes of the lot of livestock in question, is developed and presented. Next, a "partial adjustment/market efficiency" model, which asserts that transaction prices are slow to adjust because of rigidities and change from recent values partly because of new information entering the market, is derived. It is hoped that by exploring these distinct theoretical bases, a better understanding of the factors most importantly affecting livestock price discovery can be gleaned. The empirical portion of the paper is aided by data from an experimental fed cattle market.

Numerous studies using data from the real fed cattle market have attempted to determine the factors that are important in price determination/discovery. Ward (1981, 1982) includes carcass price and value, futures price, quality grade, dressing percentage, live weight, sex, lot size, forward contracting, bargaining price range, number of bids and buyers, specific buyers, trends, and region as variables in his early fed cattle price discovery work. Jones et al. include many of the same factors but add yield grade, finish uniformity, squared live weight, weight uniformity, breed, days of feed, distance from packer, number of sellers, and day of the week. Schroeder et al. (1993) consider some of the same variables as their predecessors, but also include marketings in their model. Ward, Koontz, and Schroeder further find that the use of precommitted supplies by packers has a small negative effect on transactions prices.

A good deal of research has also been carried out using data from the experimental fed cattle market (Ward et al. 2001). This market, described in the Experiment and Data section below, is designed to function in ways that are similar to the real market, but it can provide readily available data in a more timely fashion than can the real market. Ward et al. (1996) include lagged boxed beef price, lagged futures market price, total show list, lagged marketings, and potential profit or loss in their price discovery model for the experimental market. Indicator variables for specific packers, feedlots, transaction type (cash or forward) and weight classes are also included. Anderson et al. investigate the effects of reducing public price and quantity information on prices in the experimental market, and find that the absence of current market information created market inefficiencies by increasing price risk and decreasing production efficiency.

The effects of imposing a marketing agreement onto the experimental market are reported by Ward et al. (1999). They find that transaction prices are higher but more variable during agreement periods than during non-agreement periods. Ward and Lee investigate the effects of imposing mergers between different beef packers in the experimental market, and observe, unexpectedly, that prices *increase* during merger periods.[1] Profits of the merged firm also increase, perhaps due to increased efficiency within the merged firm. Lyford et al. (2001) estimate the effects of increased levels of contracting within the experimental market, and find that greater variability of cash prices results. No clear effect upon price levels is found.

The next section of the paper presents the derived demand and partial adjustment/market efficiency models that will be used. After that, the data employed and the experiment used to generate them are discussed. The following section outlines the procedure used; subsequently, results are presented and discussed. Finally, the paper is summarized and conclusions are drawn.

Theory

Final consumers of a good determine the shape and position of the demand function in the retail market. Consumers of beef, for instance, have individual demand schedules for various cuts possessing certain characteristics pertaining to flavor, tenderness, and other attributes. These demand schedules for various characteristics can be aggregated over consumers to allow a single retail demand function for beef to be conceptualized. This demand for finished beef products at the retail level is often called the "primary demand" for beef.

"Derived demand" is the demand for inputs used in the production of those goods for which primary demand exists. Without the demand for a finished product, there would be no demand for the inputs to the production process that creates the finished product; hence, the demand for inputs is *derived* from the demand for finished products. As Tomek and Robinson note, primary and derived demand differ by the amount of marketing and processing charges per unit of product. Numerous derived demand markets for inputs to a consumer good may exist: for instance, there is a derived demand for beef at the wholesale level, in the fed cattle market, and also at the stocker and producer levels. Demand at each of these levels is derived from the primary demand for beef in the retail market.

Ladd and Martin further refine the concept of derived demand by showing how the price of an input is the sum of the values of that input's characteristics to the purchaser. Suppose the production function for boxed beef is written

(1) $Q_B = F_B(\varphi_{1B}, \varphi_{2B}, \ldots \varphi_{mB})$,

where Q_B is the quantity of boxed beef produced by a beef packer, and the φ_{jB} are the j=1, 2, ..., m input characteristics used in producing Q_B. The equation then states that the quantity of boxed beef produced depends upon the amounts of various input characteristics used to produce it. If $x_{1B}, x_{2B}, \ldots x_{nB}$ are the quantities of inputs, including fed cattle, used to produce Q_B, then the total amount of the j^{th} input characteristic used in production can be written

(2) $\varphi_{jB} = \Omega_{jB} (x_{1B}, x_{2B}, \ldots x_{mB}, \varphi_{j1B}, \varphi_{j2B}, \ldots \varphi_{jnB})$,

where φ_{jiB} is the quantity of characteristic j that enters into the production of boxed beef through the use of one unit of input i. The production function (1) can then be rewritten

(3) $Q_B = G_B(x_{1B}, x_{2B}, \ldots x_{mB}, \varphi_{11B}, \varphi_{12B}, \ldots \varphi_{mnB})$.

Assuming for simplicity that the beef packing firm is a single output firm, its profit function is

(4) $\Pi = P_B F_B(\varphi_{1B}, \varphi_{2B}, \ldots \varphi_{mB}) - \sum_{i=1}^{n} r_i x_{iB}$,

where P_B is the price of boxed beef and r_i is the price of input i.

The profit maximizing use of input i is then given by the first-order condition

$$(5)\ \partial\pi / \partial x_{iB} = P_B \sum_{j=1}^{m} (\partial F_B / \partial\varphi_{jB})(\partial\varphi_{jB} / \partial x_{iB}) - r_i = 0,$$

and the price of input i is

$$(6)\ r_i = P_B \sum_{j=1}^{m} (\partial F_B / \partial\varphi_{jB})(\partial\varphi_{jB} / \partial x_{iB}).$$

In this formulation, $(\partial\varphi_{jB} / \partial x_{iB})$ is the marginal yield of j in the production of boxed beef from the i^{th} input, and $(\partial F_B / \partial\varphi_{jB})$ is the marginal product of one unit of j used in producing boxed beef. Accordingly, $P_B \times (\partial F_B / \partial\varphi_{jB})$ is the value of marginal product for j used in boxed beef production, and can be interpreted as an imputed price paid for that characteristic. If the imputed price is designated as T_{jB}, (6) can be rewritten as

$$(7)\ r_i = \sum_{j=1}^{m} T_{jB} (\partial\varphi_{jB} / \partial x_{iB}),$$

which says the price paid for each input to boxed beef production (including fed cattle) is the sum of the marginal yield values for that input's useful characteristics to boxed beef.

In the fed cattle market, heterogeneous lots of cattle will contain different amounts of desirable characteristics. For example, cattle from two different weight groups might be processed into different amounts of boxed beef. Since saleable boxed beef is produced by using the useful characteristics contained in fed cattle, cattle of different weights are worth different amounts of money per live hundredweight. Ladd and Martin summarize the product characteristics approach to derived demand for inputs in two themes: (1) the price of an input equals the sum of the values of the characteristics of that input to the purchaser, and (2) input demand is affected by that input's characteristics. If these themes hold, the characteristics of the input in question—for the purposes of this essay, fed cattle—determine its value in the product (retail) market. Accordingly, the same characteristics determine its value in the fed cattle market. The derived demand model for the fed cattle market should thus include any variables which capture the overall industry demand for fed cattle, as well as any variables which relate specifically to the characteristics of particular lots of animals. Of course, other factors, particularly those relating to industry current and expected supply conditions, must be included to ensure the derived demand model is fully specified.

A second distinct theoretical framework for livestock price discovery stems from the "partial-adjustment" (PA) model, and has been used extensively for empirical estimation. The PA model has been developed into its modern form by Nerlove (1956a, 1956b, 1958a, 1958b), who attempts to derive accurate estimates of supply and demand elasticities for agricultural products. He argues that short-run elasticities cannot be accurately measured because they correspond to a single point in time only, and that estimation of long-run elasticities is difficult because of constantly changing prices and adjustment paths. As a result, he advocates a dynamic model over a static one, and argues that dynamic models are better at explaining data, produce coefficients that are more reasonable in sign and magnitude, and generate residuals that exhibit less serial correlation.[2]

To capture the dynamic aspects of agricultural supply and demand, Nerlove employs a distributed lag model. He assumes a behavioral model which implies a single period distributed lag only incidentally, rather than testing for significance at varying lag lengths. Assuming static expectations, he postulates that the quantity of a commodity demanded changes only in proportion to the difference between the long-run equilibrium quantity desired and the current quantity demanded (1958a). To derive this result, he begins with a long-run demand function,

(8) $q^*_t = a + bp_t + cy_t$,

where q^*_t is the long-run equilibrium quantity demanded, p_t is the current price, and y_t is current income.[3] This equation cannot be estimated directly since q^*_t is not observable. But if the relation between the current quantity q_t and the long-run equilibrium quantity is given by the difference equation

(9) $q_t - q_{t-1} = \gamma\,(q^*_t - q_{t-1})$,

where γ is the coefficient of adjustment, then the first expression can be substituted into the second to obtain

(10) $q_t = a\gamma + b\,\gamma p_t + c\gamma\, y_t + (1-\gamma)q_{t-1} + u_t$,

which is an equation in autoregressive form, and is therefore estimable.

PA models are widely used because of the intuitive appeal of the notion that quantities and prices adjust slowly over time to new conditions. Use of such models is common in agricultural supply analysis. Askari and Cummings survey over six hundred studies that employ the Nerlove formulation for various agricultural commodities, including beef. PA models are also common for analysis of macroeconomic variables. For the fed cattle market, it seems intuitive that adjustment of quantities produced to recent prices cannot be instantaneous. The biological production lag for cattle, technological rigidities, habit inertia, asset fixity, resource control, and institutional constraints all contribute to a gradual adjustment process. This gradual adjustment process is often cited as justification for inclusion of a lagged dependent variable in regression models.

Inclusion of the lagged dependent variable in the PA model has been the subject of much discussion. Waud asserts that the appropriate specification of Nerlove's model is

$$(11)\ q_t = a\gamma\delta + b\gamma\delta p_t + c\gamma\delta y_t + [(1-\delta)+(1-\gamma)]q_{t-1} - (1-\delta)(1-\gamma)q_{t-2} + u_t$$

and that (10) is simply a special case of this expression where $\delta = 1$, representing the case where expectations are static in the adaptive sense. He notes that the users of the PA model implicitly assume that expectations are formed thusly, since they are not specified explicitly as being formed in any other way. If the value of either δ or γ is one, then the coefficient on q_{t-2} will not be significant, and the PA model is the appropriate specification. As will be discussed next, it is appropriate for the purposes of this paper to impose a value of one for δ, thus the PA model will be proper for estimation.

Fama is widely credited with relating the level of efficiency in a market to the ways in which prices of assets in that market reflect different types of information. An efficient market, he explains, is one which fully reflects all available information. He develops "weak", "semi-strong", and "strong" form tests of efficiency for markets where prices reflect historical, current public, and all relevant (including non-public or insider) information, respectively. Sufficient (but not necessary) conditions for market efficiency are (i) no transactions costs in trading, (ii) complete, costless information is available to all participants, and (iii)implications of current information for current and future prices is agreed upon by all participants.

The relevance of the market efficiency model to the fed cattle market can be seen by outlining the relationship between information and prices in Fama's work. Consider the relationship

(12) $E(p_{j,t+1}|\Phi_t) = [1 + E(r_{j,t+1}|\Phi_t)]p_{j,t}$

where E is the familiar expectational operator, $p_{j,t}$ is the price of the asset[4] at time t, $p_{j,t+1}$ is the analogous price at time (t + 1), $r_{j,t+1}$ is the single-period percentage return on the asset, and Φ_t is the available information set in time period t. The expression states that the expected price of the asset in the next period depends only on the expected return to the asset, *given a specific information set.* If the expected return to the asset is realized, then, the expected price of the asset in period (t + 1) will be realized *unless the information set changes*. It must then be the case that changes in information are responsible, in part, for changes in the price of an asset between periods.

Garbade, Pomrenze, and Silber find that observed prices contain considerable information, and that market participants are alert to the quality of the information contained in those prices. In the context of Fama's market efficiency hypothesis, then, observed prices form part of the information set Φ_t upon which future prices are conditioned. Analogously, the previous period's observed prices have an effect on the current period's prices insofar as they are part of the relevant information set. Market participants derive important information about current expected prices from lagged prices, and lagged prices are therefore appropriate to include in the price discovery model. If Fama's market efficiency concept is applied to livestock price discovery, then, it can be seen that the PA model is appropriate, given the important role played by the information contained in the lagged price.

Experiment and Data

Data from the real fed cattle market are often difficult to obtain. The proprietary nature of many agribusiness data, particularly in the modern climate of increased consolidation, often means researchers have problems to address but little information with which to proceed. The Fed Cattle Market Simulator (FCMS), an experimental market for fed cattle, was developed at Oklahoma State University to mitigate the problem of a lack of data on transactions between beef packers and cattle feeders. The FCMS has been used as an aid in teaching, research, and extension. Ward et al. (1996) provide an in-depth description of the FCMS.

The FCMS follows the experimental simulation approach. Four teams of two to four people assume the roles of beef packing firms and eight more teams manage simulated cattle feedlots. Each of the twelve teams has the goal of maximizing profits for its firm. Optimizing behavior on the part of participants is encouraged through periodic "updates" on the best and worst performing packer and feeder teams, respectively, as well as through the awarding of traveling trophies at regular intervals. The packer and feeder teams trade paper lots of 100 head of fed cattle in seven minute open negotiation trading sessions, in which members of the packer teams travel around the trading room to visit various feedlot teams in order to procure the cattle needed to ensure their plants run at or near the minimum-cost slaughter volume. Each of these trading sessions represents one week in the real fed cattle market. Firms may trade fed cattle on a cash or forward delivery basis and may also participate in futures market hedging and/or speculating. As these open negotiation trading sessions proceed, cash and futures market information is provided to the entire group of participants on electronic displays. A cyclical cattle supply, intended to resemble the real fed cattle market, is part of the structure of the FCMS. Cattle are placed on feed at 700 lbs., gain 25 lbs. per week, and appear on the fed cattle market showlist at 1100 lbs. Cattle remain on the showlist until they are sold or reach a weight of 1200 lbs.; if they are not sold by the end of the trading session in which they have attained that weight, the FCMS automatically sells them to a hypothetical fifty packer at a heavily discounted price. Packers prefer to purchase heavier cattle because of cost and processing economies associated therewith. Feeders, conversely, aim to sell fed cattle at 1150 lbs., which mimimizes their breakeven cost.

Packers in the FCMS purchase fed cattle as inputs and produce boxed beef and byproducts as their outputs. The boxed beef price is based on a real market demand function and varies inversely with the number of lots and the weight of cattle traded. It relates the supply of fed cattle and their weight to the demand for beef from the wholesale market and thus is an important component of the derived demand price signal received by packers and feeders. Feeders' inputs consist of the feed required for their cattle to gain the requisite 25 lbs. per week, and the cost of feeder cattle, which varies inversely with supply. Output from the feedlots is fed cattle sold to packers. Feeders calculate and monitor the breakeven price for their cattle in an effort to turn at least a small profit. The total profits available to the industry vary as the supply of feeder cattle varies and as the boxed beef price varies.

The FCMS was structured to resemble a real market fed cattle procurement region, in which feeders are usually more numerous than packers. As such, it is more difficult, *ceteris paribus,* for feeders to exert market power to drive up the price of fed cattle than it is for packers to drive the price down. It is the ability to affect market prices in times of high or low supply or demand that determines the overall profitability of the two types of firms (Lyford et al. (2002)). The cattle feeding firms are homogeneous in structure, but the four packers are not; each packer has a unique minimum-cost slaughter volume, ranging from eight to twelve lots per week. The most successful packers tend to procure very close to their minimum-cost slaughter volume on a period-to-period basis.

The FCMS generates data that occur in cross-sectional time series. Anywhere from twenty to fifty lots of cattle may be traded in a given trading session; the average over a semester-long period is between thirty-six and thirty-seven. Data for this study are taken from experimental sessions that took place over single academic semesters during each of 1994, 1995, and 1996. Agricultural economics, animal science, and agricultural education students participated in the experiments. Total trading weeks varied slightly over the three years, thus only the common transaction periods are included here, allowing for direct comparison of the estimated coefficients. During the sixty common transaction periods, 2,198 transactions took place during 1994, 2,210 during 1995, and 2,197 during 1996. Summary statistics for the three years' data are shown in Table 1. Carlberg and Ward use ANOVA to test the hypothesis that the data generated in each of the three years are not significantly different. The hypothesis is not rejected.

Procedure

Jones et al. assert that since the short-run supply of cattle is inelastic, the derived demand model for cattle can be expressed in price-dependent form. The model must include those variables that capture the input demand characteristics of fed cattle, as well as other variables theoretically justified by their effects on transaction prices in the experiment. Accordingly, the derived demand model is specified as

$$(13)\ PR_{it} = \beta_0 + \beta_1 BBP_{t-1} + \beta_2 FUT_{t-1} + \beta_3 MKT_{t-1} + \beta_4 TSL_t + \beta_5 WT_{it}$$

$$+ \sum_{k=1}^{2} \beta_{6k} DTYPE_{ikt} + \sum_{l=1}^{4} \beta_{7l} DPCKR_{ilt} + \sum_{m=1}^{8} \beta_{8m} DFDR_{imt} + e_{it},$$

where the variables are as defined in Table 2. Lagged boxed beef is included because it is the mechanism through which demand conditions at the wholesale (and hence retail) markets are coordinated with supply conditions in the fed cattle market. This variable should have a positive coefficient; as the boxed beef price increases, packers are able to pay more for fed cattle. The boxed beef price is lagged in the model because the most recent period's price is the information most useful to participants for price discovery. The lagged futures price is also included; it provides an indication of expected market conditions and forms part of the information set used to calculate expected prices. The lagged futures price coefficient is also expected to be positive.

Two variables which capture the supply conditions in the experiment are included in the derived demand model. The total show list variable gives the total number of lots of cattle available for sale by cattle feedlots at the beginning of the market period. The greater the number of cattle on the show list, the lower should be the transaction price. Lagged marketings are also included as an indication of volume of the previous period's sales. It is expected that a greater volume of sales in the previous period will have caused prices to decline in that period, and that the pattern of lower prices should prevail in the current period.

As noted above, the weight of the lot of cattle traded is important to both packers and feeders. Animal weight is important according to the product characteristics model, and is expected to significantly affect transaction prices. The expected sign of the coefficient is ambiguous; cattle feeders do not like to keep heavier cattle on the show list but packers prefer to slaughter them. The sign of the parameter estimate will therefore depend on the negotiating skill and strength of the packer and feeder teams.

Three classes of indicator variables are included in the model; one each for transaction type, specific packer, and specific feeder. The transaction type variable specifies cash or forward contract transaction. Carlton shows that uncertainty and transaction costs create incentives for firms to use contracts. If these incentives are strong enough, contract prices will exceed cash prices. However, Eilrich et al., using data from 68 pens of cattle marketed over two years, find that net basis contract prices are lower than cash prices. As such, there is no clear expected sign for the variable. The variables for packers and feeders are included to capture the effects of individual negotiating and reputational effects of the teams. No *a priori* expectations for parameter sign are attached to any particular packing or feeding firm.

The partial-adjustment/market efficiency model includes all of the same variables as the derived demand model, but also contains lagged average price to capture rigidities and inertia in the beef supply chain and the informational content of past prices. A lag length of one on the price time series is assumed because it captures the essence of the partial-adjustment model advocated by Nerlove (1956a, 1956b, 1958a, 1958b) and the market efficiency model of Fama (1970). The partial-adjustment/market efficiency model is then

$$(14)\ PR_{it} = \gamma\beta_0 + (1-\gamma)\beta_1 PR_{t-1} + \gamma\beta_2 BBP_{t-1} + \gamma\beta_3 FUT_{t-1} + \gamma\beta_4 MKT_{t-1} + \gamma\beta_5 TSL_t + \gamma\beta_6\, WT_{it} + \sum_{k=1}^{2} \beta_{7k}\, DTYPE_{ikt} + \sum_{l=1}^{4} \beta_{8l}\, DPCKR_{ilt} + \sum_{m=1}^{8} \beta_{9m}\, DFDR_{imt} + e_{it}.$$

A "mixed model" is used to estimate equations (13) and (14) for each of the three years' data. The mixed model is a generalization of the standard linear formulation, but allows both the means and the variances of data to be modeled. The parameters of the mean model are the "fixed-effects" parameters, and are associated with known regressors, as in usual estimation procedures. The parameters of the variance-covariance model can be specified in the mixed model as following a number of alternative covariance structures. This allows a more flexible specification of the covariance of the error term than does the standard linear model. A "random-effects" specification is chosen for the experimental market data. In the random-effects specification, a dual-component error term is assumed

(15) $e_{it} = u_t + v_{it}$,

where u_t is an effect that is unique a specific cross-section (panel) of data and v_{it} is the portion of the error term associated with the overall model. In the experimental market, u_t is specified as being unique to each trading session. The random-effects specification is tested with a likelihood ratio (LR) test as the unrestricted variance-covariance structure versus the restricted case of the general linear model. The test statistic is

(16) $-2(\ln L_R - \ln L_U) \sim \chi^2 (J)$,

where J is the degrees of freedom equal to the difference in the number of parameters in the restricted versus unrestricted specification of the covariance structure. In this case, J=1.

The mixed linear model can be written as

(17) $PR_{it} = \mathbf{X}\beta + \mathbf{Z}\eta + \mathbf{e}_t$,

where **X** is the matrix of observations on the known regressors in (13) and (14), β is the vector of fixed-effects parameters, $\eta$is the vector of random-effects parameters, **Z** is the known design matrix of η, and $\mathbf{e}_t$ is the vector of error terms. The elements of $\mathbf{e}_t$ are no longer required to be independent and homogeneous (SAS Institute, Inc.). The MIXED procedure in SAS is used to estimate (13), and the NLMIXED procedure is used to estimate (14), employing restricted maximum likelihood (REML) as the estimation method.[5]

Dickey-Fuller tests for stationarity of the price time series were carried out. If the series were not stationary, estimation results could be spurious (Kennedy). The VARMAX procedure in SAS was used to carry out the test for each of the three data sets, and none was found to be nonstationary.

Though economic theory should dictate choice of model, other factors are often considered as well. McGuirk, Driscoll, and Alwang discuss the importance of a battery of misspecfication tests to minimize erroneous conclusions. Since this paper focuses on alternative theoretical bases for price discovery rather than specification tests, only standard tests are carried out. Criteria such as R^2, Akaike's Information Criterion (AIC), and the Schwartz's Bayesian Criterion (SBC) can also be used for model selection. Since REML is used, R^2 cannot be calculated, and a likelihood-based criterion must be employed instead. The AIC increases as R^2 increases, but degrades as model size increases (Greene). It can be written as

(18) $AIC(K) = \log(\mathbf{e}'\mathbf{e} / n) + 2K / n$,

where n is the number of observations and K is the number of model parameters. Schwartz's Baysian criterion is calculated in a similar way, but has a greater penalty for added regressors. It is calculated as

(19) $SBC(K) = \log(\mathbf{e}'\mathbf{e} / n) + K \log n / n$,

and will lean toward a simpler model. Both the AIC and SBC were calculated for each of the three years' data for both models.

Results

Results of the REML estimation of the mixed model as shown in equations (13) and (14) are presented in Table 3. It is clear that the derived demand and partial-adjustment/market efficiency models produce substantially different estimates for some of the coefficients. The coefficients on lagged marketings are lower for the partial adjustment/market efficiency model than for the derived demand model in each of the three years. For the other supply variable (total show list), the coefficients are higher for the PA/ME model in two of the three years. Overall, the expected signs are obtained on the supply variables in all but one case.

In two of the three years, coefficients are higher for lagged boxed beef prices in the PA/ME model than in the derived demand model. Similarly, estimates for lagged futures market prices are higher in the PA/ME model for two of three years. Conversely, coefficients on the weight variable are lower for two of the years, and higher for the third. Estimates of the effect of cash versus forward contract transaction are similar in magnitude for both models for each of the three years, as they are for the other indicator variables.

The expected signs are obtained for nearly all variables under either specification. The adjustment coefficient (γ) is positive in each of the three market efficiency models and of similar magnitude for two out of the three years. The coefficients for the 1994 and 1996 data indicate that from the perspective of the PA model, adjustment is rather slow (recall the coefficient is 1 minus the partial adjustment factor) at approximately twenty-five percent per trading period. The much quicker adjustment speed in the 1995 experiment could be the result of less reliance on the previous period's price as a source of information. It could also be the result of some behavioral traits peculiar to the group of participants that year.

The coefficient on lagged boxed beef is significant and of the expected sign for five of the six models estimated, providing support for its hypothesized effect on fed cattle transactions prices. The derived/primary demand relationship therefore appears to hold in the experimental market. Similarly, the futures price variable has the expected sign for each of the models and is significant for five out of six of the models. This indicates that participants take the futures market into account when negotiating bid/ask prices.

The two supply variables behave as anticipated in the estimated models. Lagged marketings have a negative and significant (at least at the 0.10 level) effect on prices in four of six models. Similarly, the total show list variable has the expected negative sign in all models, and is significant in all but one. The theoretical result that prices will decline as supply increases is clearly borne out in the experimental market.

The weight variable has a negative effect on price in each model, and is significant in four out of six. This means that packers were able to procure heavier cattle at a discount, even though such animals are more valuable to them. Feeders, therefore, are twice damaged by keeping cattle too long on the showlist: they become costly to feed as the minimum breakeven price of 1150 lbs. is passed, and less money is received from the packers, as well. That packers can pay less for animals worth more to them may be evidence that negotiating strength switches to them as cattle weight increases, as Lyford et al. (2002) find.

The cash sale variable is significant in each of the six models, and has a negative effect on transaction prices for 1994 and 1996, but not 1995. This may indicate that the reduced transactions costs and uncertainty associated with contracting are sufficient to increase forward contract prices. In 1995, a marketing agreement was imposed between the largest packer and two of the feedlots. This may have reduced the potential gains to additional contracting in that year, explaining the positive sign on the cash transaction estimate. It is also possible that the effects of cash sales on transactions prices are very sensitive to specific participants in the experimental market. Simply put, some participants may be better able to take advantage of different pricing methods than others.

Results of LR tests for the appropriateness of the random-effects specification of the variance-covariance model are shown in Table 4. The unrestricted model, which contains a random effect specific to the transaction week, is found to be the correct specification. The calculated test statistic exceeds the critical χ^2 value with one degree of freedom of 6.63 for each of the three years. This supports the hypothesis that intraweek variability is an important component of the mixed model applied to data from the experimental market. Were this variability not accounted for, estimated coefficients would be less efficient than they are under the correct specification.

The AIC and SBC selection criteria are presented in Table 5. It should be stressed that theory and not fit is the appropriate method for model choice. Nevertheless, in this case it is found that the partial-adjustment/market efficiency model provides a better fit than the derived demand model for each of the three years' data. This may be further justification for inclusion of the lagged dependent variable in empirical livestock price discovery work. Informational content of past prices appears to contribute considerable information to current period price discovery.

Summary and Conclusions

The objective of the research reported in this paper was to present and compare alternative theories and empirical models of price discovery, with a focus on livestock markets. Given current levels of average versus value-based pricing, understanding the price discovery process in livestock markets is important for industry stakeholders so that they can interpret price signals accurately. Much empirical work for livestock price discovery has been previously carried out, both for the real and experimental markets. This paper used data from an experimental market for fed cattle to illustrate differences between two plausible theoretical models.

Derived demand and partial-adjustment/market efficiency models for transaction prices in the experimental market were specified and estimated for 1994, 1995, and 1996 using a mixed linear model. Nearly 2,200 observations were included in each of the three data sets. A random-effects covariance structure was selected to allow intraweek variability of transactions prices to be explicitly considered in estimation. Likelihood ratio tests were carried out to assess the validity of the random-effects versus the restricted covariance structure and it was found that the random-effects specification is appropriate. The regressors in each of the models were specified as fixed-effects parameters. Finally, model selection criteria were outlined and presented. While these criteria should be of secondary importance when choosing a model, they are often used by researchers to aid in that task.

Most of the variables included in the models had the expected sign and were significant at the five percent level for each data set. Inclusion of the lagged dependent variable in the partial-adjustment/market efficiency model changed the magnitudes of estimates of other regressors relative to the derived demand model, but in general did not affect their significance. Parameter estimates for each of the three years' data were similar with a few exceptions.

The choice of theoretical model is the first and most important step in any applied research. Often, the researcher will have alternative theoretical models from which he may choose; more than one specification may be appropriate for the problem at hand. Choice of model should be based on research objectives. For the fed cattle market, a strong case can be made for use of either the derived demand or partial-adjustment/ market efficiency model. If it is believed that the past observations on the dependent variable are important in explaining current values due to a slow adjustment process or informational content of lagged values, then that model is the correct specification. If the researcher feels that the characteristics of the fed cattle, along with the supply and demand conditions, are enough to fully describe transaction prices, then the derived demand model will suffice. As has been shown, either model produces reasonable estimates; for this research, Akaike's Information Criterion and Schwartz's Bayesian Criterion both indicate that the partial adjustment/market efficiency model provides a slightly better fit. Alternative theoretical approaches may be appropriate under some circumstances.

Notes

1. With fewer firms, it is generally expected that oligopsony profits would increase

2. In fact, Nerlove was quite proud of the fact that his models produced Durbin-Watson statistics very close to 2.0. Unbeknownst to him, this was more a result of statistical bias than of correct model specification. The Durbin-Watson d statistic is now regarded as an inappropriate test for serial correlation in models with lagged dependent variables.

3. Nerlove deflated price and income.

4. Fama's research involved capital market goods (ie stock market securities), but the analysis can be generalized to any asset of value, including an input to a production process, such as fed cattle.

5. Because of the presence of the partial adjustment coefficient γ in (14), NLMIXED rather than MIXED must be used. The procedures work in otherwise identical ways.

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Table 1. Summary Statistics, FCMS Data, 1994-1996

	1994	1995	1996
Trading Periods	60	60	60
Transactions	2,198	2,210	2,197
Average Price	78.59	78.53	78.31
Std. Dev.	3.46	3.65	3.62
Average Quantity	36.60	36.80	36.67
Std. Dev.	6.27	6.12	7.61

Table 2. Variable Descriptions for Derived Demand and Partial-Adjustment/ Market Efficiency Models

Variable	Description
PR_{it}	fed cattle transaction price i in period t, ($/cwt)
PR_{t-1}	lagged average transaction price, ($/cwt)
BBP_{t-1}	boxed beef price, lagged one period, for Choice YG1-3 550-700 lb carcasses, ($/cwt)
FUT_{t-1}	live cattle futures closing price, lagged one period, for the nearby closing Month, ($/cwt)
MKT_{t-1}	total pens of cattle marketed/purchased, lagged one period
TSL_t	total pens of cattle on the show list the beginning of the period
WT_{it}	weight of the lot of animals traded in transaction i during time period t (i.e. 1100 lbs, 1125 lbs, etc.)
$DTYPE_{ikt}$	zero-one dummy variable for transaction type; k=1-2 1=cash 2=forward contract Base=forward contract
$DPCKR_{ilt}$	zero-one dummy variable for individual packers; l=1-4 1=PCKR1 2=PCKR2 3=PCKR3 4=PCKR4 Base=PCKR1
$DFDR_{imt}$	zero-one dummy variable for individual feedlots; m=1-8 1=FDR1 2=FDR2 3=FDR3 4=FDR4 5=FDR5 6=FDR6 7=FDR7 8=FDR8 Base=FDR1

Table 3. Mixed Model Estimates for Derived Demand and Partial-Adjustment/ Market Efficiency Models, 1994-1996

	1994		1995		1996	
Variable	Der.Dem.	Mkt.Eff	Der.Dem.	Mkt.Eff.	Der.Dem.	Mkt.Eff
Intercept	15.601**	15.411	22.883**	14.652	30.819**	92.488**
	(7.437)	(14.052)	(7.390)	(10.325)	(9.775)	(43.955)
Gamma	-	0.265**	-	0.575**	-	0.233**
		(0.057)		(0.073)		(0.097)
BBP_{t-1}	0.339**	0.522**	0.346**	0.407**	0.183**	-0.139
	(0.043)	(0.096)	(0.029)	(0.042)	(0.053)	(0.232)
FUT_{t-1}	0.372**	0.189	0.353**	0.376**	0.501**	0.645**
	(0.084)	(0.162)	(0.067)	(0.089)	(0.082)	(0.247)
MKT_{t-1}	-0.096**	-0.235**	-0.051**	-0.056*	0.022	-0.196
	(0.029)	(0.067)	(0.024)	(0.032)	(0.034)	(0.153)
TSL_t	-0.024**	-0.015	-0.061**	-0.044**	-0.067**	-0.091**
	(0.012)	(0.022)	(0.013)	(0.017)	(0.011)	(0.034)
WT_{it}	-0.001	-0.003	-0.006**	-0.008**	-0.0057**	-0.0024*
	(0.001)	(0.004)	(0.002)	(0.003)	(0.002)	(0.001)
Cash sale	-0.312**	-0.307**	0.328**	0.342**	-0.804**	-0.799**
	(0.076)	(0.076)	(0.102)	(0.101)	(0.100)	(0.099)
Packer 2	-0.490**	-0.490**	-0.362**	-0.357**	-0.089	-0.095
	(0.058)	(0.058)	(0.076)	(0.076)	(0.085)	(0.085)
Packer 3	-0.267**	-0.268**	-0.287**	-0.288**	-0.125*	-0.125*
	(0.056)	(0.056)	(0.076)	(0.074)	(0.074)	(0.074)
Packer 4	-0.155**	-0.155**	-0.153**	-0.148**	0.329**	0.329**
	(0.054)	(0.054)	(0.074)	(0.073)	(0.076)	(0.076)

Table 3. Mixed Model Estimates for Derived Demand and Partial-Adjustment/ Market Efficiency Models, 1994-1996 (continued)

	1994		1995		1996	
Variable	Der.Dem	Mkt.Eff	Der.Dem	Mkt.Eff.	Der.Dem	Mkt.Eff
Feedlot 2	0.059	0.056	0.156**	0.155	0.646**	0.647**
	(0.074)	(0.075)	(0.099)	(0.099)	(0.100)	(0.100)
Feedlot 3	-0.113	-0.112	0.842**	0.830**	0.849**	0.848**
	(0.077)	(0.077)	(0.103)	(0.103)	(0.111)	(0.111)
Feedlot 4	-0.012	-0.011	0.478**	0.477**	1.173**	1.172**
	(0.075)	(0.075)	(0.100)	(0.100)	(0.110)	(0.110)
Feedlot 5	-0.375**	-0.372**	0.605**	0.611**	0.792**	0.079**
	(0.075)	(0.075)	(0.100)	(0.100)	(0.113)	(0.112)
Feedlot 6	0.057	0.055	0.442**	0.441**	0.752**	0.762**
	(0.072)	(0.072)	(0.097)	(0.097)	(0.112)	(0.112)
Feedlot 7	-0.170**	-0.177**	0.417**	0.414**	0.678**	0.682**
	(0.074)	(0.074)	(0.099)	(0.099)	(0.109)	(0.109)
Feedlot 8	-0.066	-0.069	0.270**	0.272**	0.748**	0.743**
	(0.077)	(0.077)	(0.099)	(0.099)	(0.114)	(0.114)

Note: double and single asterisks denote significance at the five and ten percent levels, respectively.

Table 4. Likelihood Ratio Tests of Random-Effects Model, 1994-1996

Test Statistic	1994	1995	1996
Likelihood Ratio $\chi^2(1) = 6.63$	1668	2152	1475

Note: the size of the Likelihood Ratio test is 0.025.

Table 5. Akaike's Information Criterion and Schwartz's Bayesian Criterion for Model Selection, 1994-1996

Year	Partial Adjustment Model AIC	Partial Adjustment Model SBC	Derived Demand Model AIC	Derived Demand Model SBC
1994	5277	5321	5397	5401
1995	6799	6843	6859	6863
1996	6967	7010	7041	7045

Note: smaller values indicate a better fit under the AIC and SBC.

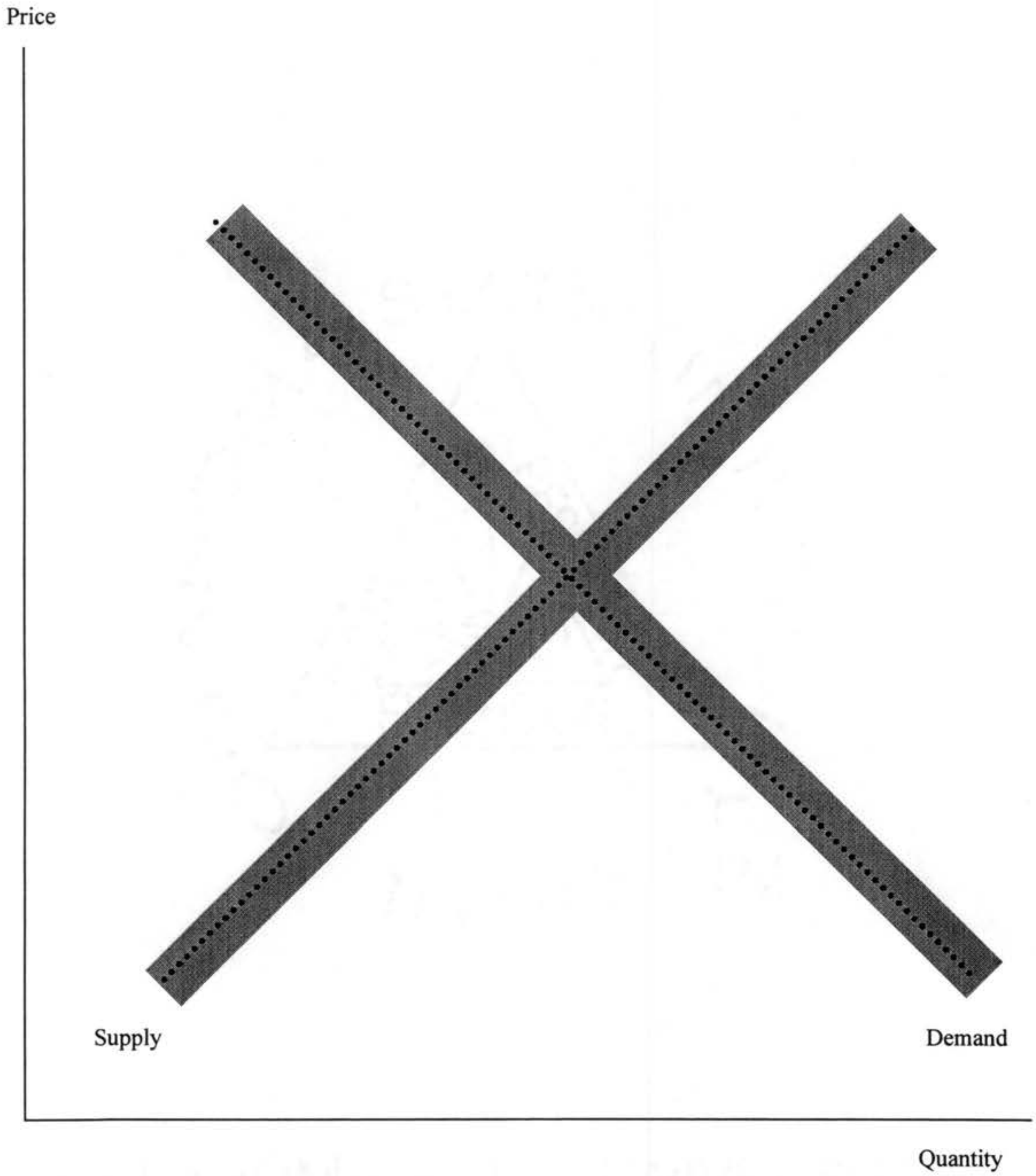

Figure 1. Supply and Demand Bands

III. Success Factors for Value-Added New Generation Cooperatives

Introduction

Agricultural producers have long sought to capture a greater share of the downstream value their commodities create. As rural population and incomes dwindle, the need to do so is becoming increasingly more pressing. Farmers have a long tradition of cooperative behavior, both in purchasing inputs and in collectively marketing their raw products. Today, there are more than 40,000 cooperatives in the United States, generating over $120 billion in economic activity (United States Department of Agriculture). Most recently, in an effort to add value to their products, farmers have begun to vertically integrate into processing activities, often in the form of New Generation Cooperatives (NGCs). In 1997, the "value added" of farmer cooperatives topped $10 billion (Kraenzle and Cummins).

Typically, an NGC (previously called a New Wave Cooperative, or Next Generation Cooperative) retains the traditional cooperative tenets of one member/one vote (though this may vary by state) and dividends based on patronage, but has two important additional characteristics (Stephanson, Fulton, and Harris). The first is delivery rights tied to share issuance. Investors in NGCs typically help fund construction or purchase of a processing facility through the purchase of shares which entail the obligation to deliver one unit of the applicable commodity per share. The second unique NGC characteristic is restricted membership. Membership is restricted to those who provide the equity capital (and thus incur the risk) for the venture, and new shares are generally not issued unless the processing facility requires expansion. Usually, shares in NGCs can be traded, although the approval of the NGC board of directors is often required. This is to done to prevent private corporations from acquiring control of the cooperative. Cook proposes a four-stage model of cooperative genesis, growth, and demise, and shows how NGCs are a natural outcome in the process.

The purpose of this paper is to determine the importance of various factors to the success of NGCs, as rated by managers of those enterprises. Torgerson (2001a) points out that research is essential to learning about the success and failure of cooperatives. Results of the research reported here will allow the quantification of perceptions that exist about the factors that are important to new generation cooperatives. These enterprises have purposes and goals that are distinct from traditional cooperatives, but are also distinct from investor owned firms. As such, knowledge about those factors which NGCs rate as most important to their success can provide important information to both existing and new NGCs, as well as to extension agents and government personnel who are involved in their development.

Survey

Data for this paper were collected via a survey of NGCs operating in several agricultural industries. The survey, shown in Appendix A, was designed to have managers or directors of NGCs rank five factors in each of ten categories from most to least important to the success of their cooperative. Factors to be included in the survey were identified through a review of cooperative and business literature (i.e. Cooper), and through meetings between the author and extension personnel at Oklahoma State University. Each of the five factors in a category was assigned a value from 1 to 5, with 1 being assigned to the factor perceived to be most important to the respondent's own NGC. Each number could be used only once in each category, with no ties in importance being assigned. Respondents were also asked to rank the categories themselves in order of importance, from 1 to 10, using each ranking only once. The categories, in order of presentation on the survey, were "Product Related", "Human Resource/Organizational", "Government/Regulatory Environment", "Financing and Costs", "Logistics", "Operational", "Industry", "Managerial", "Strategic", and "Planning and Development".

The list of potential respondents came mainly from the Illinois Institute for Rural Affairs' (IIRA) "Directory of New Generation Cooperatives", with additional NGCs identified via discussions with extension personnel and an internet search. A list of 72 potential respondents was identified, representing most of the NGCs currently in existence.[1] Each NGC was contacted in advance to identify a suitable recipient and solicit participation, and the survey was then mailed accordingly. After three mailings, a 75% response rate was attained.[2] Respondents were then placed into one of eight groups, each representing closely related commodities or processing activities. If a respondent did not clearly fit into one of the eight commodity/activity groups, it was placed in a ninth group, which included one anonymous response. Table 1 shows the commodity/activity groups and the number of respondents classified into each.

Unweighted Mean Factor Ratings

Figures 1 to 10 show the individual category factor ratings given by the 50 respondents. The horizontal bars illustrate the distribution of aggregate responses for each factor, with the number of responses given within or just after each region within each bar. The text below the bars gives the number of responses (N) to each factor rating, the mean, and the median response. Because not each of the 50 respondents rated each category or each factor, the number of responses within each category ranges from

44 to 49. Table 2 presents the results of ANOVA tests for significant differences between the means of each factor rating in each category, showing which factors were rated statistically differently from other factors in the same category. Differences in means in Table 3 are discussed when Table 2 shows them to differ at the 5% significance level. Table 3 gives the mean responses for each factor for the groups defined in Table 1. Numbers in parentheses in Table 3 denote statistically significant differences in least-squares (LS) mean responses between groups at the 10% significance level. LS means estimate the marginal means over a balanced population (SAS Institute, Inc.), and were used because of the different number of respondents in each category. It should be noted that while significantly different LS means between group factor ratings are strong evidence of different mean ratings, lack of significance in LS mean differences does not necessarily mean the groups rated factors the same. Because of the small group sizes, LS means may not be able to determine statistically significant differences with an appropriate degree of certainty.

Product Related

Figure 1 shows that "product quality", was ranked most important in this category by 27 of 48 respondents, second most important by 16, third most by 3, fourth most by 3, and least important in the category by no respondents. The mean response was 1.6, and the median was 1, and Table 2 shows that it was ranked significantly higher than all other factors in the category. Comparing these results with others in Figure 1, it is clear that "product quality" was rated most important in the category across all respondents. "Customer service" was rated the second most important, "product uniqueness" third, "technology incorporated" fourth, and "brand recognition" fifth. ANOVA results indicate that the factors ranked third and fourth were not significantly different and neither were those ranked fourth and fifth, although the third ranked factor was significantly higher than the fifth.

There are some noteworthy results of LS means comparisons of the factors in the "Product Related" category. These are shown in Table 3. Respondents in Group 6, which includes perishable table-ready products, rated "product uniqueness" significantly higher than did respondents in Group 1 (Corn Processors/Ethanol/Energy) and Group 7 (Coffee/Sugar/Table Nuts). That Group 1 respondents did not rate this factor very high is not surprising, given that users of their products are mostly industrial and there is little to distinguish their product from competitors'. The finding of significant differences for this factor between Groups 6 and 7 is more interesting, since they both produce final consumer products. It is likely that the significant difference in responses is due to the more perishable nature of products in Group 6 versus Group 7, and to the fact that several of the NGCs in Group 6 specialize in the marketing of organic produce, itself an especially unique good. Table 3 also reveals significant differences in LS means for the "technology incorporated" factor. Group 1 and Group 4 (Oilseed Processors) both ranked this factor significantly higher than did Group 2 (Livestock) and Group 6. This result is not unexpected, given that the NGCs in the former two groups are involved in processing, whereas those in the latter two groups focus on marketing activities. "Brand recognition" was rated significantly higher by NGCs in Group 8 (Producer Alliances) than in Group 9 (Other/Anonymous). This may be due to the fact that Group 9 NGCs are mostly involved in industries with less processed products and hence little reliance on brand names.

Human Resource/Organizational

"Labor force quality" was the highest ranked factor in this category, with more than half of the respondents rating it most important. ANOVA results imply that it was ranked significantly higher than all other factors in the category (Figure 2). By simple means, the second through fifth most important factors were "communication within co-op", "communication with board", "communication with members", and "use of outside experts", although ANOVA results indicate that the second and third ranked factors were not significantly different and neither were the fourth and fifth ranked. It was expected that "communication with board" would be highly rated. This is because, as Wadsworth (2000) observes, conflicts between managers and board members, which are disruptive to smooth corporate governance, occasionally arise. Wadsworth (2001) further finds that effective member relations are essential to cooperative success. Additionally, Trechter and King outline how effective cooperative communication can help build member commitment, and Allen discusses how a strong communication network was important to the success of a prominent nut cooperative.

LS means comparisons suggest that the "use of outside experts" factor was significantly more important to Group 2 respondents than to those in Groups 6 or 7. This could be due to the fact that NGCs in the latter groups are involved in more mature industries where virtually all needed expertise has been internalized through the hiring of experienced managers and technology specialists. Also, those livestock NGCs that are involved in processing are more likely to have to use outside experts to meet special regulatory requirements. For instance, HACCP, waste handling, and environmental impacts may all represent greater concerns to NGCs in Group 2 than those in Groups 6 and 7. Although it did not show up in the LS means comparisons, in general those groups (i.e. 1, 4, 5) that are highly mechanized had higher rankings for "quality of labor force" than those who are more focused on marketing (i.e. 2, 6).

Government/Regulatory

This category had the lowest response rate, with only 44 or 45 of the 50 respondents rating the various factors, as shown in Figure 3. Reluctance to rank the factors in this category may be a reflection of the perception on the part of NGC managers that government does not have an important role to play in their operation. "Co-op existence laws", "co-op tax advantages (i.e. 521 tax status)"[3], and "direct government agency funding" were rated first, second, and third by simple arithmetic means. "Co-op existence laws" received the highest number of #1 rankings, though ANOVA reveals that the ratings of the top three factors were not significantly different. "Demand enhanced by regulation" and "government planning support/technical assistance" were ranked fourth and fifth most important, but again ANOVA shows that their overall ratings are not significantly different. They were, however, ranked significantly lower than the top three factors.

"Co-op tax advantages (i.e. 521 tax status)" was revealed by LS means to be significantly more important to NGCs in Group 5 (which contained relatively "newer" NGCs) than Group 7 (relatively "older"). NGCs in the latter group may have been less able to take advantage of 521 tax status because they already had an institutional structure in place when the legislation was passed. Although LS means do not show a significant difference, "demand enhanced by regulation" is rated substantially more highly by Group 1 NGCs than by those in any other group. This is because most in that group are involved in the production of ethanol, which benefits from government regulation in two ways: first, regulations requiring ethanol blended gasoline exist or are pending in several states. Second, corn processing plants receive a large government subsidy if they produce at least one million gallons per month. That is likely the reason that most ethanol NGCs have almost exactly that production capacity.

Financing and Costs

In this category, ANOVA results suggest that "low operating costs" and "member capital base" were not statistically different as the two most important factors. The arithmetic mean was slightly more favorable for "low operating costs", but more respondents rated "member capital base" as the most important factor in the category (Figure 4). Those two factors were thus virtually tied for top rank, but were both ranked significantly higher than "Low financing costs", which came in third. That factor was followed by "output price stability" and "input price stability", which were not statistically different according to ANOVA, though the former factor was chosen as most important in the category by seven respondents, compared to only one for the latter. Both were statistically different from "low operating costs".

Although no significant differences among groups were revealed by LS means analysis, some interesting comparisons can be made. For instance, "low operating costs" was rated most important for Groups 3, 4, 6, and 7, whereas "member capital base" was the top choice for Groups 1, 2, 5, and 8. Many NGCs in the latter groups have substantial regulatory requirements to meet and incur considerable expense in meeting them. For instance, ethanol producers must adhere to regulations by the Bureau of Alcohol, Tobacco, and Firearms, as well as the Department of Energy. They are also highly automated, requiring considerable capital investment. So are NGCs in Group 5, who must build or purchase a flour mill to handle their processing requirements. Some Group 2 (Livestock) NGCs, similarly, must adhere to food safety guidelines, as required by the United States Department of Agriculture (USDA) Food Safety and Inspection Service (FSIS). Gehrke and Matson note that lack of capital was the primary cause of failure for the earliest cooperative meatpacking efforts from 1914-1920. Campbell (2001) observes that Farmland, the most successful livestock NGC, could not have survived without requiring a large initial investment by members. Co-ops that have these types of requirements need large cash infusions and are likely to consider "member capital base" relatively more important than an NGC focused mainly on marketing activities, for example, an organic vegetable cooperative in Group 6.

Logistics

Figure 5 shows that "Proximity to inputs" is ranked the highest in this category by arithmetic mean, followed by "transportation/ distribution infrastructure" and "site selection". ANOVA reveals that of those three factors, the first and second are not significantly different and neither are the second or third, but the first and third differ, and so by transitivity the three factors can be ranked. Note also that the number of respondents who rated each of those three factors as most important in the category are very similar. Though ANOVA shows "proximity to customers" to be statistically the same as "site selection", transitivity again illustrates that the former is rated fourth rather than third. "Geographical member dispersion" is rated as the least most important factor in the category.

NGCs in Groups 5 and 6 both rated “proximity to customers” more important than did those in Group 1, according to LS means. This is due to the perishable nature of the products in the former two groups versus the latter. Most of the NGCs in Group 5 produce flour and/or flour-based products, and most of the those in Group 6 produce perishable table-ready produce. Both of these products must be handled carefully, and neither can be stored for long periods of time without risk of contamination or spoilage. Ethanol, which is the main product of Group 1 NGCs, can be stored and transported more easily and with less risk of insect infestation, so it is not surprising that NGCs in that group rated “proximity to customers” as significantly less important than did their counterparts from Groups 5 and 6. Conversely, “proximity to inputs” was rated by Group 1 NGCs more highly than by those in Group 5. To save transportation costs for bulky corn, ethanol is usually made “on the spot”, with co-products then used in nearby feedlots or dairy operations. The end product of wheat processors, conversely, is easily contaminated and so should be produced close to end markets to reduce shipping costs and losses. For this type of NGC, the input rather than the output is shipped nearer to end use points, since a high percentage of the input is transformed into a desirable output.

Operational

“Strong selling/marketing effort” was rated highest by 17 of the respondents, making it the overall most important factor in the category (Figure 6). “Business volume”, “risk management”, and “targeted customer base” were second, third, and fourth in terms of simple means, though ANOVA shows them to be not statistically different. Those three were all rated statistically lower than “strong selling/marketing effort”, but all were higher than the lowest rated factor, “vertical integration”. This indicates that NGCs do not consider further downstream marketing activities to be important, possibly because they have vertically integrated as far as they can while still maintaining a market presence. The initial feasibility study may have shown that farther integration is infeasible, and there could be simply be too much uncertainty associated with going any farther.

Group 6 rates "targeted customer base" as significantly more important than does either of Groups 1 or 5 according to LS means. This is not unexpected due to the influence of specific consumer tastes on the activities of NGCs in that group. For instance, many NGCs in Group 6 are organic vegetable cooperatives, and target their products to very health-conscious produce buyers. NGCs in Groups 1 and 5, on the other hand, produce more homogeneous and commonly used products and do not target specific consumer segments as customers. This is not to say that NGCs in those two groups do not focus on selling. In fact, Table 3 shows that "strong selling/marketing effort" is the most important factor in the category to NGCs in both Groups 1 and 5. Group 7, on the other hand, rated "business volume" as most important in the category, reflecting their reliance on high volume/low margin sales.

Industry

"Reputation" and "market size" have the same mean and are not statistically different according to ANOVA, although the former has a lower median and more respondents rated it highest in the category (Figure 7). By simple means, the third through fifth rated factors (all ranked statistically lower than "reputation" and "market size") are "number of competitors", "competitors' prices", and "economic climate", though the mean responses for each of those factors were not significantly different. The medians of the first two of those three factors were equal, but the third had a lower median, indicating that it may be the least important in the category according to the respondents.

Groups 2, 3, and 6 all rated "reputation" significantly higher than did Group 5 according to LS means. The simple means given in Table 3 also show that Groups 1, 4, and 7 also did not rate "reputation" as highly as did Groups 2, 3, and 6. This indicates that those NGCs that are more mechanized or processing focused place less importance on reputation than do NGCs that have more of a marketing focus. "Competitors' prices" is rated as most important by Group 7, again reflecting the position of many Group 7 NGCs in a high volume/low margin industry. Those in Group 8 agreed that competitors' prices were most important; this may reflect the broad-thinking competitive scope of the producer alliance NGCs.

Managerial

Adrian and Green conducted a survey of cooperative managers, and found them to be knowledgeable within several key areas. In this category, Figure 8 shows that "managers with knowledge of industry", "experienced managers", and "full-time general manager" are first, second, and third most important by arithmetic mean. However, ANOVA shows that they are not significantly different, though the first of those three factors received the highest number of responses rating it most important in the category. "Continuity of management" was rated as the fourth most important in the category, and "ongoing managerial training" was the least important.

No significant differences in LS means were found for the factors in this category, but inspection of Table 3 reveals some trends across all groups. Since the survey was filled out mostly by NGC managers, it is interesting to see how they rate the factors most closely associated with their own duties. For instance, five of the nine groups rated "managers with industry knowledge" as the most important factor in the category, but none rated "continuity of management" the highest on average. Also, every group except for Group 7 rated "ongoing managerial training" as the least important factor in the category, and for Group 7 it was the second least important. This may be because manager knowledge is commodity and/or technology specific. Additional training may only be required as new commodities or technologies are included in the NGC's business.

Strategic

Respondents rated "business strategy" and "product focus" first and second most important in this category according to simple mean, but ANOVA shows that the two were not rated statistically differently, although the former was rated as most important by a higher percentage of NGCs (Figure 9). This suggests that these enterprises are aware of the importance of strategic planning. Both of those factors were rated higher than "ongoing planning/checking" and "multiple-market sales", which were tied for third and were not significantly different. The former had a higher mean ranking, but the latter was rated most important by more overall respondents. The least important factor in the category was found to be "enforce member agreements", indicating that NGCs did not encounter many difficulties in that area. This is because patronage dividends are based on deliveries to the cooperative, so it is in members' best interests to adhere to their agreements.

No significant differences between the LS means of the various groups were found. Nevertheless, there was consistency in the mean rankings among groups. For instance, eight of the nine groups rated “enforce member agreements” as the least important factor in the category, echoing the results shown in Figure 9. “Product focus” was rated most important on average by more groups than “business strategy”, even though the latter was chosen most important by more individual NGCs. This confirms the idea that the two factors were virtually tied for the distinction of being most important in the “Strategic” category.

Planning and Development

“Local champion(s) or leader(s)” was clearly rated most important in that category, being ranked as such by more than half the respondents (Figure 10). ANOVA found no significant difference between “steering committee” and “feasibility study”, which were second and third, respectively, in terms of simple means. Both of those were rated statistically lower than “local champion(s) or leader(s)” and higher than the fourth and fifth ranked factors, “alliance/partnership”and “proximity to other successful co-ops”, respectively.

Significant differences between any of the LS means for the different groups were not found. However, it is interesting to note that “proximity to successful co-ops” was rated least important or tied for least important for each of the nine groups. This indicates that NGCs do not believe an important factor to success is locating close to other successful cooperatives, even though they may serve as inspiration for producers to join the new venture. It is also intriguing that “alliance/partnership” was rated second lowest or tied for second lowest by all of the groups. Since NGCs are the result of cooperative behavior on the part of producers, it is odd that alliances or partnerships with existing co-ops are not important to them.

Category Ratings

The distribution of responses for the ten overall categories is shown in Figures 11 and 12. “Planning and Development”, with a mean of 3.7, was rated the most important of all categories, followed closely by “Financing and Costs” with a mean of 3.8. The third most important was “Managerial” (mean 4.0), and then “Operational” (4.7) at fourth, fifth was “Strategic” (5.7), sixth was “Product Related” (5.8), “Industry” (6.1) was seventh, “Human Resource/Organizational” (6.5) was eighth, ninth was “Logistics” (7.0), and “Government/Regulatory Environment” was rated the least most important overall category, with a mean ranking of 7.0.

Table 3 shows the mean ratings for each of the 10 categories for all 9 groups, and illustrates that there were some statistical differences between the LS mean rankings of some of the categories. For instance, the “Product Related” category was ranked significantly less important for Group 1 NGCs than for Group 6 or 8. For Group 6, this is not unexpected since the those in that group have products that are perishable, and product quality is easily discernable to consumers. NGCs in Group 1, on the other hand, are largely ethanol producers whose product is homogenous in terms of quality. A similar situation exists for Group 4 (though the LS means were not significantly different); quality is not a major distinguishing characteristic of the output oilseed processors produce.

Significant differences were also found for the LS means of Group 1 (which rated it sixth most important) versus Group 6 (which rated it tied for least important) for the “Government/Regulatory Environment” category. This is largely due to the importance of the “demand enhanced by regulation” factor to Group 1 NGCs, for reasons previously outlined. NGCs in Group 6, by contrast, are involved in production of consumer-ready foodstuffs, and may consider government regulation of their industry excessive. Groups 3, 5, 7, and 8 also rated this category as least important of the ten, and no group had it rated higher than sixth overall.

There was a relatively even split of categories receiving the highest ranking from respondents. “Planning and Development” and “Financing and Costs” were each ranked the highest by three groups (one ranking for the latter category was a tie). “Managerial” and “Product Related” were the most important for two groups each. That the latter was ranked highest for two groups is interesting given that it was only ranked sixth overall by all respondents combined. This reflects the fact that it was not ranked highly by NGCs in Group 1, which was the largest group and thus had the most influence on the overall responses shown in Figures 11 and 12.

Weighted Overall Factor Rankings

Individual factor rankings for each factor for each NGC can be calculated by weighting the within-category factor rank by the overall category rank. For example, the factor rated highest by an NGC in its highest rated category is accordingly the most important of the 50 total factors. Similarly, the factor rated the lowest in the lowest rated category is the least important of all the factors to an NGC. When aggregated over all respondents, or even all NGCs in a group, such a weighting should allow direct rankings of factors across various categories.

This calculation was carried out for each factor for each respondent, and then averaged over all respondents. This yielded a mean weighted rating for each factor; the factors were then ranked from most to least important by lowest average weighted rating.

The same calculation can be carried out for factors within individual groups. The overall factor rankings and weighted mean ranks are presented from most to least important in Table 4, and the results by group are shown in Table 5.

"Local champion(s) or leader(s)" was ranked as the most important success factor across all NGCs. It was ranked highest of the 50 factors by two of the nine groups, and was in the top five for four more groups. "Low operating costs" was ranked second most important, and was also ranked highest by two of nine groups, with an additional two groups placing it in the top five. Third was "steering committee", which did not receive the highest rankings from any groups, but was in the top five for four groups and in the top ten for an additional four. The fourth most important factor was "member capital base", ranked in the top five by three groups and in the top ten by another five. Rounding out the top five was the "feasibility study" factor, ranked most important overall by one group, in the top five by two more, and in the top ten by another two groups.

Eight of the ten highest ranking factors came from three categories. The importance of "Planning and Development" category was evident in the overall weighted factor rankings, with three of the five most important factors coming from that category. The "Financing and Costs" category, which contained the other two factors ranked in the top five, was also confirmed as important to NGCs. Three of the five factors ranked six through ten came from the "Managerial" category, including "managers with knowledge of industry", which was ranked sixth overall, "experienced managers, ranked eighth, and "full-time general manager", coming in at tenth. "Product quality", a factor from the "Product Related" category, came in at seventh most important. At ninth was "strong selling/marketing effort" from the "Operational" category.

The least important factor across all NGCs was found to be "geographical member dispersion" from the "Logistics" category. That factor was ranked among the five least important by seven of the nine groups. "Government planning support/technical assistance" from the "Government/Regulatory Environment" category was the second least important overall, and was ranked in the five least important factors by five of nine groups. The NGCs' apparent lack of enthusiasm for government involvement is made clear by this result: even though respondents ranked the "Planning and Development" category as the highest, merely adding the word 'government' to 'planning' was sufficient for the factor to be rated among the lowest. The third least important factor was identified as "demand enhanced by regulation", also from the "Government/Regulatory Environment" category. That factor was ranked among the five least important by six groups. "Use of outside experts" from "Human Resource/Organizational" came in at fourth least important, and was ranked in the five least important factor by four groups. The fifth least important factor for NGCs was found to be "enforce member agreements" from the "Strategic" category. Three groups rated that factor as among their five least important.

Corn Processing/Ethanol/Energy

For Group 1, the largest group with fourteen NGCs, the five most important factors were "local champion(s) or leader(s)", "strong selling/marketing effort", "full-time general manager", and a tie between "feasibility study" and "member capital base". That the first and fourth most important factors (and the fifth highest ranked is also related to this category) both are in the "Planning and Development" category reflects the importance of planning to that type of NGC. The other two factors in the top five illustrate the importance that corn processing NGCs place on daily operations. Given the mechanization, labor force requirements, and large capitalization of those types of facilities, these results are not surprising.

Nor is it surprising that "product uniqueness" and "brand recognition" from the "Product Related" category are ranked as the least and fourth least important factors to Group 1 NGCs, given the homogeneous nature of their output. Third and fifth least important were "communication with members" and "use of outside experts", both from the "Human Resource/Organizational" category, and fourth was "geographical member dispersion" from "Logistics".

Livestock

Group 2 was comprised of six livestock NGCs, who rated "local champion(s) or leader(s)", "product quality", "multiple-market sales", "experienced managers", and "reputation" as first to fifth overall most important factors, respectively. Merlo asserts that the beef industry's reputation as a whole has suffered from its inability to produce a consistent, convenient product that is as affordable as chicken or pork. This may help explain the selection of "product quality" and "reputation" as being among Group 2's most important success factors. Interestingly, no two of the top five factors for Group 2 came from the same category. It is noteworthy that "multiple-market sales", the third most important factor to Livestock NGCs, was rated no higher than twenty-first by any other group. This is because this type of enterprise sells different cuts of meat into different markets. For beef processors, for example, there are distinct markets for primals, sub-primals, trimmings, hides, bones and offal/renderings. It is more difficult to sell round and chuck than cuts from the loin and rib. For this reason, that factor is of considerable importance to livestock NGCs.

The least important factor for NGCs in Group 2 was "demand enhanced by regulation", followed by "geographical member dispersion", "proximity to customers", "government planning/technical support", and "site selection". That three factors in the "Logistics" category and two in the "Government/Regulatory Environment" category were ranked among the five least important for this group is telling: this type of NGC does not rely heavily on distributional factors or the actions of policy makers in its operations. This trend may be changing as the newest Group 2 NGCs are developing, however: Campbell (2002) notes that 40% of the dollars of the USDA's new value-added grants program were awarded to livestock ventures. This may mean that newer livestock NGCs are becoming more receptive to government planning aid than in the past.

Poultry/Eggs

Though there were only three respondents in Group 3, their factor rankings are informative. "Managers with industry knowledge" was ranked as the most important overall factors for these NGCs, followed by "experienced managers" and "business strategy", which were tied for second. The fourth most important factor was "low operating costs", and fifth place was a tie between "steering committee" and "reputation". Two factors from the "Managerial" category were in the top five, showing the importance of effective management to Group 3 NGCs. Moser (2000) notes that these factors are critical to poultry NGCs because of the importance of previous managers' experience in product development and sales. "Business strategy" was ranked considerably higher for this group than for any other (second overall, versus thirteenth for Group 1), showing the relative importance of that factor and the importance of the "Strategic" category NGCs in that group.

Two of the five factors rated least important for Group 3 NGCs came from the "Government/Regulatory Environment" category ("government planning/technical support" was tied for lowest, and "demand enhanced by regulation" was third lowest), and another two were in the "Product Related" category ("brand recognition" and "product uniqueness" at fourth and fifth least important, respectively). "Geographical member dispersion" was tied for lowest ranked. None of these rankings was noticeably out of line with the rankings assigned by other groups, but they do echo the results for other groups of low importance placed on government involvement.

Oilseed Processors

Two NGCs made up Group 4, and their rankings of "feasibility study", "steering committee", and "local champion(s) or leader(s)" as first, second, and third highest overall revealed the considerable importance they place on the "Planning and Development" category. "Experienced managers" was ranked as fourth most important, and "member capital base", which also relates closely to the development stages for NGCs, was fifth. These results reflect that fact that most NGCs in this group are relatively new, and the planning and development stages are still fresh in their minds. Moser (1999) discusses the importance of these factors for developing an oilseed processing NGC. The results further reveal the importance of members' ability to fund a processing facility with considerable start-up capital requirements.

Least important to Group 4 NGCs was the "brand recognition" factor, followed by "demand enhanced by regulation", and "product uniqueness". The first and third of those factors are from the "Product Related" category, again showing that producers of a product slightly removed from the consumer do not consider those types of factors relatively as important. The fourth and fifth lowest ranked factors, "vertical integration" and "targeted customer base", are both in the "Operational" category.

Wheat Processors

The NGCs in Group 5 ranked "quality of labor force", "product quality", "steering committee", "market size" as the first through fourth most important factors. There was a tie for fifth between "product focus" and "feasibility study". High rankings for the first, third, and fourth of those factors reflect the fact that Group 5 NGCs are involved in a highly competitive output market (Boland and Barton), and must focus on high volumes and quality products to succeed. That two of the factors are from the "Planning and Development" category again shows the importance of the early stages of NGC development to overall success.

The least important factor to NGCs in Group 5 was "geographical member dispersion", echoing a common theme among groups. Notably, the next four least important factors all came from the "Government/Regulatory Environment" category: they were "government planning/technical support", "demand enhanced by regulation", "co-op existence laws", and "direct government agency funding". This reflects the overall low ranking of that category by NGCs in yet another group, although "co-op tax advantages (i.e. 521 tax status)" was ranked as the fourteenth most important overall.

Table Vegetables/Organic/Seafood

The ten enterprises in Group 6 are unique among NGCs because they sometimes do not require large member capital infusions to fund processing facilities. Rather, they focus on the marketing of specialized and usually perishable products. NGCs in this group considered factors in the "Product Related" category to be of primary importance, ranking "customer service", "product quality", and "product uniqueness" as the first, second, and fourth most important overall. This is not surprising since organic NGCs have arisen as a result of the food quality concerns of consumers (Karg 2000). "Local champion(s) or leader(s)" was the third highest ranked factor for these NGCs, and "low operating costs" was ranked fifth. Both of these factors were also ranked among the most important by NGCs in several other groups. This shows that although Group 6 NGCs place unique importance on product related factors, they do have several important factors in common with other groups.

The two least important factors to NGCs in Group 6, "government planning/technical support" and "demand enhanced by regulation", both came from the "Government/Regulatory Environment" category, matching the overall trend across groups. Third least important was "enforce member agreements". It is not surprising that this type of NGC does not consider that factor to be very important, since not having a large production facility means that capacity usage considerations are not important, and as such, a committed volume of raw inputs by members is not as critical. The fourth least important factor was "economic climate". In a rich economy such as that of the U.S., it is unlikely that the state of the economy has a significant effect on food consumption patterns. "Use of outside experts" was fifth least important to Group 6 NGCs.

Coffee/Sugar/Table Nuts

Products for the one coffee NGC, two sugar NGCs, and one table nut NGC in this category are unique in that they are processed, similar to those in Groups 1, 4, and 5, yet they are also consumer-ready, similar to the products of Groups 3 and 6. The first and fourth most important factors for this group were "low operating costs" and "low financing costs" from the "Financing and Costs" category. "Business volume" and "local champion(s) or leader(s)" were tied for second most important for Group 7, with "product quality" identified as the fifth most important. These rankings reflect these NGCs' positions in industries that are moderately competitive with large sales volumes and medium scale processing facilities. Control of costs was clearly designated as an important concern to NGCs in Group 7. This is not surprising, given pervasive low sugar prices. Recently American Crystal, the oldest NGC in the United States, was forced to forfeit sugar to the government for the first time in twenty years (Karg 2001).

Interestingly, the "Product Related" category, which contained the fifth most important factor for Group 7 ("product quality"), also contained factor ranked second least important, "product uniqueness". This may indicate that although these NGCs feel that they must provide a high quality product to be successful, to some extent their products cannot be distinguished from competitors' based on unique characteristics. "Use of outside experts" was ranked as least important overall. Two factors from the "Strategic" category were ranked third and fourth least important; they were "enforce member agreements" and "multiple market sales". This indicates that members of those NGCs are not troublesome when it comes to fulfilling delivery requirements, and that selling multiple products is not a concern for NGCs in this group. Fifth least important was "geographical member dispersion", which was ranked similarly by most other groups.

Producer Alliances

The two producer alliances included in Group 8 are unique types of respondents. Typically, interested producers must be a member of a producer alliance to invest in an alliance's NGC. The alliance looks for a potential NGC idea, acquires feasibility study funds, finds interested producers to invest, and sets up the enterprise. The alliance then allows the management team to take over the operation, and focuses on its next project. Respondents in this group therefore can be expected to have a broader focus than a single commodity, though the commodities with which they are most familiar will influence their overall factor rankings.

The Group 8 NGCs chose four factors from the "Product Related" categories among their five most important overall. "Brand recognition" was ranked the highest, followed by a tie between "product quality" and "customer service". Tied for fifth was "product uniqueness" from that category with "managers with industry knowledge" from the "Managerial" category. It is noteworthy that the product related factors are rated so highly by those who are in the business of setting up NGCs. This might mean that a product focus is important in the conceptual stages of an NGC, but as the idea comes to fruition and begins operation, other factors soon become the focus.

"Demand enhanced by regulation" and "government planning/technical support" were tied for the lowest ranking by the producer alliances, again showing the low importance given to the "Government/Regulatory Environment" category overall. Tied for third least important were "site selection" and "geographical member dispersion", both in the "Logistics" category. This shows that in the earliest stages, factors that might be of concern to managers of an operating enterprise are not very important to those responsible for planning. The fifth least important factor was "enforce member agreements". Commitment by producers has typically been a big problem for marketing cooperatives, but with the large initial investment made by investors in NGCs, it is becoming less so. Strong brands usually result in strong commitments by producers because they make benefits more tangible. Note, again, that Group 8 NGCs rated "brand recognition" as the most important factor.

Other (Alfalfa, Forestry, Cotton, Anonymous)

The NGCs in Group 9 came from the alfalfa, forestry, and cotton industries, with one anonymous response. With such a heterogeneous group, it is difficult to interpret overall rankings. Nevertheless, three of the four NGCs in that group are involved in production and/or processing of raw commodities, so they are similar in that regard. "Low operating costs" was ranked as the most important, followed by "managers with industry knowledge" and then two factors from the "Planning and Development" category, "steering committee" and "local champion(s) or leader(s)". This is more evidence of the overall importance of the factors in that category. The fifth most important factor was "member capital base", which is not surprising since the alfalfa and forestry NGCs are in their early stages.

The least important factor to Group 9 NGCs was "brand recognition", which is not surprising given that none of the three identifiable NGCs markets under a name brand. "Economic climate" was the second least important factor, next was "use of outside experts", and then two factors from the "Logistics" category, "geographical member dispersion" and "site selection". The low ranking of factors in that category may reflect the fact that bulky commodities are processed into products that are not logistically difficult to get to purchasers. Further evidence in favor of that hypothesis is the fact that "proximity to inputs", ranked twenty-seventh, was eight positions higher than the next most important factor in the category.

Summary and Conclusions

New Generation Cooperatives are becoming increasingly more common as agricultural producers strive to increase their share of the value produced by their commodities. NGCs, distinguishable from traditional cooperatives by limited delivery rights and restricted membership, often require large initial investments on the part of members. These enterprises retain the important cooperative principles of one-member/one vote (although some states allow flexibility in this area) and dividends based on patronage, but are more akin to investor-owned firms than their traditional counterparts. As such, the factors influencing success for NGCs may not be exactly the same as for those on either end of the ownership philosophy spectrum.

This paper detailed the results of a survey of NGC managers regarding the factors most important to NGC success. Factors in the survey were placed in ten broad categories, and were included on the basis of a review of business and cooperative literature, and on the basis of consultations with extension personnel. Respondents were asked to rate the five factors in each category from 1 to 5, using each rating only once, for the most to least important. Of the 67 unique NGCs identified from the Illinois Institute for Rural Affairs' "Directory of New Generation Cooperatives", discussion with extension personnel, and an internet search, 50 returned usable surveys, yielding a 75% response rate. The respondents were grouped into nine categories based on similar commodities or activities.

Several sets of results were presented. Figures 1 through 12 illustrated the overall number of "1" through "5" responses as well as the mean and median ratings for each factor for the 50 respondents. Table 2 showed the within-category p-values for the null hypothesis of equal mean ratings of factors. Table 3 broke down the mean ratings by factor for each of the nine groups, and showed which least-squares means were found to be significantly different across groups.

The product of the within-category factor rating and the overall category rating can be used to rank the factors for each respondent, each group, and overall. Table 4 showed the overall factors rated from 1 to 50 across all respondents, and Table 5 further broke down the overall factor rankings by group. Several interesting differences in factor rankings across groups were noted, and it was clear that factor rankings depended on the specific commodity in question. Groups whose NGCs produce goods closer to the final consumer and with a lower degree of processing and product homogeneity tended to rank different factors more highly than did groups whose NGCs are engaged in industries with more processing and more product homogeneity.

In general, factors in the "Planning and Development" category and the "Financing and Costs" category were revealed to be most important. Conversely, factors in the "Government/Regulatory Environment" and "Logistics" were often among the lowest ranked. Other categories, such as "Product Related" and "Strategic" had factors which were ranked highly by some groups but not as highly by others. As such, it seems clear that some factors are important to the success of almost all NGCs, others are important to almost none, and, as expected, the importance of some other factors depends on the type of NGC being studied.

These results should aid in the development of new NGCs and the operation of existing ones. Examples of NGCs that have failed due to poor planning or operation abound. Cognizance of the factors which are important to a particular type of NGC should help raise the success rate for NGCs, and thus enhance opportunities for producers to capture more of the value that is added to their commodities. NGCs can make important contributions to agricultural producers and to rural areas, keeping people and money from relocating elsewhere. It is in helping accomplish that goal that the results presented here are most important.

Notes

1. Torgerson (2001b) notes that as many as 75-100 NGCs may currently exist. Many of them are in the formative stages.

2. Of the 72 NGCs identified as potential respondents, a few were no longer in existence. In a few other cases, more than one identified potential respondent represented the same NGC. The number of unique potential responses was thus lowered to 67, and 50 usable responses were returned. Two unique unusable responses were not included in the calculation of the response rates.

3. 521 tax status exempts co-ops from corporate income tax if certain provisions are met.

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Table 1. Groupings of NGC Survey Respondents

Group	Respondents	Activity/Commodity
1	14	Corn Processing/Ethanol/Energy
2	6	Livestock
3	3	Poultry/Eggs
4	2	Oilseed Processors
5	5	Wheat Processors
6	10	Table Vegetables/Organic/Seafood
7	4	Coffee/Sugar/Table Nuts
8	2	Producer Alliances
9	4	Other (Alfalfa, Forestry, Cotton, Anonymous)
Total	50	

Table 2. p-values of Tests for Significant Differences in Mean Factor Ratings Within Factor Categories (H_0: means are equal)

In-Group Factor Comparison	Product Related	H.R./ Org.	Gov't/ Regulatory	Financing & Costs	Logistics
1-2	<0.01	<0.01	0.52	0.69	0.01
1-3	0.08	0.02	<0.01	<0.01	0.66
1-4	<0.01	<0.01	0.38	<0.01	0.18
1-5	0.03	<0.01	<0.01	<0.01	<0.01
2-3	<0.01	<0.01	<0.01	<0.01	<0.01
2-4	<0.01	<0.01	0.80	0.04	0.17
2-5	<0.01	0.09	<0.01	<0.01	<0.01
3-4	<0.01	0.43	<0.01	<0.01	0.04
3-5	0.76	<0.01	0.26	0.65	<0.01
4-5	<0.01	<0.01	<0.01	0.01	<0.01

In-Group Factor Comparison	Operational	Industry	Managerial	Strategic	Planning/ Development
1-2	0.53	<0.01	0.82	<0.01	0.03
1-3	<0.01	0.62	<0.01	<0.01	<0.01
1-4	0.02	0.03	0.17	0.74	<0.01
1-5	0.39	0.02	<0.01	<0.01	<0.01
2-3	<0.01	<0.01	<0.01	<0.01	0.33
2-4	<0.01	0.51	0.22	<0.01	<0.01
2-5	0.82	0.67	<0.01	<0.01	<0.01
3-4	<0.01	0.04	<0.01	<0.01	<0.01
3-5	<0.01	0.03	<0.01	0.82	<0.01
4-5	<0.01	0.82	<0.01	<0.01	<0.01

Table 3. Mean Responses and Significant Mean Differences, by Factor by Group

	Group								
Factor	1	2	3	4	5	6	7	8	9
Product Related									
product uniqueness	3.9 (6)	3.0	4.0	4.0	3.3	2.1 (1,7)	4.3 (6)	3.5	2.0
product quality	1.6	1.7	1.3	1.0	1.3	1.8	1.3	2.5	2.3
technology incorporated	2.6 (2,6)	5.0 (1,4)	3.3	2.0 (2,6)	3.8	4.9 (1,4)	3.8	5.0	3.0
customer service	2.8	2.3	2.0	3.0	2.8	2.4	2.0	2.5	2.7
brand recognition	4.0	3.0	4.3	5.0	4.0	3.8	3.8	1.5 (9)	5.0 (8)
Human Resource/Organizational									
quality of labor force	1.8	2.8	1.7	1.0	1.3	2.1	2.3	3.0	2.5
use of outside experts	3.9	2.3 (6,7)	4.7	4.5	3.5	4.6 (2)	5.0 (2)	3.0	4.5
communication within co-op	2.6	3.5	2.0	2.0	3.3	2.6	2.0	2.0	2.8
communication with board	2.9	2.7	2.7	3.0	2.8	3.1	3.0	3.0	3.0
communication with members	3.9	3.7	4.0	4.5	4.3	2.6	2.8	4.0	3.3

Table 3. Mean Responses and Significant Mean Differences, by Factor by Group (continued)

Factor	1	2	3	4	Group 5	6	7	8	9
Government/Regulatory Environment									
co-op existence laws	3.0	1.5	2.3	1.0	3.0	2.2	2.0	1.0	3.0
co-op tax advantages	2.7	3.2	2.0	2.5	1.3 (7)	2.1	4.3 (5)	2.0	3.0
demand enhanced by regulation	2.7	4.2	3.7	5.0	3.5	3.9	3.0	4.5	4.0
direct gov't agency funding	2.2	2.5	3.0	3.0	3.0	2.9	3.3	3.0	2.0
gov't planning/ tech. support	2.4	3.7	4.0	3.5	4.3	3.9	2.3	4.5	3.0
Financing and Costs									
input price stability	3.5	4.2	4.3	4.0	4.0	3.6	3.8	3.5	3.3
output price stability	3.4	2.8	4.7	5.0	3.5	3.9	4.3	2.5	3.5
low operating costs	2.4	2.5	1.7	1.5	2.3	2.3	1.0	3.0	2.8
low financing costs	3.5	3.3	2.0	2.8	3.3	2.6	2.5	5.0	2.8
member capital base	2.2	2.2	2.3	2.0	2.0	2.6	3.5	1.0	2.8

Table 3. Mean Responses and Significant Mean Differences, by Factor by Group (continued)

Factor	Group 1	2	3	4	5	6	7	8	9
Logistics									
site selection	2.4	3.2	1.3	2.5	2.8	3.5	3.0	4.5	3.5
proximity to inputs	1.8	2.0	3.0	2.5	3.3	2.0	3.0	3.0	2.0
proximity to customers	3.8 (5,6)	3.5	3.3	3.5	1.5 (1)	2.4 (1)	3.0	1.5	3.3
transport./dist. infrastructure	2.4	2.7	2.3	1.5	2.8	3.2	2.3	1.5	2.5
geog. member dispersion	4.6	3.7	5.0	5.0	4.8	2.9	3.8	4.5	3.8
Operational									
business volume	2.4	4.0	2.7	2.5	2.8	2.9	1.8	3.0	2.8
risk management	2.5	2.5	3.0	1.5	2.8	4.1	3.5	3.5	2.0
vertical integration	4.6	3.3	3.3	4.0	3.3	4.4	4.0	5.0	5.0
strong selling/ mktg. effort	1.8	2.2	3.0	3.5	2.3	1.9	2.8	1.5	2.5
targeted customer base	3.7 (6)	3.0	3.0	3.5	4.0 (6)	1.7 (1,5)	3.0	2.0	2.8

Table 3. Mean Responses and Significant Mean Differences, by Factor by Group (continued)

Factor	Group 1	2	3	4	5	6	7	8	9
Industry									
reputation	2.8	1.3 (5)	1.3 (5)	3.0	5.0 (2,3,6,9)	2.1 (5)	3.3	3.0	1.8 (5)
economic climate	2.8	3.3	2.3	2.0	3.8	3.6	4.0	4.5	4.8
market size	2.4	3.3	2.7	2.0	1.5	3.0	2.5	3.0	3.5
number of competitors	3.4	3.3	4.0	3.5	2.0	3.1	3.5	3.0	2.5
competitors' prices	3.6	3.7	4.7	4.5	2.8	3.2	1.8	1.5	2.5
Managerial									
full-time gen. manager	2.3	2.2	3.0	3.5	2.0	3.1	2.5	3.5	2.5
experienced managers	2.6	1.8	2.0	1.5	2.5	3.1	2.8	3.5	2.3
continuity of management	3.6	3.0	3.7	3.5	3.5	2.6	4.3	2.0	4.3
managers with ind. knowledge	2.6	3.2	2.0	2.3	2.3	2.1	2.0	1.0	1.3
ongoing mgr. training	4.0	4.8	4.3	4.8	4.8	4.1	3.5	5.0	4.8

Table 3. Mean Responses and Significant Mean Differences, by Factor by Group (continued)

Factor	Group 1	2	3	4	5	6	7	8	9
Strategic									
product focus	2.6	2.5	3.7	3.0	1.8	2.0	1.8	2.0	2.3
enforce member agreements	4.0	4.3	4.7	4.5	4.5	4.2	4.0	5.0	3.3
ongoing planning/checking	2.7	3.7	3.0	1.5	3.5	3.6	2.8	3.5	2.3
business strategy	2.1	2.3	1.0	3.0	2.3	2.4	2.5	1.5	3.3
multiple market sales	3.6	2.2	2.7	3.0	3.0	2.8	4.0	3.0	3.7
Planning and Development									
local champion(s) or leader(s)	1.8	1.2	2.3	2.0	2.6	1.8	2.0	1.5	1.7
steering committee	2.5	2.5	2.0	2.0	1.8	2.3	2.8	2.5	1.3
feasibility study	2.4	3.2	1.7	2.0	1.8	2.5	2.8	3.5	3.0
alliance/ partnership	3.8	3.7	4.3	4.0	4.4	4.0	3.8	3.5	4.3
proximity to other successful co-ops	4.6	4.5	4.7	5.0	4.4	4.5	3.8	5.0	4.7

Table 3. Mean Responses and Significant Mean Differences, by Factor by Group (continued)

	Group								
Factor	1	2	3	4	5	6	7	8	9
Overall Category Rankings									
product related	8.0 (6,8)	4.2	7.7	9.0	4.5	2.9 (1)	6.3	1.0 (1)	6.0
gov't/regulatory environment	5.3 (6)	7.5	9.7	8.5	9.0	9.2 (1)	9.5	10.0	4.8
logistics	6.6	8.0	7.7	4.5	8.0	6.3	6.5	9.0	7.3
planning and development	3.8	3.2	4.0	1.5	5.5	4.1	3.5	3.5	2.5
managerial	4.1	4.5	2.3	4.0	3.8	4.6	4.3	3.5	3.5
human resource/ organizational	7.8	6.2	4.7	6.0	4.8	6.1	8.5	5.0	6.0
financing and costs	4.4	4.7	3.3	4.5	5.0	2.9	3.0	4.0	2.3
operational	4.4	5.8	5.3	8.0	4.5	4.0	3.5	6.0	4.5
industry	5.6	6.2	5.7	3.5	4.8	7.7	6.0	6.5	6.8
strategic	5.1	4.8	4.7	5.5	5.3	7.2	7.0	6.5	3.0

Note: numbers in parentheses are those groups which have different least-squares means at the 10% significance level.

Table 4. Overall Factor Rankings and Weighted Mean Ranks

Rank	WMR	Factor	Group
1	7.2	local champion(s) or leader(s)	Planning and Development
2	8.3	low operating costs	Financing and Costs
3	8.6	steering committee	Planning and Development
4	8.7	member capital base	Financing and Costs
5	9.2	feasibility study	Planning and Development
6	9.2	managers with knowledge of industry	Managerial
7	9.7	product quality	Product Related
8	10.4	experienced managers	Managerial
9	10.8	strong selling/marketing effort	Operational
10	11.2	full-time general manager	Managerial
11	12.0	product focus	Strategic
12	12.5	low financing costs	Financing and Costs
13	12.9	continuity of management	Managerial
14	13.2	risk management	Operational
15	13.5	business strategy	Strategic
16	13.6	business volume	Operational
17	13.7	output price stability	Financing and Costs
18	14.0	quality of labor force	HR/Organizational
19	14.2	alliance/partnership	Strategic
20	14.2	input price stability	Financing and Costs

Table 4. Overall Factor Rankings and Weighted Mean Ranks (continued)

Rank	WMR	Factor	Group
21	14.2	reputation	Industry
22	14.3	customer service	Product Related
23	14.4	targeted customer base	Operational
24	15.8	co-op existence laws	Government/Regulatory
25	15.9	proximity to inputs	Logistics
26	16.3	proximity to other successful co-ops	Planning and Development
27	16.8	communication within co-op	HR/Organizational
28	16.8	market size	Industry
29	16.8	multiple market sales	Strategic
30	17.1	co-op tax advantages	Government/Regulatory
31	17.3	ongoing managerial training	Managerial
32	17.7	ongoing planning/checking	Strategic
33	18.3	transportation/distribution infrastructure	Logistics
34	18.4	communication with board	HR/Organizational
35	18.6	technology incorporated	Product Related
36	19.1	vertical integration	Operational
37	19.3	number of competitors	Industry
38	19.4	direct government agency funding	Government/Regulatory
39	19.9	competitors' prices	Industry
40	20.0	site selection	Logistics

Table 4. Overall Factor Ratings and Weighted Mean Ranks (continued)

Rank	WMR	Factor	Group
41	20.2	product uniqueness	Product Related
42	21.0	proximity to customers	Logistics
43	21.1	economic climate	Industry
44	22.1	brand recognition	Product Related
45	22.9	communication with members	HR/Organizational
46	24.1	enforce member agreements	Strategic
47	26.2	use of outside experts	HR/Organizational
48	26.5	demand enhanced by regulation	Government/Regulatory
49	27.9	government planning support/ technical assistance	Government/Regulatory
50	29.9	geographical member dispersion	Logistics

Note: WMR is "weighted mean rank", the average over all respondents of the category rank weighted by the factor rank.

Table 5. Weighted Mean Ratings by Factor by Group

Factor	Overall	Group 1	2	3	4	5	6	7	8	9
Product Related										
product uniqueness	41	50	18	46	48	19	4	49	4	32
product quality	7	19	2	16	14	2	2	5	2	38
technology incorporated	35	38	37	44	32	29	20	39	7	41
customer service	22	43	9	24	41	24	1	15	2	39
brand recognition	44	47	10	47	50	30	16	42	1	50
Human Resource/Organizational										
quality of labor force	18	26	32	10	6	1	18	38	32	26
use of outside experts	47	46	22	38	40	30	46	50	39	48
commun. within co-op	27	39	35	13	19	27	26	28	10	21
commun. with board	34	41	25	20	31	17	37	44	18	17
commun. with members	45	48	42	31	43	38	29	41	29	37

Table 5. Weighted Mean Ratings by Factor by Group (continued)

Factor	Overall	Group 1	2	3	4	5	6	7	8	9
Government/Regulatory Environment										
co-op existence laws	24	20	14	40	13	47	34	7	15	40
co-op tax advantages	30	16	45	35	36	14	35	44	35	34
regulatory enh. demand	48	34	50	48	49	48	49	37	49	43
direct gov't agency funding	38	17	30	45	41	46	45	26	44	22
gov't plan/ tech. support	49	44	47	49	45	49	50	13	49	36
Financing and Costs										
input price stability	20	26	34	22	31	37	13	19	24	9
output price stability	17	24	16	26	37	35	14	22	13	12
low operating costs	2	6	11	4	13	13	5	1	22	1
low financing costs	12	30	26	7	23	26	8	4	35	6
member capital base	4	4	7	7	5	15	10	7	6	5

Table 5. Weighted Mean Ratings by Factor by Group (continued)

		Group								
Factor	Overall	1	2	3	4	5	6	7	8	9
Logistics										
site selection	40	25	46	14	19	41	39	33	47	46
proximity to inputs	25	14	27	39	17	45	17	36	42	27
proximity to customers	42	45	48	41	26	16	25	32	24	44
transport./dist. infrastructure	33	33	41	36	8	42	38	24	24	35
geog. member dispersion	50	49	49	49	37	50	41	46	47	47
Operational										
business volume	16	7	44	22	34	28	19	2	28	17
risk management	14	9	21	31	22	10	28	20	40	10
vertical integration	36	37	28	28	47	24	31	24	44	42
strong selling/ mktg. effort	9	2	24	24	43	12	7	12	12	15
targeted customer base	23	31	29	26	46	34	6	10	27	19

Table 5. Weighted Mean Ratings by Factor by Group (continued)

Factor	Overall	Group 1	2	3	4	5	6	7	8	9
Industry										
reputation	21	23	5	5	18	43	24	30	35	15
economic climate	43	29	32	28	8	30	47	43	43	49
market size	28	22	36	18	10	4	40	26	34	45
number of competitors	37	35	40	41	19	11	42	40	33	30
competitors' prices	39	40	43	43	26	22	43	16	15	33
Managerial										
full-time gen. manager	10	3	15	11	25	7	26	10	18	10
experienced managers	8	12	4	2	4	7	22	16	20	8
continuity of management	13	21	16	11	23	20	15	29	10	25
mgrs. with ind. knowledge	6	10	20	1	10	7	11	7	4	2
ongoing mgr. training	31	28	37	15	35	33	33	31	30	31

Table 5. Weighted Mean Ratings by Factor by Group (continued)

		Group								
Factor	Overall	1	2	3	4	5	6	7	8	9
Strategic										
product focus	11	10	11	31	30	5	21	18	20	7
enforce mbr. agreements	46	42	37	37	39	43	48	48	46	29
ongoing planning/checking	32	15	30	19	13	38	44	35	41	13
business strategy	15	13	19	2	29	18	32	34	15	20
multiple market sales	29	36	3	21	26	20	36	47	35	24
Planning and Development										
local champ. or leader	1	1	1	16	3	23	3	2	8	4
steering committee	3	8	7	5	2	3	9	6	13	3
feasibility study	5	4	6	7	1	5	11	14	22	14
alliance/ partnership	19	18	13	31	6	40	23	20	9	22
proximity to successful co-ops	26	31	22	30	12	35	30	23	30	28

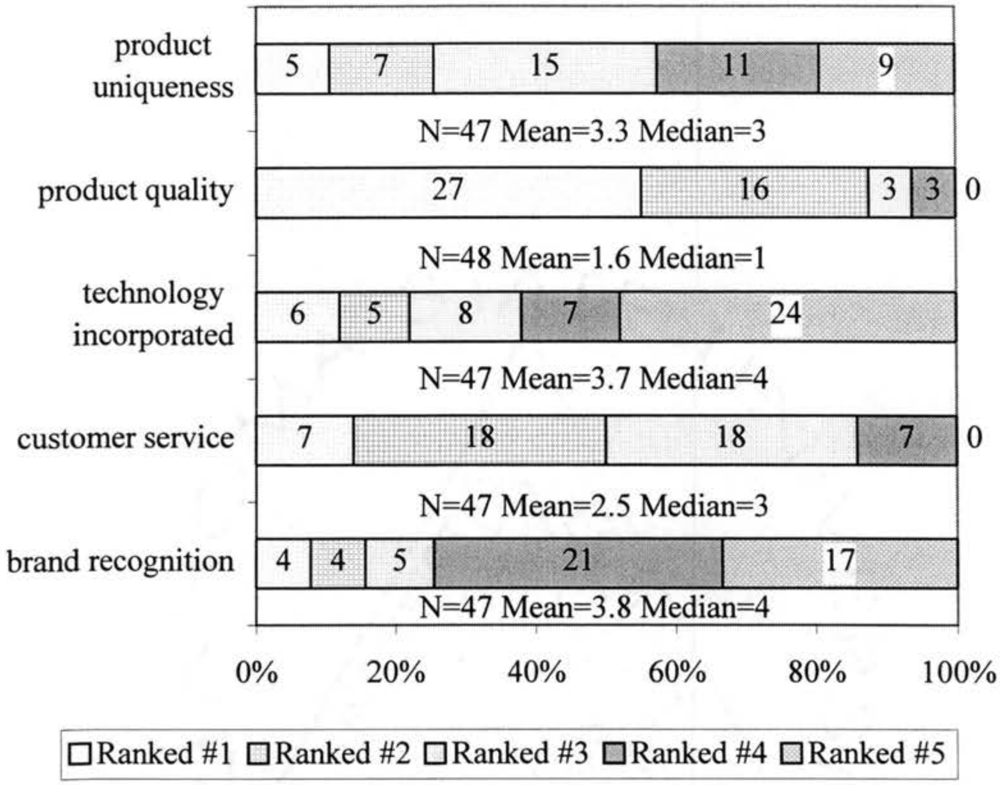

Figure 1. Distribution of Responses in the 'Product Related' Category

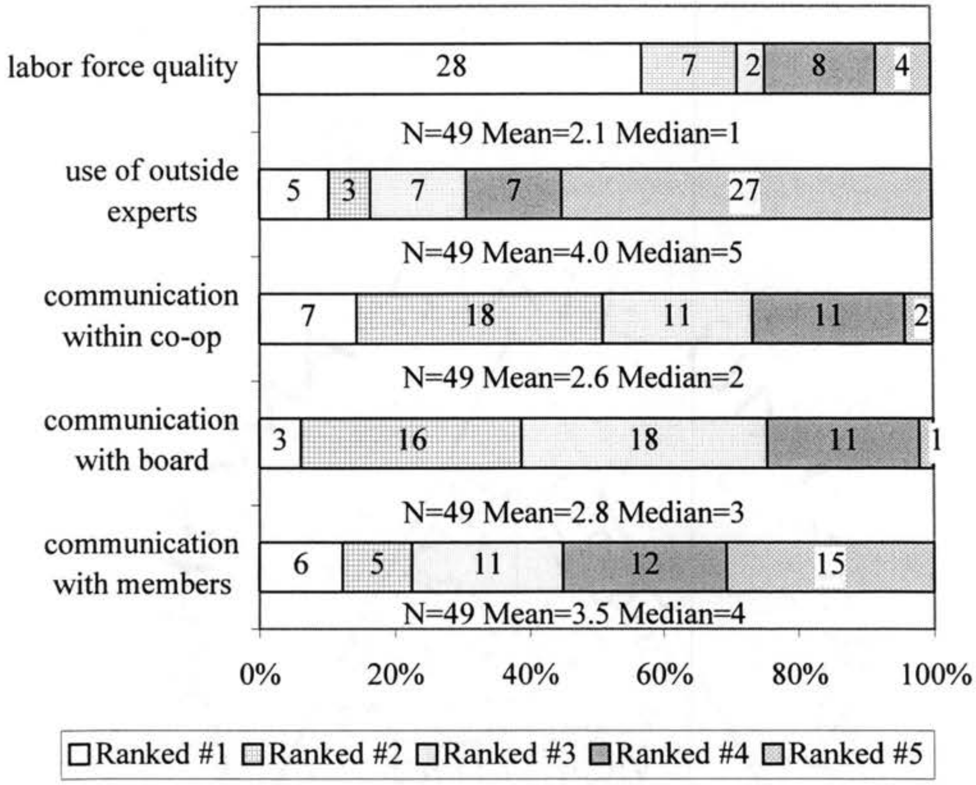

Figure 2. Distribution of Responses in the 'Human Resource/Organizational' Category

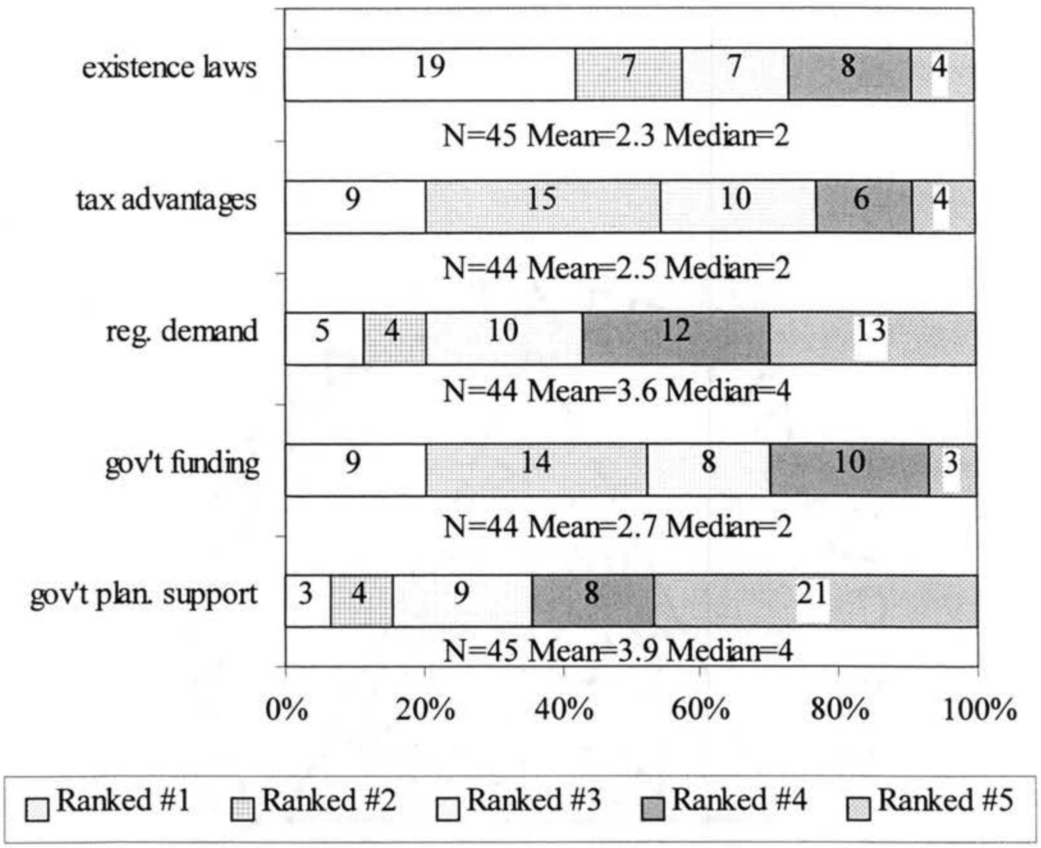

Figure 3. Distribution of Responses in the 'Government/Regulatory Environment' Category

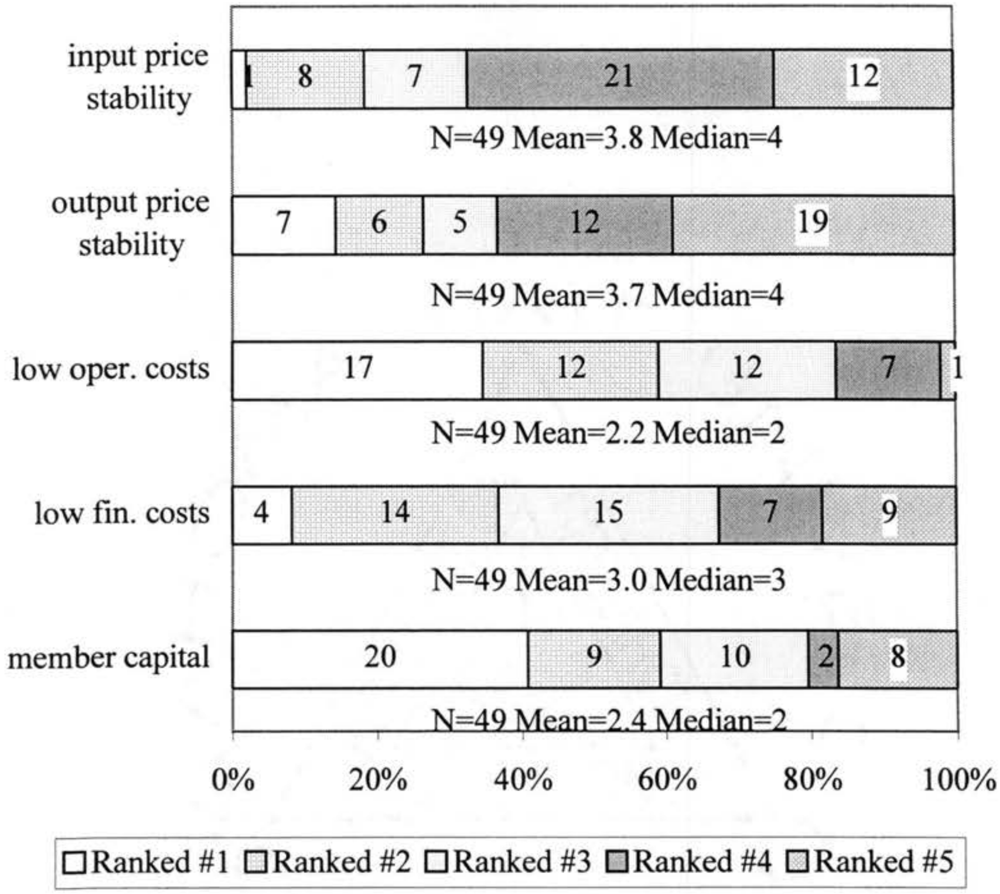

Figure 4. Distribution of Responses in the 'Financing and Costs' Category

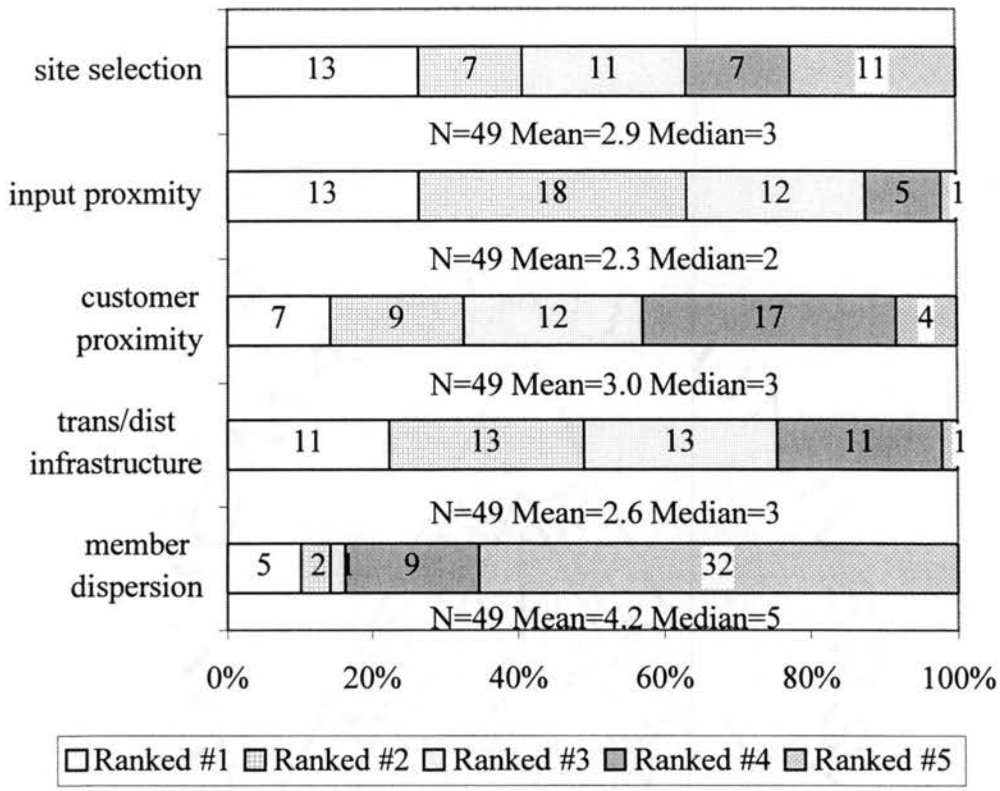

Figure 5. Distribution of Responses in the 'Logistics' Category

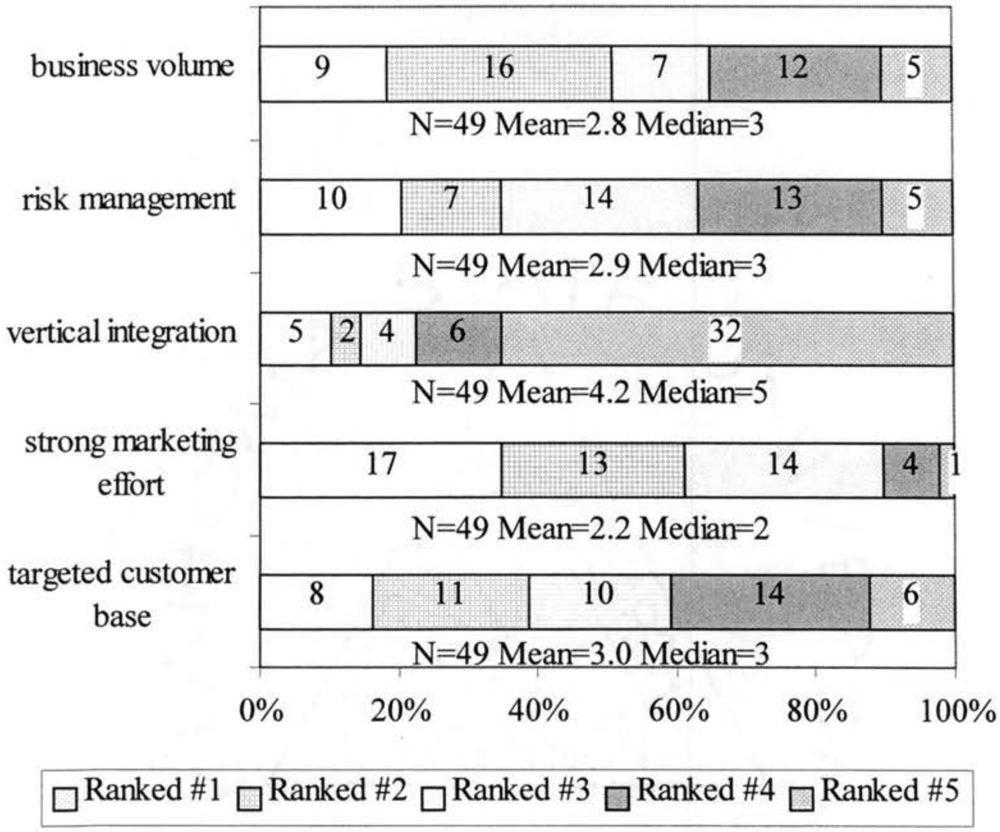

Figure 6. Distribution of Responses in the 'Operational' Category

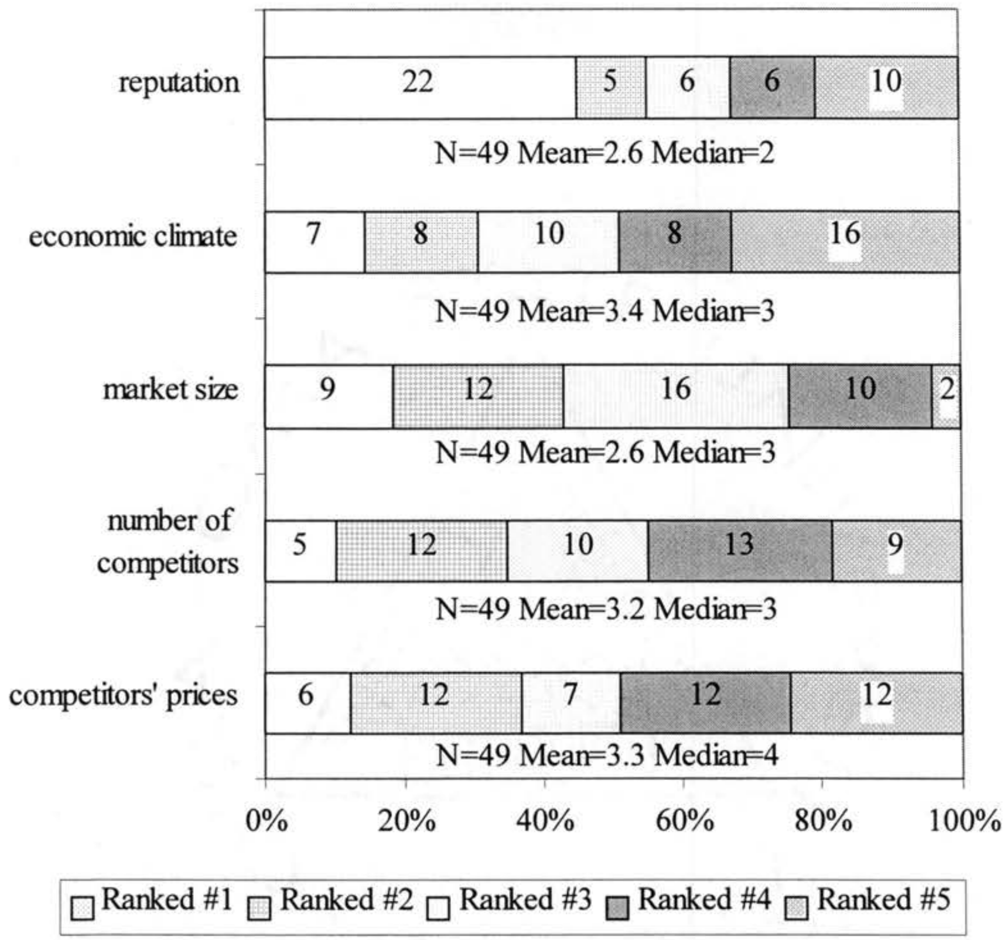

Figure 7. Distribution of Responses in the 'Industry' Category

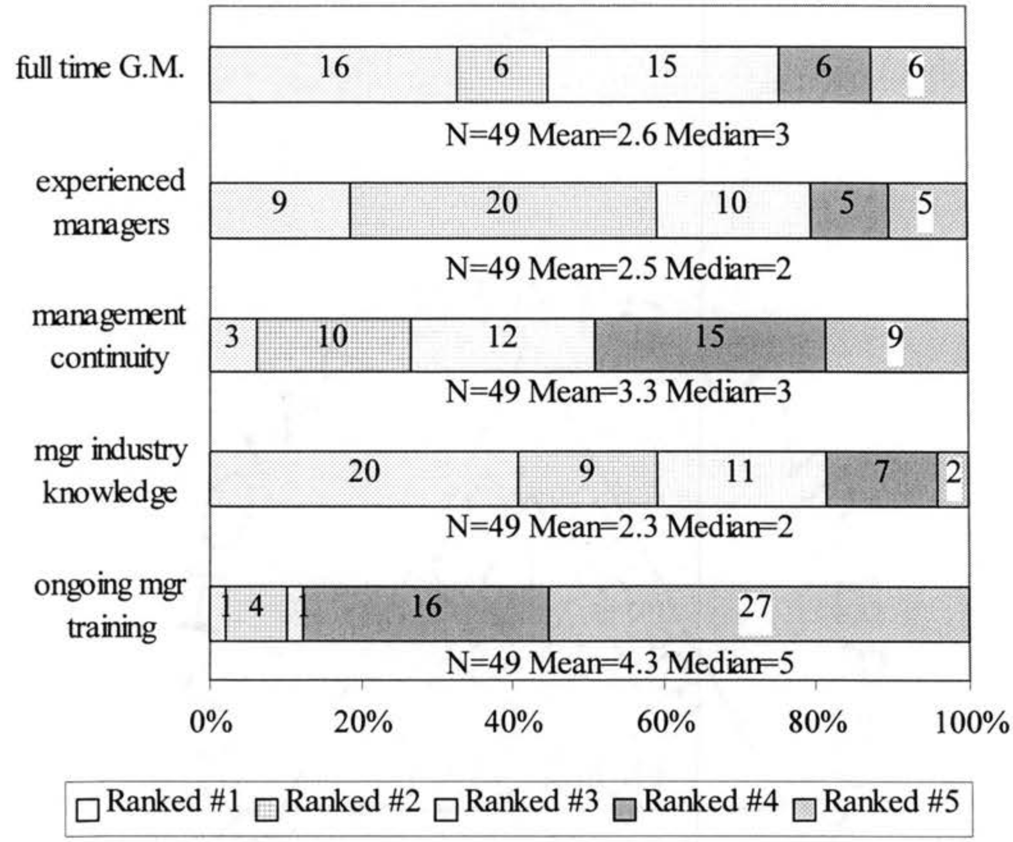

Figure 8. Distribution of Responses in the 'Managerial' Category

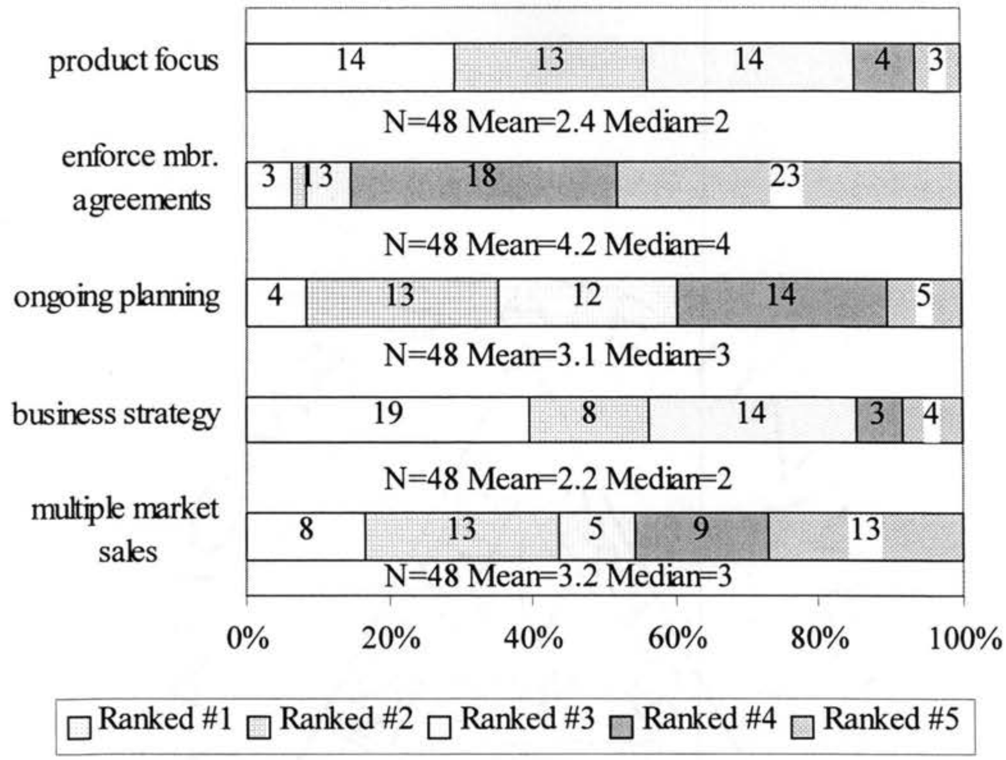

Figure 9. Distribution of Responses in the 'Strategic' Category

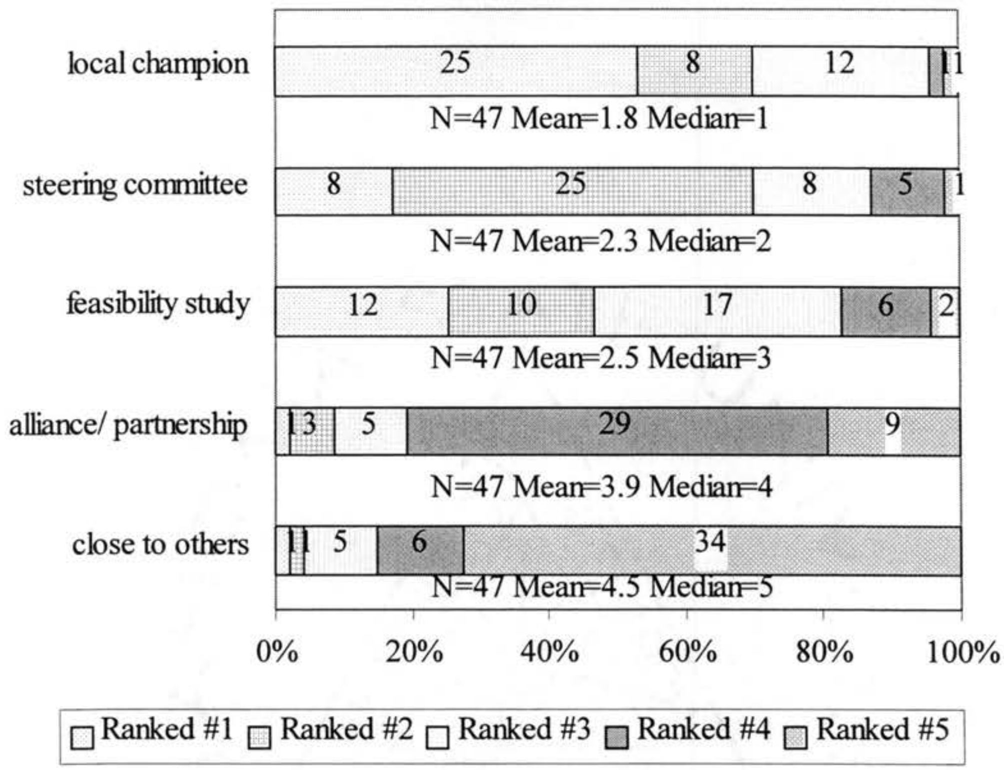

Figure 10. Distribution of Responses in the 'Planning and Development' Category

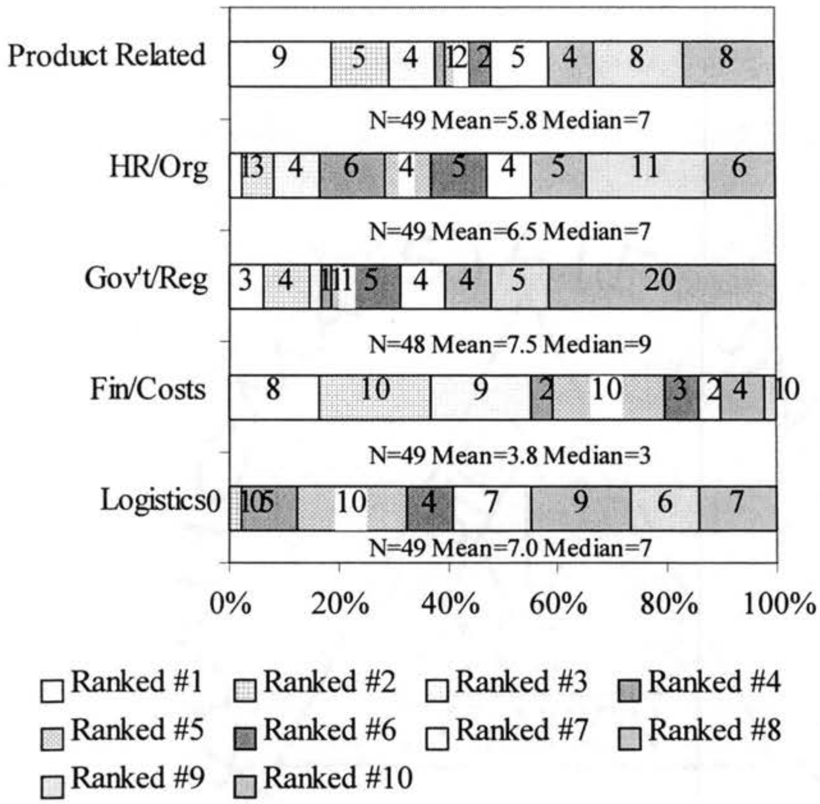

Figure 11. Distribution of Responses for First Five Overall Category Rankings

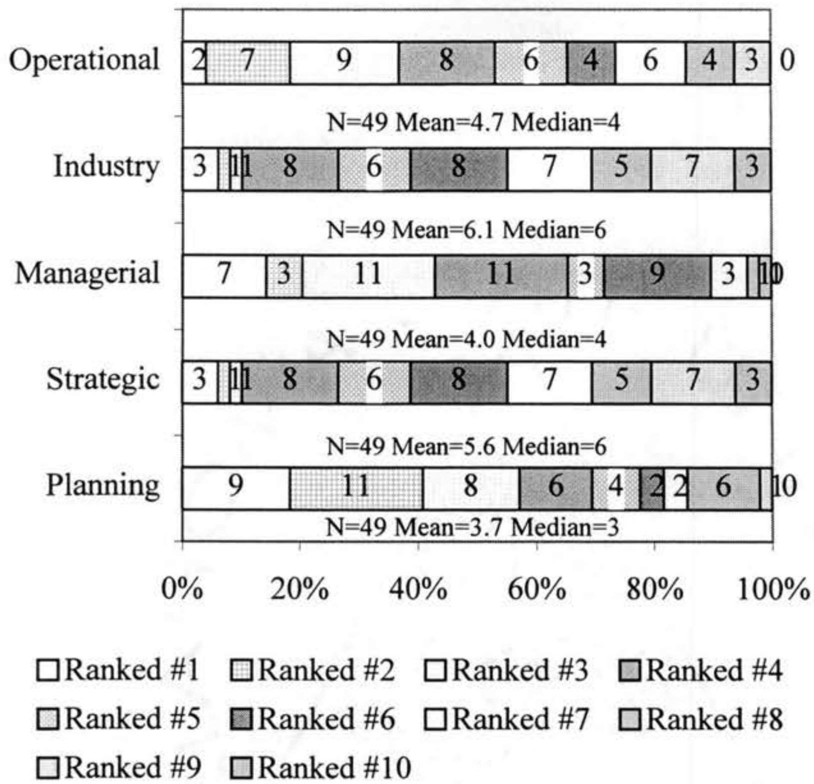

Figure 12. Distribution of Responses for Second Five Overall Category Rankings

Appendix A

Value-Added Cooperative Questionnaire

Please rank the factors listed in the following categories **in order of importance** to the success of your cooperative. Each category contains five factors. The **most important factor** in a category should receive a "1" in the available space, the second most important a "2", and so on, with the least important factor receiving a "5". Please rank all factors in each category.

Please rank the following factors with respect to their importance to the success of a cooperative.

Product Related (give most important factor a "1", second most a "2", and so on...)

___**product uniqueness**: product has unique characteristic(s) for satisfying customer needs

___**product quality**: the ability of the product to function properly and consistently

___**technology incorporated**: level of technological sophistication in production/ processing

___**customer service:** working with customers in the use of products after selling and ensuring problems are corrected if the product does not function correctly

___**brand recognition**: the co-op's product is branded, or tied to a branded product

Human Resource/Organizational (give most important factor a "1", second most a "2", and so on...)

___**quality of labor force**: ability of employees to do their jobs properly and consistently

___**use of outside experts**: bringing in outside help or consultants when a task cannot be done in-house

___**communication within co-op**: communication between and among co-op managers and employees

___**communication with board**: communication between the co-op managers and board of directors

___**communication with members**: communication between managers/directors and the co-op's members

Government/Regulatory Environment (give most important factor a "1", second most a "2", and so on...)

___**co-op existence laws**: laws that allow members to act collectively; ie Capper-Volstead Act. These laws exempt co-ops from falling under antitrust rules such as the Sherman Anti-Trust Act.

___**co-op tax advantages (ie 521 tax status)**: "521 status" exempts co-ops from corporate tax if certain requirements are met ___**demand enhanced by regulation**: government regulation creates a demand for the product; for example, for environmental reasons

___**direct government agency funding**: grants or loans are available from government agencies, or a state/federal subsidy is received by the co-op (not a producer payment/subsidy)

___**government planning support/technical assistance**: government assistance, in the form of funding or manpower, is available for the planning of the co-op or conducting a feasibility study

Financing and Costs (give most important factor a "1", second most a "2", and so on...)

___**input price stability**: limited variation in prices of needed inputs/commodities

___**output price stability**: limited variation in prices of products produced/sold

___**low operating costs (not financing)**: running the co-op's operations at a minimum cost

___**low financing costs**: ability to obtain financing at low interest rates

___**member capital base**: members have sufficient initial equity, requiring less borrowing

Logistics (give most important factor a "1", second most a "2", and so on...)

___**site selection**: availability of land and adequate utilities

___**proximity to inputs**: distance inputs must be transported to be processed

___**proximity to customers**: distance outputs must be transported to get to customers

___**transportation/distribution infrastructure**: ease of access to adequate roads, rail service, etc.

___**geographical member dispersion**: how members are "scattered" across one or more regions

Operational (give most important factor a "1", second most a "2", and so on...)

___**business volume**: amount of output that is produced and sold

___**risk management**: identification, understanding, and management of various types of risk

___**vertical integration**: purchase by the co-op of another link in the supply chain; for instance, purchase of a further processing facility, wholesale, or retail outlet

___**strong selling/marketing effort**: emphasis placed on sales/marketing of a product

___**targeted customer base**: co-op's targeted markets/customers are well-defined

Industry (give most important factor a "1", second most a "2", and so on...)

___**reputation**: the co-op's reputation for doing business with members and customers ___**economic climate**: such as recessions, interest rates, unemployment rates, exchange rates, etc.

___**market size**: volume of business done by the co-op; both by the co-op and its competitors

___**number of competitors**: number of businesses in the co-op's market selling the same or a competing product

___**competitors' prices**: price charged by co-op's competitors for the same or a competing product

Managerial (give most important factor a "1", second most a "2", and so on…)

___**full-time general manager**: general manager on staff full-time

___**experienced managers**: managers have previous managerial experience

___**continuity of management**: low turnover rate for managers

___**managers with knowledge of industry**: managers have knowledge of the industry co-op operates in

___**ongoing managerial training**: managers receive periodic updates to their training

Strategic (give most important factor a "1", second most a "2", and so on…)

___**product focus**: co-op efforts focus on improving and enhancing product quality

___**enforce member agreements**: members' delivery obligations and other responsibilities are enforced

___**ongoing planning/checking**: co-op does planning & checking of performance on an ongoing basis

___**business strategy**: co-op has an overall business strategy vis-à-vis competitors which is adhered to

___**multiple-market sales**: selling in more than one geographic market, or selling multiple products

Planning and Development (all of these factors relate to the early planning/development stage for a co-op)

___**local champion(s) or leader(s)**: most promotion and legwork was done by local champion(s)/leader(s)

___**steering committee**: early on, a committee of individuals was responsible for "keeping things rolling"

___**feasibility study**: an initial feasibility study was done to assess the viability of the co-op

___**alliance/partnership**: an alliance or partnership with an existing co-op was entered into or planned ___**proximity to other successful co-ops**: a closely located successful co-op was looked to as an example

Please rank these 10 categories with respect to their overall importance to co-op success. Assign a "1" to the most important category, "2" to the second and so on down to "10" for the least important.

___Product Related
___Government/Regulatory Environment
___Logistics
___Planning and Development
___Managerial
___Human Resource/Organizational
___Financing and Costs
___Operational
___Industry
___Strategic

Please fill out the following (optional). This information will not be released in any way.

Co-op Name (please print):____

Your Name and Position (please print):____

Please check one of the following

___I agree to possible further contact to clarify/follow up any of the responses I have given

___Please **do not** contact me to clarify/follow up on any of the responses I have given

Thank you for helping us with your responses! If you have any questions or concerns, please contact Jared Carlberg, 308 Agricultural Hall, Stillwater, OK 74078 or call (405) 744-9969 or email carlbej@okstate.edu

Appendix B

Oklahoma State University
Institutional Review Board

Protocol Expires: 2/7/03

Date: Friday, February 08, 2002

IRB Application No AG0227

Proposal Title: ADDING VALUE IN THE 21TH CENTURY: LESSONS FROM VALUE-ADDED ENTERPRISES

Principal Investigator(s):

Jared Carlberg
308 Ag Hall
Stillwater, OK 74078

Clement E. Ward
513 Ag Hall
Stillwater, OK 74078

Reviewed and Processed as: Exempt

Approval Status Recommended by Reviewer(s): Approved

Dear PI :

Your IRB application referenced above has been approved for one calendar year. Please make note of the expiration date indicated above. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval.
2. Submit a request for continuation if the study extends beyond the approval period of one calendar year. This continuation must receive IRB review and approval before the research can continue.
3. Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of this research; and
4. Notify the IRB office in writing when your research project is complete.

Please note that approved projects are subject to monitoring by the IRB. If you have questions about the IRB procedures or need any assistance from the Board, please contact Sharon Bacher, the Executive Secretary to the IRB, in 203 Whitehurst (phone: 405-744-5700, sbacher@okstate.edu).

Sincerely,

Carol Olson

Carol Olson, Chair
Institutional Review Board

VITA 2

Jared Garfield Carlberg

Candidate for the Degree of

Doctor of Philosophy

Thesis: BEEF PACKER CONDUCT, ALTERNATIVE APPROACHES TO PRICE DISCOVERY, AND SUCCESS FACTORS FOR NEW GENERATION COOPERATIVES

Major Field: Agricultural Economics

Biographical:

Personal Data: Born in Regina, Saskatchewan, on March 24th, 1973, the son of Collette and Raymond Carlberg.

Education: Graduated from Fillmore High School, Fillmore, Saskatchewan in June 1991; received Bachelor of Arts degree with Honours in Economics and a Bachelor of Commerce degree from the University of Saskatchewan in May 1997; received a Master of Science degree in Agricultural Economics from the University of Saskatchewan in October 1999. Completed the requirements for the Doctor of Philosophy with a major in Agricultural Economics at Oklahoma State University August of 2002.

Experience: Raised in the farming community of Osage, Saskatchewan; worked as a research assistant in the Department of Agricultural Economics, University of Saskatchewan, from September of 1997 until August of 1999; research and teaching assistant in the Department of Agricultural Economics, Oklahoma State University, from August of 1999 until May of 2002.

Professional Memberships: American Agricultural Economics Association, Western Agricultural Economics Association, Southern Agricultural Economics Association, American Economic Association.