PRICE DETERMINATION IN SLAUGHTER CATTLE PROCUREMENT

SECTION 4
TRANSACTIONS DATA: ANALYSIS OF FACTORS AFFECTING PACKER CHOICE OF SLAUGHTER CATTLE PROCUREMENT AND PRICING METHODS

In obtaining fed cattle for slaughter, packers must choose among several alternative methods of both procurement and pricing. The most commonly reported procurement methods include: (1) the open or spot market, (2) marketing agreements, i.e., long-term purchase arrangements in which the packer agrees to purchase a specified number of cattle per specified time period, (3) forward contracting, and (4) packer fed/owned. The most commonly reported pricing methods include: (1) liveweight, (2) carcass weight, and (3) formula, e.g., pricing based on a packer's weekly average prices paid or on an average of two or more price reports, etc. While procurement and pricing policies may be made at the firm or plant level, the actual procurement and pricing decisions are often made in the field by cattle buyers salaried by meat packers or employed on a commission basis. At each level, however, a number of factors ultimately affect the procurement and pricing methods chosen for different lots of cattle including key characteristics related to the purchasing plant or firm, the fed cattle seller, the particular lots of fed cattle purchased, and the slaughter and sale of beef by packers. A number of those factors are represented in the daily fed cattle purchase transactions records (i.e., the transactions data) collected by PSP from the top 43 steer and heifer beef packing plants for the period April 5, 1992, to April 3, 1993.

In this section, the transactions data are analyzed to identify those characteristics that significantly affected the *choices* of fed cattle procurement and pricing methods by the top steer and heifer packing plants during the period of the data and to measure the extent of their effects. After laying out the underlying methodology and the model to be used, the transactions data as used for this analysis are described. The empirical results are then discussed including some indication of the predictive ability of the model. Following a brief discussion of the limitations of this study, conclusions and implications of the empirical results related to the procurement and practices of the top beef packers are discussed.

Methodology

A *Polychotomous Choice Model* is used to identify and measure the effects of those transactions characteristics that affected the *choice* of cattle procurement method and the *choice* of lot pricing method by packers during the period of the data. After discussing the application of this type of model for analyzing procurement and pricing method choices by packers, the specification of the model as used for the analysis is considered.

The Polychotomous Choice Model and Cattle Procurement and Pricing Choices

For both procurement and pricing methods, the dependent variables of the polychotomous choice model correspond to discrete values, taking on discrete values from 0 to k-1, where k refers to the maximum number of procurement or pricing methods. Cattle procurement and lot pricing methods are examples of unordered categorical variables. That is, they are dependent variables whose values may be defined in any order desired.

Because the dependent variables correspond to discrete values, the probability that the *j*th procurement or pricing method is chosen, conditional on the given transactions characteristics, can be investigated. Because procurement and pricing methods are represented by unordered variables and because there are more than two types for each method, the analysis requires the use of the *multinomial logit model.*

In the multinomial logit model, for the *i*th observation corresponding to a set of right-hand-side (RHS) variables (x_i), the probability of the selection of choice j is given as:

$$(1)\quad P_{ij} = \frac{\exp\,(B_j\ x_i)}{\sum_{j=0}^{k} \exp\,(B_j\ x_i)} \qquad j = 0,\ 1,\ \ldots\ ,\ k1$$

where P_{ij} is the probability that for the ith observation (for I = 1,...,n), choice j is made; the B_j are the parameters to be estimated; and k=4 for procurement methods and k=5 for pricing methods. Following Greene, the normalization rule is that B_0=0. Also, for all I:

$$(2)\quad \sum_{j=0}^{k1} P_{ij} = 1.$$

Each of the n observations falls into one of the k types of procurement or pricing methods with the probabilities as given in the equations above. Let y_{ij}=1 if the ith observation falls into the jth type category and let y_{ij}=0 otherwise. Then the likelihood function for the multinomial logit model is written as:

$$(3)\quad L = \prod_{i=1}^{n} P_{i0}^{y_{i0}}\ \ P_{i1}^{y_{i1}}\ \ \cdot\ \cdot\ \cdot\ \ P_{ik1}^{y_{ik1}}$$

$$(4)\quad \log L = \sum_{i=1}^{n} \sum_{j=0}^{k1} y_{ij} \log\ P_{ij}$$

or as:

To determine estimates of the parameters B_1, B_2, . . ., B_k, the foregoing log-likelihood function is maximized. However, because the log-likelihood function is nonlinear in parameters, an iterative estimation procedure must be used. Given the maximization of the log-likelihood function, likelihood ratio tests can be used to determine which of the exogenous transactions characteristics

are statistically significant. Also, after deriving estimates of the parameters B_1, B_2, . . ., B_k, the probabilities that for the ith observation the jth type of procurement or lot pricing methods is chosen can be computed. Estimation of the multinomial logit model requires the use of specialized computer software. For this analysis, the LIMDEP package is used (Greene).

To derive marginal effects in the multinomial logit model, consider $\partial P_{ij} / \partial x_{ij}$, the change in the probability of the jth choice given a change in x_i, which is given as:

$$(5) \quad \frac{\partial P_{ij}}{\partial x_i} = P_{ij} \left[B_j - \left(\sum_{j=0}^{k1} B_j P_{ij} \right) \right] \qquad j = 0, 1, \ldots, k1$$

Neither the sign nor the magnitude of $\partial P_{ij}/\partial x_{ij}$ need bear any relationship to those of the B_j. Note also that for a given x_i, the marginal effects sum to zero across all types of a procurement or pricing method:

(6) $\sum_{j=0}^{k1} \frac{\partial P_{ij}}{\partial x_i} = 0$. That is, given changes in x_i, not only will at least one probability of a choice rise but also at least one probability must fall. The marginal effects may also be converted into elasticities as follows:

$$(7) \quad \_{ij} = \frac{\partial P_{ij}}{\partial x_i} \frac{x_i}{P_{ij}} = P_{ij} \left[B_j \left(\sum_{j=0}^{k1} B_i P_{ij} \right) \right] \frac{x_i}{P_{ij}}, \quad j = 0,1,\ldots,k1.$$

The multinomial logit model also may be used to predict the choices made in the procurement and pricing decisions. Given the set of RHS variables x_i, as well as the estimated coefficient vectors B_1, B_2, . . ., B_{k-1}, the associated probabilities P_{i0}, P_{i1}, . . ., P_{ik-1} may be computed. The maximum of (P_{i0}, P_{i1}, . . ., P_{ik-1}) is then the prediction of the procurement or lot pricing method chosen for a particular lot I.

The following contingency table, also known as the prediction-success table, can be used to determine the usefulness of the multinomial logit model for prediction purposes:

		PREDICTION					
		0	1	2	…	k-1	Total
A	0	d_0					n_0

C	1	d_1				n_1
T	2		d_2			n_2
U						
A	–			–		–
L	k-1				d_{k-1}	n_{k-1}
	Total	m_0	m_1	m_2	…	m_{k-1}	n

The n_0, n_1, n_2, . . ., n_{k-1} in the table refer to the number of observations corresponding to actual outcomes of the choices made. The m_0, m_1, m_2, . . ., m_{k-1} refer to the observations corresponding to the predicted outcomes in a particular category. The d_0, d_1, d_2, . . ., d_{k-1} refer to the number of observations for which the actual outcomes and the predicted outcomes match. For example, if P_{i0}=.43, P_{i1}=.17, P_{i2}=.07, and P_{i3}=.33 (note that the sum of these hypothetical probabilities equals 1), then the predicted outcome is that associated with the subscript 0 (the first of the four possibilities) since it has the highest probability. If, in this case, the actual outcome is also the first of the four choices, then the model made a successful prediction. Consequently, the diagonal elements of the prediction-success table (d_0, d_1, d_2, . . ., d_{k-1}) indicate the ability of the model to make successful predictions.

Thus, a measure of the multinomial logit model in making successful predictions is given by: $\frac{\sum_{j=0}^{k1} d_j}{n}$.

As well, the predictive ability of the model could be determined by outcome as:

$$\frac{d_0}{n_0}, \frac{d_1}{n_1}, \frac{d_2}{n_2}, \ldots, \frac{d_{k1}}{n_{k1}}.$$

Model Specification

Except for the work by Ward about 15 years ago, research on slaughter cattle pricing and procurement practices of meat packers is scant. Although useful, the Ward study is a *qualitative* not a *quantitative* assessment. As far as the authors are aware, the research reported here is the first quantitative analysis of the pricing and procurement practices of meat packers. Although the factors discussed by Ward are considered, this analysis also augments his work. To this end, the RHS variables (i.e., the x_i) in the polychotomous choice models for procurement and lot pricing methods are postulated to include the following:

Procurement Method: (1) output price of beef; (2) maximum slaughter capacity; (3) capacity utilization; (4) the number of cattle in the lot; (5) the average weight per head in the lot; (6) the number of days elapsed between purchase and slaughter; (7) the regional Herfindahl index; (8) the distance in miles between the seller and the packer; (9) seasonality; (10) cattle type; (11) yield grade of the lot; and (12) quality grade of the lot.

Lot Pricing Method: (1) output price of beef; (2) maximum slaughter capacity; (3) capacity utilization; (4) the number of cattle in the lot; (5) the average weight per head in the lot; (6) the number of days elapsed between purchase and slaughter; (7) the regional Herfindahl index; (8) the distance in miles between the seller and the packer; (9) seasonality; (10) cattle type; (11) yield grade of the lot; (12) quality grade of the lot; and (13) procurement method.

Note that the only difference in the specification of the two models is that the lot pricing method model includes procurement method as an RHS variable while the reverse is not true. In other words, procurement and pricing decisions are hypothesized to be non-simultaneous. By hypothesis, procurement decisions are made initially independent of pricing decisions. The lot pricing method choice, on the other hand, is hypothesized to be affected by the choice of procurement method. For example, if the procurement method is the spot market (which comprises approximately 81% of the transactions according to the transactions data), then the pricing method is generally either liveweight or carcass weight (Figure 4.1). By the same token, if the procurement method is forward contracting or packer fed cattle (7.5% and 3.0% of the transactions, respectively), then the most predominant lot pricing method is carcass weight.

The *output price* as defined and used in this analysis is the weighted average revenue per lb received for seven types of beef output shipped by each packer: (1) whole carcass equivalents, (2) primals, (3) sub-primals, (4) other fabricated cuts, (5) trimmings, boneless beef, or grinding material from fabrication operation, (6) carcass beef (whole, halves, quarters), and (7) by-products, variety meats, and kill floor grinding material. The output price information was made available by PSP from their Beef Packer Costs and Returns Survey (BPCRS) by packing plant and by week (see Table 1.6 in section 1 of this report).

Information on *slaughter capacity* also was provided from the BPCRS by PSP. Only two observations on slaughter capacity were collected for each plant, one for the first day of the period (April 5, 1992) and the other for the last day of the period (April 3, 1993). If the plant capacity was different on the two dates, the maximum of the two capacity observations was used in our analysis. Slaughter capacity (measured as number of head slaughtered per hour) is a proxy variable for returns to scale in plant operations. Slaughter capacity is the same across weeks but, in general, varies by plant.

Procurement and pricing methods also may depend in part on *characteristics of the purchase lots*. The model includes several lot characteristics as RHS variables, including: (1) the number of cattle in the lot; (2) the average weight of the lot; (3) cattle type; (4) yield grade; and (5) quality grade of the lot. The first is a simple count of the number of cattle in the lot. The second is the total liveweight of the lot divided by the number of cattle in the lot. Cattle types include: (1) dairy; (2)

fed Holsteins; (3) steers; (4) heifers; and (5) mixed. Because cattle type is a qualitative factor, dummy variables were used to account for this attribute of the purchase lots. The same is true for yield grades and quality grades of the lots. Two groups of variables are included to capture these important quality characteristics intrinsic in each lot. The first group is represented by three dummy variables corresponding to the prominent yield grade in each lot: (1) lots that are predominantly yield grade 1 (YG1), (2) lots that are predominantly yield grade 2 (YG2), and (3) lots that are predominantly yield grades 3, 4, and 5 (YG3). The second group of quality variables is a series of dummy variables representing lots that are predominantly prime (P), choice (C), or select (S).

Because transactions took place over the period of a year (April 5, 1992, to April 3, 1993), procurement and pricing methods may vary by season. Quarterly dummy variables were employed to represent *seasonality* for the following three-month periods: (1) April 1992 to June 1992, (2) July 1992 to September 1992, (3) October 1992 to December 1992, and (4) January 1993 to April 3, 1993.

Ward found that most cattle are purchased for a specific plant from within a 100-mile radius of that facility, whether a firm had one or several slaughtering plants. He also found that some cattle were regularly purchased from between 100 to 300 miles away from the plant depending on cattle-feeding density and competition. Consequently, three *seller/packer distance relationships* are represented in the model: (1) less than 100 miles from the seller to the packer; (2) between 100 and 300 miles from the seller to the packer; and (3) greater than 300 miles from the seller to the packer. These distance relationships were not explicitly part of the transactions data provided by PSP. Rather, the distances were calculated given the location of the packers and the sellers as provided in the transactions data. Each transaction was then categorized into one of the three distance groups.

Ward also considered the *number of days elapsed between purchase and slaughter* in his discussion of cattle procurement practices of packers. He found that most cattle were purchased three to seven days in advance of slaughter. The amount of time cattle are purchased and/or held before slaughter certainly may affect the procurement and/or pricing decisions made by packers.

Sellers may believe packers have a relative advantage in cattle transactions for several reasons: (1) there are relatively few packers to which they can sell their fed cattle; (2) packers buy cattle frequently; (3) packers operate in a specific geographic area; and (4) packers have direct contact with retailers and food service firms. It is true that meat packing is geographically more concentrated than either feeder calf production or cattle feeding. Packers typically locate plants near the source of cattle supplies rather than near densely populated areas of consumers. Colorado, Illinois, Iowa, Kansas, Minnesota, Nebraska, Texas, and Wisconsin are the principal states involved in meat packing during the period of the transactions data. The 4 largest meat packers accounted for 85% of U.S. commercial slaughter while the 8 largest firms slaughtered 94%. Under typical conditions, meat packers have limited procurement areas because of the cost of transporting cattle long distances. Thus, meat packer concentration also is higher within certain states than nationally.

Although there are 20 firms represented in the transactions data, complete data to perform the multinomial logit analysis were available only for 13 firms. To account for packer concentration in

the cattle procurement market, a *regional Herfindahl-Hirschman Index (RHHI)*, the most commonly used measure of industry concentration, is included in both the procurement method model and the pricing method model as a measure of market power in the input market. In 1992, the Department of Justice and Federal Trade Commission issued the *Horizontal Merger Guideline* which defines market concentration using the Herfindahl-Hirschman Index (HHI). The HHI is calculated as the sum of the squared market shares of each firm in the industry. For example, if an industry has five firms with market shares of 30%, 20%, 20%, 20%, and 10%, then the HHI is 2200 ($=30^2 + 20^2 + 20^2 + 20^2 + 10^2$). By way of comparison, the four-firm and eight-firm concentration ratios and the HHI for the 50 largest U.S. companies are reported for selected manufacturing industries for 1987 in Table 4.1. The highest reported HHI was for household refrigerators and freezers (2,256) while the lowest was for wood kitchen cabinets (91). These HHIs correspond to four firm concentration ratios of 85% and 16%, respectively. Thus, the higher the HHI, the greater the concentration in the industry.

In order to determine regional differences in procurement and pricing methods, nine regions were developed using two criteria: (1) geographical location of the plant and (2) procurement area for the plant. The regions were designated as follows: (1) Nebraska, (2) Texas, (3) Kansas, (4) Colorado, (5) California and Arizona, (6) Idaho, Washington and Utah, (7) Iowa and Illinois, (8) Wisconsin and Minnesota and (9) Pennsylvania. To validate these regional definitions, plant procurement patterns were examined. If a plant purchased a majority of cattle from a region outside its physical location, it was reassigned to a different region. The cattle procurement regions as defined by PSP were deemed too broad because most cattle were purchased within 300 miles of the plant where they were slaughtered.

Competition among firms varies by state. The number of meat packing firms included in the transactions data range from two to five in other states. In the Ward study, packers typically had two to four principal competitors in their respective areas. The RHHIs were constructed using the previously defined regions (Table 4.2).

Description of the Data

Both transactions and "non-transactions" data items from the BPCRS as provided by the PSP were used in this analysis. The non-transactions items were used to compute the output price of beef and maximum slaughter capacity variables used and were then merged with the transactions data. The transactions data sets including observations on 200,616 lots of fed cattle slaughtered during the April 5, 1992, through April 3, 1993, period of the data. Because the data collected from five cow and bull packing plants were only daily summaries and did not include information on procurement and pricing methods or a number of other transactions characteristics used as RHS variables in the model, the transactions data for those plants were eliminated from the analysis. Transactions data for four steer and heifer packing plants were incomplete and similarly dropped from the analysis. Consequently, the dataset used for this analysis includes only the data for 39 steer and heifer packing plants. Also, missing observations and/or zero observations pertaining to RHS variables were

omitted. For this analysis, an additional 303 observations were considered to be outliers and deleted from the dataset for several reasons. First, 142 observations corresponding to an output price of $0.27 per pound and 117 observations corresponding to an output price of $0.17 per pound were deleted. Second, 15 observations for which average weights per head of cattle were less than 800 pounds or greater than 1,900 pounds were deleted. The result was that the transactions data for 182,036 of the lots purchased (91% of the raw transactions dataset) were available to perform the multinomial logit model analysis. Further, to make this data set compatible with that used in Chapter 5, we also deleted observations for which delivered liveweight cost/lb was less than $0.40 or greater than $1.08. Thus, the final tally of transactions used to perform the multinomial logit model analysis was 182,007.

Descriptive statistics of the variables used in the respective model specifications are provided in Table 4.3. The representative (average) lot contained about 120 head of cattle with an average liveweight per head of about 1,170 lb. The total delivered cost per head averaged about $880. An average of 12 days elapsed between procurement and slaughter. On average, the maximum slaughter capacity was about 280 head per hour. The weighted average revenue from beef sales (output price) was $1.26 per pound. The mean RHHI was 3,865. Roughly 53% of the cattle were purchased by the packer from sellers within 100 miles of the plant, 32% were purchased from sellers between 100 and 300 miles away from the plant, and the remaining 15% from plants over 300 miles away from the plant.

About 23% of the cattle were slaughtered between January and April of 1993, 25% between April and June of 1992, 26% between July and September of 1992, and 26% between October and December of 1992. Lots with a majority of steers comprised 55% of the number of transactions while lots with a majority of heifers comprised nearly 33%. The remainder were lots with a majority of either dairy cattle, mixed cattle, or fed Holsteins.

About 81% of the cattle lots were procured through the spot market. Only 9% were procured through marketing agreements, 8% through forward contracts, and 3% through packer fed arrangements. Roughly 44% of the lots were priced on a liveweight basis; 38% on a carcass weight basis; and 18% on a formula basis.

A closer inspection of the data indicates widely different cattle procurement and pricing practices by region (Tables 4.4 and 4.5). On a regional basis, most of the cattle were procured through the spot market (Table 4.4). The percentage of cattle obtained through the spot market ranged from a low of 58% for California and Arizona to a high of nearly 100% for Wisconsin and Minnesota. In Nebraska, Texas, and Kansas, forward contracting was used for about 8% to 12% of the cattle procured in those regions. In California and Arizona, nearly 38% of the cattle lots procured was packer fed. Marketing arrangements were used for 11%, 19%, and 24% of the cattle lots procured in the Kansas, Texas, Idaho, Washington, and Utah regions, respectively. Regionally, in Nebraska, Wisconsin and Minnesota, most cattle are priced on a carcass weight basis. In Idaho, Washington, and Utah, cattle are priced predominantly on a formula basis. In the remaining region, the most common pricing method is liveweight pricing.

Empirical Results

The empirical analysis conducted involved the estimation of the multinomial logit models for procurement and pricing methods as specified earlier through the use of the LIMDEP statistical package (Greene). The factors affecting the choice of procurement and pricing methods across all firms and regions are analyzed. The significance level chosen for these analyses was 0.05. The estimated coefficients and the associated marginal effects from the multinomial logit models corresponding to procurement and pricing methods across all firms and regions are provided in Tables 4.6 and 4.7.

Procurement Methods

In the procurement methods choice model, all but four coefficients were statistically significant. Using equation (1) and the estimated coefficients from Table 4.6, the probabilities of procurement method choice across all packers at the sample means of the RHS variables are calculated as: (1) 0.8898 for the spot market, (2) 0.0742 for marketing agreements, (3) 0.0250 for forward contracting, and (4) 0.0108 for packer fed. This set of probabilities corresponds closely to the percentage of transactions by procurement method.

The marginal effects, corresponding to changes in probabilities of procurement method selection due to unit changes in the RHS variables, are provided in Table 4.6 for six key RHS variables: (1) slaughter capacity; (2) capacity utilization; (3) output price; (4) number of head per lot, (5) average weight per head, and (6) regional firm concentration. The changes in probabilities are converted to elasticities using equation (7). By placing emphasis on elasticities for "continuous" variables, marginal effects are not sensitive to units of measurement.

As indicated by the marginal effects, a 1% increase in *slaughter capacity* results in an increase of 0.6947% in the probability of using forward contracts but a 1.3385% decrease in the probability that the cattle procured are packer fed; with a 0.1012% increase in the probability of procurement through marketing agreements, and a -0.0116% decrease in the probability of procurement through spot markets. That is, given an increase in slaughter capacity, packers are less likely to use the packer fed method of procuring cattle and more likely to use forward contracting with little impact on the likelihood of using other procurement methods.

The marginal effects computed for capacity utilization indicate that an 1% increase in capacity utilization results in a 1.6279% decrease in the probability of packer fed procurement, a 0.6060% increase in probability that cattle are procured through marketing agreements, and a 0.4851% increase in probability that cattle are procured through forward contracts. Marginal effects for the spot market with respect to changes in capacity utilization are relatively small.

At the same time, a 1% increase in the *number of head in the procured lot* of cattle increases the probability of using forward contracts, packer fed arrangements, and marketing agreements by 0.1722%, 0.7756%, and 0.0909%, respectively, but reduces the probability of using the spot market to procure cattle by 0.0226%. On the other hand, a 1% increase in the *average weight of the procured lot* reduces the probability of using packer fed arrangements and marketing agreements by 2.3362% and 3.7893%, respectively, but increases the probability of using the spot market by 0.3218% and forward contracts by 0.8140%.

A 1% increase in *regional firm concentration* (as measured by the RHHI) boosts the probability of using packer fed arrangements by 3.1758% but results in a 0.3249%, 0.2250%, and 0.0110% decrease in the probability of using forward contracts, marketing agreements, and the spot market, respectively.

A 1% increase in the *output price of beef* increases the probability of procurement through packer fed arrangements and marketing agreements by 2.0644% and 0.5462%, respectively, but decreases the probability of procurement through forward contracting by 1.8178%. The probability of using the spot market is almost unresponsive to changes in the output price of beef.

Increasing the *number of days between purchase and slaughter* of cattle (i.e., the elapsed number of days) decreases the probability of using the spot market but increases the probability of using of all other procurement methods.

Seasonality also affects the probability of the selection of a given procurement method. Compared to the October 1992 to December 1992 period (the base period), the probability of using forward contracts to procure cattle is higher for the January 1993 to April 1993 (Q1) period and the April 1992 to June 1992 (Q2) period but lower for the July 1992 to September 1992 (Q3) period. The probability of using marketing agreements and packer fed arrangements, as compared to the base period, is higher for the Q3 period but lower for the Q1 and Q2 periods. Finally, relative to the base period, the probability of using the spot market, *ceteris paribus*, is higher for the Q1, Q2, and Q3 periods.

The *type of cattle* procured also affects the probabilities of choosing a method of procurement. The spot market is more likely to be used for lots of cattle that are predominantly heifers or mixed cattle than for lots of just steers, but less likely to be used for lots that are predominantly dairy cattle or fed Holsteins. Forward contracting is more likely to be used for lots of dairy cattle and heifers than for lots of steers, but less likely to be used for lots of the other types of cattle (fed Holsteins, and mixed). Lots of dairy cattle procured are more likely to be packer fed than lots of steers, while lots of fed Holsteins, heifers, and mixed cattle are less likely to be packer fed. Marketing arrangements are more likely to be used to procure lots of fed Holsteins relative to lots of steers and is less likely to be used to procure lots of heifers, dairy cattle, and mixed cattle.

The empirical results also indicate that the *distance of the seller from the plant* affects the choice of procurement method. If procurement occurs within 300 miles of the packing plant, the probability of using either packer fed arrangements or marketing agreements rises while the probability of using

forward contracting falls as compared to procurement outside a 300-mile radius of the plant. In other words, the procurement of cattle within 300 miles of the plant is more likely to be done by either packer fed arrangements or marketing agreements, and is less likely to be done through forward contracting than is the case for procurement of cattle from sellers more than 300 miles from the plant. The effects of distance on the probability of using the spot market are mixed with a slightly lower probability associated with shorter distance (i.e., within 100 miles of the packer). The largest effects among the quality variables are associated with the YG1 dummy variable. The probability of using the spot market and for forward contracts increases with YG1, while the probability of using packer fed arrangements or marketing agreements decreases.

Pricing Methods

The estimated coefficients and the associated marginal effects from the multinomial logit models corresponding to lot pricing methods across all firms and regions are provided in Table 4.7. In this model, 68 of the 69 estimated coefficients were found to be statistically different from zero. Again, using equation (1) and the estimated coefficients (Table 4.7), the probabilities of lot pricing method choice across all packers at the sample means of the RHS variables are calculated as: (1) 0.3975 for carcass weight pricing, (2) 0.0618 for formula pricing; and (3) 0.5405 for liveweight pricing. In other words, there is a 93.81% probability that any given lot of cattle included in the transactions dataset was priced on either a liveweight or carcass weight basis. Those two pricing methods accounted for roughly 80% of the transactions in the transactions dataset (see Table 4.3). On the other hand, there is a 6.18% probability that the lot was priced using formula pricing method.

The calculated marginal effects indicate that unit changes in RHS variables affect the probabilities of using liveweight pricing and carcass weight pricing in opposite directions. Changes in factors that positively affect the probability of choosing liveweight as the pricing method negatively affect the probability of choosing carcass weight as the pricing method and vice versa.

Further, an examination of the marginal effects elasticities indicates that a 1% increase in *slaughter capacity* leads to 0.1715% and 0.6994% increases in the probability of pricing cattle lots on a carcass weight and formula basis, respectively, but a 0.2062% decline in the probability of pricing lots on a liveweight basis. A 1% increase in capacity utilization leads to a 0.0046% and 1.0122% decrease in the probability of using formula and liveweight pricing, but to a 0.1638% increase in the probability of using carcass weight pricing.

Also, a 1% increase in the *number of head per lot* increases the probability of pricing on a liveweight basis by 0.1691%, but decreases the probabilities of pricing on any other basis. According to the marginal effects elasticities, a 1% increase in the *average weight of the lot* increases the probability of pricing on a carcass weight basis and formula basis by 2.3310% and 0.9176%, respectively, while decreasing the probability of pricing on a liveweight basis by 1.8197%.

A 1% increase in *regional firm concentration* with, all else held constant, increases the probability of pricing on a carcass weight basis by 0.0945%, but decreases the probability of pricing on a liveweight and formula basis by 0.0377% and 0.2779%, respectively.

Increases in the *output price of beef* increase the probability of using all pricing methods except the carcass weight pricing method.

Probabilities of using all pricing methods, except carcass weight, decline as elapsed time between purchase and slaughter increases. *Seasonality* plays a role in the probability of selecting a particular pricing method. Relative to the base period (October to December 1992), the probability of pricing on a carcass weight basis is higher in the first six months of the year. The reverse is true for the liveweight pricing method. As compared to the base period, the probability of selecting the formula method is higher in the April to September 1992 period but is lower in the January to March period.

Cattle type also influences the probabilities of lot pricing method choice. Relative to the base case (i.e., lots of predominantly steers), the probability of choosing the carcass weight pricing methods is higher but the probabilities of choosing any other pricing methods are lower when the lots are predominantly dairy cattle. For lots that are mostly fed Holsteins, the probability of pricing on carcass weight and liveweight bases is lower compared to the base case but is higher for formula pricing. For lots of mostly heifers, the probability of pricing on a liveweight basis is lower compared to the base case, but is higher for all other pricing methods. For lots of mixed cattle, the probabilities of pricing on either a carcass weight or liveweight basis are higher than the base case, but are lower for formula pricing.

The *yield grade* and *quality grade* of the lots also affects the choice of pricing method. The probability of choosing the carcass weight and formula pricing methods is lower for lots of YG1 and YG3-5 cattle as compared to lots of YG2 cattle (the base case). But, the opposite is true for liveweight pricing. The probability of choosing liveweight or formula pricing methods is lower for select quality grade cattle than choice quality grade cattle, but the probability of choosing carcass weight pricing is higher.

Considering the d*istance between the seller and the packer*, lots of cattle from sellers within 300 miles are less likely to be priced on a carcass weight and formula basis than cattle from sellers further than 300 miles from the packer. At the same time, however, lots of cattle from within 300 miles of the packer are more likely to be priced on a liveweight basis than lots from more distant sellers.

The *procurement method* selected clearly affects the probability of selecting a given pricing method. As compared to procurement through the spot market (the base case), the selection of forward contracting tends to increase the probability of selecting carcass weight and formula as the pricing methods but reduces the probability of selecting liveweight as the pricing method. This same result is true concerning the selection of packer fed arrangements and marketing agreements. These results with the exception of the relationship between the packer fed procurement method and liveweight pricing method, are consistent with the actual pattern of procurement and pricing methods exhibited in the transactions data (see Figure 4.1). The indirect and direct effects of changes in RHS variables can be traced through procurement methods to pricing methods as follows:

$$(8)\ \frac{dPM_i}{dx_i} = \frac{\partial PM_i}{\partial x_i} + \frac{\partial PM_i}{\partial PRM_i}\frac{\partial PRM_i}{\partial x_i}$$ where PM_i is pricing method I and PRM_i is procurement method I.

Indirect effects are negligible in comparison to the direct effects.

Predictive Ability of the Procurement and Pricing Models Across All Regions and Firms

To examine the predictive ability of the two models across all firms and regions, a prediction-success table was constructed as described in the methodology section for both procurement and pricing methods (Tables 4.8 and 4.9). For procurement methods, the multinomial logit model correctly classifies nearly 87% of all 182,007 transactions. This success in classification is unequivocally the result of the ability of the model to correctly predict procurement transactions conducted through the spot market and by forward contracting. The model correctly predicted over 78% of those lots procured through forward contracting and over 99% of those procured through the spot market. As a predictive device, the model does extremely well in predicting the selection of the forward contract and spot market procurement methods.

The capability of the multinomial logit model to correctly classify procurement by packer fed arrangements and by marketing agreements, however, clearly is limited. This result may be due to the fact that these latter procurement methods may be sensitive to factors other than those specified in the model, e.g., weather, tradition, etc., many of which may not be represented in the transactions data.

The pricing method multinomial logit model correctly classifies about 60% of the set of transactions as to pricing methods. This success is largely attributable to the ability of the model to correctly predict the transactions which used the liveweight pricing method. The model correctly classified 80% of the lots using liveweight pricing but only 43% and 51% of the lots using carcass weight and formula pricing methods, respectively.

Limitations

Two main limitations of this study may affect the results. The first limitation involves the assumption that procurement and pricing decisions are not made simultaneously. Several attempts were made to investigate the sensitivity of the analysis to this assumption by considering jointly determined procurement and pricing decisions. Four procurement methods (spot market, marketing agreements, forward contracts, and packer fed arrangements) were combined with two classes of pricing methods: (1) pricing by weight (liveweight and carcass weight pricing methods) and (2) pricing by formula. Thus, the dependent variable of the multinomial logit model for the analysis of jointly determined procurement and pricing methods consisted of eight possible choices. The RHS variables were the same as those used in the procurement method choice analysis discussed previously. However, the nonlinear estimation procedure using LIMDEP failed to achieve convergence, predominantly due to the fact that one of the eight choices, liveweight pricing and spot market procurement, dominated the other seven choices. That is, this choice was associated

with nearly 75% of the observations. In addition to the higher, unbalanced number of observations for the eight choices, this analysis pushed the limitations of the LIMDEP program.

The second limitation of the study is that separate multinomial logit analyses of procurement and pricing methods by region were not conducted. The multinomial logit analysis could be replicated by region given additional time. For each multinomial logit analysis reported, the time required to achieve convergence of the LIMDEP program was roughly two days.

Conclusions

The empirical results confirm that a large number of factors play a significant role in the determination of the methods of procurement and pricing chosen by packers for the cattle lots they purchase. Although the level of concentration in the beef packing industry and the size of a firm (i.e., processing capacity) were shown to have an effect on the particular cattle procurement and pricing methods chosen, a number of other factors were shown to be equally or more important, such as the characteristics of the lots purchased by packers (i.e., number of head per lot, average weight per head, cattle type, yield grade, and quality grade) and seasonality (i.e., the quarter in which cattle are slaughtered). Also, the method chosen by packers to procure fed cattle was found to affect the probability that a given pricing method will be chosen. Procurement through the spot market was found to increase the tendency to use liveweight as the pricing method while procurement through forward contracting, packer fed cattle, and/or marketing agreements was found to increase the probability that packers will choose the carcass weight and formula pricing methods to price cattle.

More specifically, major conclusions that can be drawn from the results of this study include the following:

- Increases in slaughter capacity tend to increase the use of forward contracts but decrease the use of packer feeding as cattle procurement methods. Increases in regional concentration, as measured by the regional Herfindahl-Hirschman Index (RHHI), however, lead to increases in the use of packer feeding, but to decrease in the use of all other procurement methods. The elasticity of the probability of using packer feeding due to a change in the RHHI is nearly 3, by far the largest elasticity of any of the procurement methods.

- Also, as regional concentration increases (as measured by the RHHI), packers tend to choose the carcass weight pricing method. With increases in slaughter capacity (an indicator for size economies), however, packers tend to gravitate toward pricing on carcass weight and formula bases.

- As the number of days that elapse between purchase and slaughter increases, packers tend to rely on forward contracts, packer fed cattle, and marketing agreements as procurement methods. Packers are less likely, however, to use the spot market as a procurement method as the time between purchase and slaughter increases. Changes in probabilities associated with lot pricing methods are not highly sensitive to changes in the elapsed time between purchase and slaughter.

- Increases in wholesale beef demand, as reflected by increases in the output price of beef, result in decreases in the choice of forward contracts as the procurement method but result in increases in the choice of marketing agreements and packer feeding. At the same time, as the output price rises, packers tend to move toward formula-based pricing methods or liveweight pricing. Carcass weight as a pricing method is inversely related to increases in wholesale beef demand.

- The procurement of cattle from within 300 miles of packing plants is likely to be carried out using marketing arrangements or packer fed cattle. Procurement of cattle outside a radius of 300 miles of the packing plants is likely to be done through forward contacts and the use of the spot market. Also, lots of cattle from sellers within 300 miles are less likely to be priced on formula or carcass weight bases.

- The probability of choosing to procure through the spot market and forward contracts increases with lots that are predominantly yield grade 1 relative to those that are predominantly yield grade 2 while the probability of choosing packer fed arrangements or marketing agreements decreases. The probability of choosing to procure through forward contracting, packer fed arrangements, and the spot market rises with lots that are predominantly yield grade 3 or higher as compared to those that are predominantly yield grade 2, while the probability of choosing marketing agreements declines with respect to this yield grade comparison. In lots that are graded select, the probability of choosing packer fed arrangements and the spot market increases, but the probability of using forward contracts or marketing agreements declines. For cattle yield grade 2, packers tend to use the carcass weight and formula pricing methods. They move away from the liveweight pricing method under these yield grade conditions. For prime or choice cattle, packers tend to use liveweight and formula pricing methods

- Changes in factors that positively affect the probability of choosing liveweight as the pricing method negatively affect the probability of choosing carcass weight as the pricing method and vice versa.

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Figure 4.1. Percentage of Transactions by Pricing Method Conditional on Procurement Method

Table 4.1: Concentration Ratios for Selected Manufacturing Industries, 1987

SIC Code	Product Grouping	Four Firm Concentration Ratio	Eight Firm Concentration Ratio	HHI[1]
		%	%	
2043	Cereal breakfast food	87	99	2207
2067	Chewing gum and chewing gum base	96	100	--
2085	Distilled and blended liquors	53	75	883
2111	Cigarettes	92	--	--
2311	Men's and boys' suits and coats	34	47	506
2411	Logging	18	24	150
2434	Wood kitchen cabinets	16	22	91
2621	Paper mills	44	69	743
2657	Folding paperboard boxes	23	36	227
2678	Stationery products	51	63	1523
2731	Book publishing	24	38	259
2816	Inorganic pigments	64	76	1550
2911	Petroleum refining	32	52	435
3011	Tires and inner tubes	69	87	1897
3221	Glass containers	78	89	2126
3312	Blast furnaces and steel mills	44	63	607
3421	Cutlery	49	63	1089
3523	Farm machinery and equipment	45	52	802
3632	Household refrigerators and freezers	85	98	2256
3652	Household audio and video	39	59	559
3711	Equipment	90	95	--
3944	Motor vehicles and car bodies	43	55	618
	Games, toys, and children's vehicles			

[1] Herfindahl-Hirschman Index for the 50 largest companies.
Note: -- = index not reported.
SOURCE: Carlton and Perloff, p. 345.

Table 4.2: Packer Firm Concentration Patterns by Region

Region	% of National Volume	Regional Four Firm Concentration Ratio	RHHI[1]
1. Nebraska	17.9	97.0	3138
2. Texas	18.4	98.0	4179
3. Kansas	25.7	95.0	2610
4. Colorado	D	D	D
5. California and Arizona	D	D	D
6. Idaho, Washington and Utah	7.6	100.0	3914
7. Iowa and Illinois	13.0	97.5	4451
8. Wisconsin and Minnesota	5.3	100.0	3658
9. Pennsylvania	D	D	D

[1] The Regional Herfindahl-Hirschman Indices as defined in the text.
D = Deleted to avoid disclosure.

Table 4.3: Descriptive Statistics Across All Regions and Packer Firms[1]

Variable	Mean	Std Dev	Min	Max
Number of head in the lot	120	98.45	1	1,584
Liveweight of the lot (lb)	139,033	113,979	1,031	1,676,098
Elapsed days (days)	12.34	30.04	0	240
Dollar per lb ($)	0.75	0.04	0.41	1.07
Output price ($/lb)	1.26	0.17	0.76	1.80
Maximum slaughter capacity (head slaughtered per hour)	278	74.91	D	D
Average weight (lb)	1,171	101.05	805	1,899
National firm share	0.2455	0.1313	D	D
Regional firm Herfindahl-Hirschman Index	3,865	1,185	2,610	10,000
Seasonality (% of transactions occurring in:)				
Quarter 1	23.4	0.4239	0	100
Quarter 2	25.1	0.4336	0	100
Quarter 3	26.4	0.4406	0	100
Quarter 4	25.1	NA	0	100
Distance from Seller to Packer (% of cattle purchased within:)				
100 miles	52.6	0.4992	0	100
100 and 300 miles	32.5	0.4683	0	100
Over 300 miles	14.9	NA	0	100
Cattle Type (% lots with a majority of:)				
Dairy cattle	4.0	0.1961	0	100
Mixed cattle	6.4	0.2441	0	100
Fed holsteins	2.0	0.4974	0	100
Steers	55.1	0.4685	0	100
Heifers	32.5	0.1400	0	100
Procurement Method (% of lots procured through:)				
Forward contract	7.5	0.2638	0	100
Packer fed arrangement	3.0	0.1702	0	100
Marketing agreement	8.6	0.2794	0	100
Spot market	80.9	0.3927	0	100
Lot Pricing Method (% of lots priced on:)				
Carcass weight basis	37.9	0.6372	0	100
Formula basis	18.2	0.5701	0	100
Liveweight basis	43.9	0.4963	0	100

[1] Number of observations for each variable = 182,007.
D = Deleted to avoid disclosure.

Table 4.4 Procurement Methods by Region

Region	Cattle Lots Procured Through: Forward Contracts	Packer Fed Arrangements	Marketing Agreement	Spot Market
	%			
1. Nebraska	8.1	0.5	2.5	88.8
2. Texas	8.8	2.2	18.7	70.1
3. Kansas	12.2	0.3	11.0	76.4
4. Colorado	D	D	D	D
5. California and Arizona	0.0	37.7	4.4	57.9
6. Idaho, Washington and Utah	2.7	6.8	24.3	66.2
7. Iowa and Illinois	4.6	0.0	5.4	90.0
8. Wisconsin and Minnesota	3.8	0.1	0.2	95.9
9. Pennsylvania	D	D	D	D

D = Deleted to avoid disclosure.

Table 4.5 Pricing Methods by Region

Region	Percent of Cattle Lots Priced on: Carcass Weight Basis	Formula Basis	Liveweight Basis
	----------%		----------
1. Nebraska	65.9	4.6	29.4
2. Texas	14.1	23.9	61.9
3. Kansas	21.9	17.5	60.6
4. Colorado	D	D	D
5. California and Arizona	16.4	4.3	79.3
6. Idaho, Washington, and Utah	23.5	74.7	1.8
7. Iowa and Illinois	39.0	19.9	41.1
8. Wisconsin and Minnesota	52.4	5.0	42.6
9. Pennsylvania	D	D	D

D = Deleted to avoid disclosure.

Table 4.6: Estimated Coefficients and Marginal Effects in the Multinomial Logit Model for Procurement Methods Over All Firms and Regions

	Estimated Coefficients[1]			Marginal Effects[2]			
RHS Variable	B1	B2	B3	Forward Contracts	Packer Fed	Marketing Agreement	Spot Market
Capacity	-0.0073 (-20.40)	-0.0021 (-6.74)	-0.0025 (-8.65)	0.000063 [0.6947]	-0.000052 [-1.3385]	0.000027 [0.1012]	-0.000037 [-0.0116]
Capacity Utilization	-4.7395 (-27.04)	0.2710* (1.75)	-1.1875 (-8.59)	0.027268 [0.4851]	-0.039790 [-1.6279]	0.100900 [0.6060]	-0.088378 [-0.0443]
Output Price	3.0706 (21.58)	1.8698 (14.99)	1.4222 (12.55)	-0.036027 [-1.8178]	0.017794 [2.0644]	0.032073 [0.5462]	-0.003839 [0.0197]
Number of Head	0.0050 (25.86)	-0.0006 (-3.31)	-0.0016 (-8.57)	0.000036 [0.1722]	0.000071 [0.7756]	0.000061 [0.0989]	-0.000168 [-0.0226]
Average Weight	-0.0027 (-10.01)	-0.0039 (-16.73)	-0.0004 (-1.97)	-0.000017 [0.8140]	-0.000022 [-2.3362]	-0.000240 [-3.7893]	0.000244 [0.3218]
Elapsed Days	-0.0305 (-40.65)	-0.0820 (-57.18)	-0.1019 (-98.36)	0.002433 [1.1988]	0.000725 [0.8218]	0.001119 [0.1861]	-0.004277 [-0.0593]
Regional HHI	0.0009 (37.35)	0.0000* (1.12)	0.0001 (3.89)	-0.000002 [-0.3249]	0.000009 [3.1758]	-0.000004 [-0.2250]	-0.000003 [-0.0110]
Quarter 1	-0.3492 (-5.47)	-0.3465 (-6.36)	-0.2281 (-4.57)	0.005825	-0.001273	-0.008467	0.003915
Quarter 2	-0.4602 (-7.60)	-0.6841 (-13.38)	-0.4498 (-9.84)	0.011427	-0.000046	-0.016936	0.005555
Quarter 3	0.9710 (13.89)	0.9815 (15.64)	0.9480 (16.05)	-0.023228	0.000479 0	0.004046	0.021870 2
Dairy	-0.8200 (-9.89)	-2.8990 (-30.80)	-2.9083 (-48.09)	0.070463	0.021708	-0.006460	-0.085711
Fed Holsteins	-2.9803 (-2.95)	1.7859 (9.36)	0.5595 (2.96)	-0.014982	-0.038993	0.088190	-0.014215
Heifers	-0.1836 (-3.21)	-0.7493 (-15.08)	0.0406 (10.89)	-0.000538	-0.001766	-0.054032	0.055261
Mixed	-4.6775 (-17.28)	-2.4186 (-9.74)	1.1687 (7.95)	-0.020282	-0.059793	-0.239628	0.319703
D100[3]	3.3027 (42.68)	1.3846 (27.03)	0.8488 (18.67)	-0.022403	0.026248	0.036418	-0.040263
D100/300[4]	1.7151 (21.83)	0.9411 (17.49)	0.8470 (17.87)	-0.021105	0.009512	0.007335	0.004258
Yield Grade 1	-0.9871 (-8.66)	-2.0349 (-19.81)	-0.1953 (-2.70)	0.008410	-0.007100	-0.126146	0.124836
Yield Grades 3, 4, 5	0.3071 (6.55)	-0.5265 (-13.04)	-0.2205 (-5.95)	0.005812	0.005874	-0.021867	0.055181
Select	0.2261 (4.33)	-0.1079 (-2.31)	0.0412* (0.96)	-0.000781	0.002124	-0.010320	0.008977
Constant	-3.1905 (-7.62)	4.6073 (12.68)	3.9517 (11.97)				

[1] *t*- statistics are in parentheses.
[2] Marginal effects are calculated at the sample means. Marginal effects in terms of elasticities are in brackets.
[3] Cattle purchased within 100 miles of packer.
[4] Cattle purchased between 100 and 300 miles of packer.
* Not statistically significant at the 0.05 level.

Table 4.7: Estimated Coefficients & Marginal Effects in the Multinomial Logit Model for Pricing Methods Over All Firms and Regions

	Estimated Coefficients[1]		Marginal Effects[2]		
RHS Variable	B1	B2	Carcass Weight	Formula	Live Weight
Capacity	0.0013 (16.37)	0.0033 (24.74)	0.0002 [0.1715]	0.0001 [0.6994]	-0.0004 [-0.2062]
Capacity Utilization	0.3776 (8.69)	-2.2600 (-34.18)	0.1460 [0.1638]	-0.1405 [-1.0122]	-0.0055 [-0.0046]
Output Price	-0.9107 (-25.50)	2.5834 (45.41)	-0.2816 [-0.8958]	0.1724 [3.5218]	0.1082 [0.2556]
Number of Head	-0.0026 (-40.69)	-0.0063 (-52.67)	-0.0004 [-0.1394]	-0.0003 [-0.5810]	0.0007 [0.1691]
Average Weight	0.0035 (52.79)	0.0023 (22.72)	0.0007 [2.3310]	0.00004 [0.9176]	-0.0008 [-1.8197]
Regional HHI	0.00003 (6.75)	-0.0001 (-6.57)	0.000010 [0.0945]	-0.000004 [-0.2779]	-0.000005 [-0.0377]
Elapsed Days	0.0042 (8.19)	-0.0108 (-16.54)	0.0012 [0.0394]	-0.0007 [-0.1459]	-0.0005 [-0.0123]
Quarter 1	0.3937 (24.26)	-0.1538 (-6.09)	0.0980	-0.0186	-0.0794
Quarter 2	0.1467 (9.13)	0.1077 (4.44)	0.0324	0.0026	-0.0351
Quarter 3	-0.0316 (-2.04)	0.0838 (3.44)	-0.0096	0.0056	0.0039
Dairy	0.6594 (12.21)	-0.9738 (-15.68)	0.1819	-0.0727	-0.1091
Fed Holstein	0.1574 (3.09)	1.6676 (32.17)	-0.0033	0.0929	-0.0896
Heifers	0.4951 (34.89)	0.3080 (14.54)	0.1110	0.0057	-0.1167
Mixed	-0.0365* (-1.57)	-3.5256 (-31.65)	0.0780	-0.2038	0.1257
D100[3]	-0.2040 (-13.13)	-0.5734 (-26.00)	-0.0347	-0.0282	0.0630
D100/300[4]	-0.1235 (-7.71)	-0.5599 (-23.87)	-0.0158	-0.0294	0.0452
Yield Grade 1	-0.9415 (-35.75)	-2.2730 (-35.66)	-0.1695	-0.1088	0.2783
Yield Grades 3,4,5	-0.2233 (-18.92)	-0.3667 (-20.41)	-0.0444	-0.0157	0.0602

(continued on next page)

Table 4.7 (cont.)

	Estimated Coefficients[1]		Marginal Effects[2]		

RHS Variable	B1	B2	Carcass Weight	Formula	Live Weight
Select	0.0599 (4.61)	-0.0661 (-3.27)	0.0159	-0.0053	-0.0106
Forward Contracts	2.5027 (42.06)	4.3705 (65.40)	0.4918	0.1921	-0.6840
Packer Fed	0.6831 (20.93)	0.9683 (20.54)	0.1397	0.0394	-0.1792
Marketing Agreements	3.0680 (29.96)	7.2759 (72.43)	0.5557	0.3469	-0.9027
Constant	-3.7489 (-36.62)	-6.0282 (-37.61)			

[1] *t*- statistics are in parentheses.
[2] Marginal effects are calculated at the sample means. Marginal effects in terms of elasticities are in brackets.
[3] Cattle purchased within 100 miles of packer.
[4] Cattle purchased between 100 and 300 miles of packer.
[*] Not statistically significant at the 0.05 level.

Table 4.8: Prediction-Success Table: Procurement Methods Model Over All Firms and Regions

Actual Procurement Methods	Procurement Method Predictions					% Correct Classification
	Forward Contract	Packer Fed	Marketing Agreement	Spot Market	TOTAL	
Forward Contract	10,750	159	5	2,792	13,706	78.4
Packer Fed	274	440	0	4,721	5,435	8.1
Marketing Agreement	217	49	54	15,214	15,534	0.3
Spot Market	67	536	23	146,706	147,332	99.6
TOTAL	11,308	1,184	82	169,433	182,007	86.8

Table 4.9: Prediction-Success Table: Pricing Methods Model Over All Firms and Regions

Actual Pricing Methods	Pricing Method Predictions				% Correct Classifications
	Carcass Weight	Formula	Live Weight	TOTAL	
Carcass Weight	29,433	2,250	37,351	69,034	42.6
Formula	5,904	16,742	10,246	32,892	50.9
Liveweight	14,754	1,052	64,275	80,081	80.3
TOTAL	50,091	20,041	111,872	182,007	60.7

PRICE DETERMINATION IN SLAUGHTER CATTLE PROCUREMENT

SECTION 5
TRANSACTIONS DATA: A HEDONIC APPROACH TO THE ANALYSIS OF FACTORS AFFECTING SLAUGHTER CATTLE PRICES

The previous section addressed the major factors affecting the choice of slaughter cattle procurement and pricing methods. In this section, the factors affecting the prices paid for the cattle slaughtered by the top steer and heifer packing plants during the April 5, 1992, to April 3, 1993, period are identified and analyzed. Regression analysis is used to quantify the relationships between the price paid by packers for fed cattle and transactions data characteristics (see section 1 for a description of the transactions data characteristics). Using ordinary least squares (OLS) as the estimation procedure, evidence is provided of the statistical significance of such relationships. The regression results also provide quantitative measures of the extent to which changes in the prices paid by packers for cattle are related to changes in transactions data characteristics. The analyses in this section are conducted at the national level for the entire data set of useable observations and for packing plants across three geographic locations (the Midwest -- Nebraska, Colorado, Kansas, and Texas; the Upper Midwest -- Illinois, Iowa, Minnesota, and Wisconsin; and the Far West -- California, Arizona, Idaho, Utah, and Washington).

After a brief discussion of hedonic analysis in general, a hedonic model is specified for the analysis of the factors affecting the delivered costs of fed cattle to packers. Then, descriptive statistics of the transactions data used in the analysis are presented for the entire sample and by region. Following a discussion of the empirical results, the major limitations of this analysis are discussed. Finally, conclusions and implications of the empirical results for issues in slaughter cattle pricing are discussed.

Hedonic Analysis

In the economics literature, hedonic price models have been used to determine the implicit prices of various quality characteristics (e.g., Ladd and Suvanant, Brown and Rosen, and Parker and Zilberman). These models are useful for analysis of product heterogeneity issues such as product differentiation, quality, grades, and standards. Previous empirical applications of the hedonic technique generally have regressed prices or logs of prices of different varieties of a good on various specification variables such as quality characteristics or other measurable variables such as size and performance. In the hedonic analysis reported here, cross-section data over only 1 year were utilized and the delivered liveweight cost per pound paid by packers for fed cattle was regressed against lot

characteristics (average weight per head, number of head in a lot, cattle type, yield grade, and quality grade) along with other variables such as slaughter capacity, regional Herfindahl-Hirschman Indices (RHHI) as measures of the regional firm shares of packers, seasonality, the distance between packer and seller, procurement method, and pricing method. The analysis was done first for the top five packer firms in selected regions, and then across all regions and packer firms. The estimated coefficients of these equations provide some notion of the "shadow" or marginal prices of the characteristics of the cattle procured and slaughtered by all packers in specific regions of the country, by individual packer firms over all regions, and by all packers over all regions over the period of the data.

Model Specification and Hypotheses

A number of factors may affect the price paid by a packing plant for a lot of cattle, including: (1) characteristics of the lot; (2) price of the final product(s); (3) plant capacity; (4) distance from the seller to the packer; (5) seasonality; (6) exercise of market power on the buying side of the market; and (7) methods chosen for procuring and pricing the lot. Consistent with a hedonic approach, the regression results from the model utilized for this analysis provide measures of the marginal effects of the characteristics of the cattle procured on the prices paid.

Model Specification

The theoretical basis for the hedonic model used in this analysis is provided in detail in Appendix 5.1. In general, however, the hedonic model used here is specified as follows:

> Average delivered liveweight cost/pound of fed cattle = f(output beef price[1]; maximum slaughter capacity; number of head of cattle in the lot; average weight of the lot; the regional packer firm share of the fed cattle market; the distance between the seller and the packer; seasonality; cattle type; quality grade of the lot; yield grade of the lot; procurement method; and pricing method).

The right-hand-side (RHS) variables are similar to those in the models pertaining to procurement and pricing methods in section 4 of this report and are discussed at length in that section. However, in this analysis, both procurement and pricing methods enter the model specification as potential explanatory factors. The dependent variable (average delivered liveweight cost/pound paid by packers for fed cattle) is calculated for each transaction (i.e., lot of cattle) as the total delivered cost of the lot (including transportation, commission, and feed costs) divided by the total live weight of each respective lot.

[1] As in section 5 of this report, the "ouput beef price" as used here is the weighted average revenue per lb received by packers for various beef products. See the discussion in section 5 and Table 1.6 in section 1.

Hypotheses

The particular specification of the model is based on a number of hypotheses regarding the factors that affect the delivered costs of fed cattle to packers and the anticipated signs of the coefficients associated with them. Those factors are the RHS variables of the model.

The delivered cost of fed cattle should be positively related to *output beef prices* since the demand for slaughter cattle is derived from the demand for wholesale beef which, in turn, is derived from consumer demand for beef at retail.

A positive relationship between *slaughter capacity* and the delivered liveweight cost/pound of fed cattle also was expected. Maintaining profitability in an industry like the beef industry requires maximum utilization of installed capacity to minimize average costs. As capacity increases, the primary problem faced by beef packers is securing adequate supplies of uniform fed cattle of desired characteristics to continue operations at a level as close to full capacity as possible. Competition among the packers in a region for available supplies intensifies as capacity increases, forcing increases in prices of fed cattle.

An alternative explanation for a positive expected sign on slaughter capacity is offered by Salop and Scheffman. They argue that, in the case of a dominant price-leader firm with a price-taking competitive fringe, the dominant firm may be able to induce its rivals to exit an industry by raising their costs. In such an industry, if the dominant firm has some cost advantage, e.g., from scale economies, then it can bid up the price of an important input which raises industry costs. This action can be seen as an upward shift in the dominant firm's residual demand curve for that input (Figure 5.1). A sufficient condition for this strategy to be effective is for the upward shift in the dominant firm's residual demand curve (from D_d to D_d') to be greater than the resulting upward shift in its average cost curve (AC_d to AC_d') at the original optimal output level (x_d^*). The result will be that the change in the industry price of the input (ΔP) is greater than the change in the dominant firm's average cost (ΔAC_d) at the original optimal output level (x_d^*). The shift in the dominant firm's residual demand curve depends on the relative price elasticities of market demand and supply of the input and the shift in the fringe supply of the input. The lower the elasticity of market demand for the input, the greater the increase in the dominant firm's residual demand from a given increase in cost. The lower the elasticity of demand, the larger the price rise from a given reduction in fringe supply. Obviously, this would be a short run strategy since the dominant firm's rivals would eventually be driven out the industry, reducing the effectiveness of such a strategy as means of consolidating market power.

The Salop and Scheffman model implies that a positive sign for slaughter capacity would be expected if the fed cattle market is characterized by a dominant price-leader firm or set of firms with a price-taking competitive fringe. In this case, a packer or set of packers with large capacities might have an incentive to bid up the price of fed cattle, raising industry costs, and inducing smaller packers (the "fringe suppliers") to exit the industry. Consequently, an increase in slaughter capacity would be consistent with a higher cost of fed cattle paid by packers at least during a period of transition and consolidation in the fed cattle industry. In 1980, four leading firms controlled 36% of

the steer and heifer slaughter, 50% in 1985, 72% in 1990, and 82% in 1994 (Grinnell). The transactions data indicate that in 1992/93, 5 firms controlled 95% of steer and heifer slaughter. Clearly, the beef packing industry was in transition both before and during the period of the data, giving some weight to the Salop and Scheffman argument.

Average weight of the fed cattle in a lot reflects the quality of the lot. Because over-finished and heavy exotic breeds of cattle are usually discounted by packers, average weight is expected to be negatively related to the delivered liveweight cost/pound of fed cattle to the packer.

Recall from section 4 that the variables pertaining to *distance between seller and packer* are indicator (dummy) variables. The base case is a distance of more than 300 miles between the packer and the seller. Under competitive conditions, and holding all else constant, total delivered costs per pound would be expected to be equal across all lots of cattle irrespective of point-of-origin. However, if individual packers are exerting spatial market power, this would be reflected in a lower cost per pound for cattle originating from points closer to the respective plants. Alternatively, since cattle shipped over shorter distances should arrive at the packer's gate in better condition than cattle shipped longer distances, and because the transactions costs associated with purchasing cattle from more distant sellers may be higher, packers may be willing to pay higher prices for cattle from nearby sellers. In this case, the delivered cost per pound for cattle from more distant sellers may be lower than that for cattle from sellers closer to the packer.

Because *cattle type* is a qualitative factor, dummy variables are used to represent cattle types as discussed in section 4. The base case is lots that are predominately steers. Lots dominated by dairy cattle, fed Holsteins, or heifers or mixed lots were hypothesized to be discounted relative to the base case (steers).

The *yield and quality grade* reflect relative quality characteristics of cattle purchased by packers and, thus, are also expected to affect the cost of the cattle. Lots which are predominantly yield grade 1 are expected to receive a premium vis-á-vis those which are largely yield grade 2. Similarly, those lots which are comprised mostly of yield grade 3, 4, or 5 cattle are hypothesized to receive a discount relative to those that contain mostly yield grade 2 cattle. Also, lots which consist of mostly select grade cattle are hypothesized to receive a discount vis-á-vis those which consist of mostly prime or choice grade cattle.

The RHHI as a measure of the regional market concentration among packers in the fed cattle market is discussed in section 4. The greater the value of the RHHI, the greater the concentration among the largest firms in a particular region and, therefore, the greater the potential for regional fed cattle market power. The theory of imperfect markets suggests that the sign of the estimated coefficient for RHHI should be negative. That is, greater regional concentration is expected to lead to lower prices paid by packers for slaughter cattle. Thus, the negative effect of increasing regional concentration on delivered costs of cattle paid by packers may largely offset the positive cost effect of increased slaughter capacity to some extent.

The effect of captive supplies can be analyzed through the dummy variables for procurement and pricing methods. Captive supplies can be defined as "cattle owned by packers, forward contracted by them, and/or formula-priced cattle bought by packers" (Uvacek). Using this definition, captive supplies include any cattle procured using forward contracting or as packer fed cattle or priced on a formula or a grade, yield, and formula basis. Each of these procurement and pricing methods is expected to have a negative effect on the delivered liveweight cost/pound of fed cattle paid by packers.

Hypotheses cannot be made *a priori* regarding the effects of the *number of head in a lot* or *seasonality* on the delivered liveweight cost/pound of fed cattle paid by packers.

Description of the Data

Descriptive statistics for all variables in the model over all regions and firms accounting for 182,310 of the 200,616 total transactions included in the transactions dataset were presented in section 4 of this report (see Table 4.4). Due to data outliers, 303 additional observations were deleted using one of three criteria. First, if the reported delivered liveweight cost/pound was less than $0.40 or greater than $1.08, those observations were deleted. Second, 142 observations corresponding to an output beef price of $0.27 per pound and 117 observations corresponding to a price of $0.17 per pound were deleted. Finally, transactions involving cattle with reported average per head weights of less than 800 pounds or greater than 1,900 pounds were deleted. In this section, the descriptive statistics for the subset of transactions data used in this part of the study are presented by packer regions and firms.

Descriptive Statistics By Region

Descriptive statistics of the variables used in the analysis of factors affecting prices paid by region are presented in Tables 5.1 through 5.6. With the exception of seasonality, the variables differ widely across regions. Seasonal patterns, i.e., the percentage of transactions in any given quarter, only differ between 1.7% and 3.9% across all regions (Table 5.1). More interesting are plant, distance, lot size, and cattle type characteristics, which are vastly different across the various regions.

Average plant capacity ranges from 160 to 365 head per hour across all regions (Table 5.2). Within this range, three groups of plants can be defined: (1) small, (2) mid-size, and (3) large. In comparison, plants in the Wisconsin and Minnesota region, and the California and Arizona region have relatively small average capacities of 160.5 and 167.7 head per hour, respectively. On average, mid-size plants are found in the Idaho, Washington, and Utah region, the Nebraska region, and the Iowa and Illinois region with plant capacities of 220.8, 257.7, and 268.2 head per hour, respectively. The plants in the Texas region and the Kansas region are among those with the largest capacities (318.5 and 324.1 head per hour, respectively).

Average output beef prices received by plants range from $1.18/lb in the Wisconsin and Minnesota region to $1.31/lb in the Iowa and Illinois region (Table 5.2). Packers in the Kansas region the Idaho, Washington, and Utah region all receive an average $1.22/lb for their output which is less than the national average. The Texas region, the Nebraska region, the California region, and the Arizona region all receive higher prices on average than the national average ($1.28/lb, $1.28/lb, and $1.28/lb, respectively).

The majority of all cattle are purchased within a 300 mile radius of the plants where they are slaughtered (Table 5.3). Nearly 77% of the purchases made by plants in Texas occur within 100 miles of the plant, 17% between 100 and 300 miles, and only 5% outside a 300 mile radius. The majority of the cattle purchased in the Kansas region, the California and Arizona regions, and the Idaho, Washington, and Utah regions were from sellers within 100 miles of the plant (55.4%, 60.7%, and 61.7%, respectively). Plants in the Nebraska region purchased over 47% of their cattle from sellers within 100 miles, nearly 27% from sellers between 100 and 300 miles away, and almost 26% from sellers more than 300 miles away. Plants in the Wisconsin and Minnesota region purchased 44% of their cattle from sellers between 100 and 300 miles away, 40% from sellers within 100 miles, and 15% from sellers over 300 miles away. Plants in the Iowa and Illinois region followed a similar pattern with 39.9% of their cattle coming from sellers between 100 and 300 miles away, 39.7% from sellers within 100 miles, and 15.4% from sellers over 300 miles away.

The average lot sizes purchased by plants in the California and Arizona region, the Iowa and Illinois region, and the Wisconsin and Minnesota region were the smallest of all the regions at 76.6 , 75.7, and 65.8 head per lot, respectively (Table 5.4). The average lot sizes purchased by plants in the Texas region and the Kansas region, on the other hand, were among the largest at 169.6 and 142.9 head per lot, respectively. The plants in the Idaho, Washington, and Utah region and the Nebraska region purchased medium size lots on average at 107.2 and 119.5 head per lot, respectively. Because the number of head per lot and the liveweight of a lot are obviously correlated, the regions with the smallest lot sizes also had the smallest live weights.

The average weight per head of cattle purchased, however, does not necessarily correspond to the size of the lots purchased. Of all the plants in all regions, the plants in the Wisconsin and Minnesota region purchased the fewest number of head per lot (65.8 head) but the highest average number of pounds per head (1,258 lb/head) (Table 5.4). In other words, the plants in this region tended to purchase lots of fewer but larger cattle than was the case for the other regions. At the same time, the plants in the California and Arizona region purchased relatively few and relatively light cattle per lot (an average of 76.6 head per lot at an average weight of only 1,114 lb/head). The plants in the Texas region and the Kansas region purchased lots with a large number of head (169.4 head and 142.9 head) but comparartively small average weights per head (1,128 lb/head and 1,153 lb/head, respectively). The average weights of the cattle purchased by the plants in the Nebraska region, the Idaho, Washington, and Utah region, and the Iowa and Illinois region were quite similar at 1,181 lb/head, 1183 lb/head, and 1,183 lb/head, respectively.

The average delivered cost/lb (liveweight) of cattle purchased by packers ranged from a low of $0.71/lb in the Wisconsin and Minnesota region to about $0.76/lb in the Texas region (Table 5.4).

The average delivered liveweight cost/lb of cattle paid by plants in the Kansas region and the Nebraska region were all relatively high and greater than $0.76/pound. The average delivered cost/cwt of cattle to plants in the California and Arizona region, the Idaho, Washington, and Utah region, and the Iowa and Illinois region were all in the middle of the range.

The average time between purchase and slaughter was well below the national average of 12 days for cattle purchased by plants in the California and Arizona region, the Idaho, Washington, and Utah region, the Iowa and Illinois region, and the Wisconsin and Minnesota region at 7.5, 5.8, 7.8 and 5.9 days, respectively (Table 5.4). For cattle purchased by plants in the Nebraska region and the Texas region, the time between purchase and slaughter was above the national average at 13.3 and 15.9 days, respectively. The average time between purchase and slaughter was the longest (18.5 days) for cattle purchased by plants in the Kansas region.

The majority of lots purchased by plants in all regions except the Wisconsin and Minnesota region were reported to be predominantly steers (Table 5.5). Plants in the Wisconsin and Minnesota region purchased the most diverse mix of lots with 36% of the lots purchased predominantly steers, 15% predominantly dairy, 22% mixed, 19% predominantly heifers, and 6% predominantly fed holsteins. In contrast, 87% of the lots purchased by plants in the California and Arizona region were primarily steers with the other roughly 12% comprised mostly of heifers. Roughly 90% of the lots purchased by the remaining regions were categorized as steers or heifers.

Two groups of variables are included to capture important quality characteristics intrinsic in each lot. The first group is represented by three dummy variables corresponding to the prominent yield grade in each lot: (1) lots that are predominantly yield grade 1 (YG1), (2) lots that are predominantly yield grade 2 (YG2), and (3) lots that are predominantly yield grades 3, 4, and 5 (YG3). Summary statistics for these groups of variables are presented in Table 5.6. Most lots are YG2 with the highest percentage occurring in California/Arizona (66.7%). Low percentages of YG1 lots were reported by a number of regions. The highest percentage of YG3 lots occurs in Wisconsin and Minnesota (53.8%) and the lowest in California/Arizona (33.3%).

The second group of quality variables is a series of dummy variables representing lots that are predominantly prime (P), choice (C), or select (S) (see Table 5.6). Almost no lots are predominantly prime. The predominant quality grade in all regions is choice except in California/Arizona where 51.3% of all lots are select.

Empirical Results

Three sets of ordinary least squares (OLS) parameter estimates were derived using the hedonic price model. First, a set of parameters were derived using all 182,007 observations across all firms and regions. Next, to facilitate a regional comparison of the factors affecting the average delivered liveweight cost/lb of fed cattle paid by packers, parameters were derived for three regions: (1) the Midwest --Texas, Kansas, Nebraska, and Colorado; (2) the Upper Midwest -- Illinois, Iowa,

Wisconsin, and Minnesota; and (3) the Far West -- California, Arizona, Idaho, Utah, and Washington. The thirteen regions defined previously were consolidated into three regions.

Empirical Results Across All Packer Regions and Firms

About 54% of the variation in the average delivered liveweight cost/lb of fed cattle paid by packers across all firms and regions (referred to here as the average cost paid by packers) was explained by the RHS variables (Table 5.7). All variables, with one exception, were statistically significant at the 0.05 level. As expected, the results suggest that the average cost paid by packers was positively related to the output price of beef, slaughter capacity, and the number of head per lot but negatively related to average weight per head and the regional firm concentration of packers in fed cattle markets.

The elasticity of the average cost paid by packers for fed cattle with respect to the output beef price was 0.0158 indicating that a 1% increase in the output price of beef leads to only a 0.0158% increase in the average cost paid by packers for fed cattle. The implication is that little of the change in the output price of beef received by packers tends to be passed on to feeders in the price they receive for their fed cattle. The reason for this result is due in large part to the lack of variability in the largely cross-sectional transactions data as discussed more fully in the subsequent section on limitations of the study.

Although changes in the average cost paid by packers for fed cattle were positively related to changes in slaughter capacity, the effect was negligible. Again, the reason for the small effect is likely due to the cross-sectional nature of the data which limits the variability in slaughter capacity. The elasticity of the average cost paid with respect to slaughter capacity across all packers and regions was only 0.0208 so that a 1% increase in capacity would be expected to result in only a 0.0208% increase in the cost/lb paid by packers for fed cattle. Thus, even though the dominant firm strategy hypothesis cannot be rejected, this result does not support a conclusion that increases in slaughter capacity lead to lower prices paid by packers for fed cattle.

The effect of the number of head per lot purchased on the cost/lb of fed cattle paid by packers was also positive but, again, extremely small. The elasticity of the cost/lb of fed cattle with respect to the number of head in the lot was only 0.0033. That is, a 1% increase in the number of head in a purchase lot leads to a mere 0.0033% increase in the per head cost of fed cattle paid by packers.

The average cost paid by packers for fed cattle was sensitive to changes in the average weight per head in the purchase lot. With an elasticity of -0.1217, a 1% increase in the average weight per head leads to a 0.1217% decline in the average delivered cost per pound. That is, the average cost paid by packers for fed cattle tends to be discounted for over-finished cattle or the heavier exotic breeds. Thus, the average cost paid by packers for a steer or heifer that is 100 pounds (8.5%) over the mean average weight (1,171 lb) is likely to cost packers $0.75/cwt (1%) less on average than the mean average cost paid. For a lot of 120 head of steers (the mean lot size) averaging 100 lb/head over the

mean average weight, the total discount would be $1,143.90 (about 1% of the total cost). Because the percentage drop in average cost is smaller than the percentage increase in average weight (i.e., an elasticity of less than 1), however, total cost still increases. Whether or not this discount is sufficient to discourage over-finishing cattle or the feeding of heavy exotic breeds depends on the marginal cost to feeders of the additional weight.

The small regional firm Herfindahl index (RHHI) parameter estimate of -0.0000021 indicates that as regions become more concentrated in purchasing fed cattle, the average cost paid decreases but by a negligible amount. Indeed, the elasticity of the average cost paid by packers for fed cattle with respect to the RHHI is only -0.01 so that a 1% increase in the RHHI is associated with only a 0.01% decrease in the cost of fed cattle paid by packers. Again, the reason for this result is due, in large part, to the cross-sectional nature of the data and the limited variability in the RHHI variable. If the analysis had been conducted over a longer time interval, the quantitative relationship between the RHHI and the cost of fed cattle could have been more accurately assessed.

The empirical results across all packer regions and firms also provide some insight on the effects of other transactions characteristics on the average delivered cost paid by packers for fed cattle. The results indicate that fed cattle purchased from sellers within 100 miles of the plant earned $0.0019/pound more than cattle purchased from sellers more than 300 miles away from the plant. Cattle purchased from sellers between 100 and 300 miles away from the plant, however, were estimated to have brought $0.0007/pound less than cattle purchased from sellers more than 300 miles away, holding all else constant. These results indicate that, at least nationally, packers do not exert spatial monopsony market power on nearby cattle feeders. In fact, the positive sign on D1 indicates packers pay a small premium for nearby cattle. This result is consistent with the alternative hypothesis that packers pay higher prices for cattle from nearby sellers because cattle shipped shorter distances arrive in better condition than cattle shipped longer distances and because the transactions costs associated with purchasing cattle from more distant sellers may be higher.

The highest average delivered costs/lb were estimated to have been paid in the January to March 1993 quarter while the lowest prices were paid in the July to September 1992 quarter.

As expected, packers paid more for lots that were predominantly steers than for any other type of cattle. They paid $0.93/cwt less for lots of predominantly heifers, $3.65/cwt less for lots of predominantly mixed cattle, $5.45/cwt less for lots of predominantly dairy cattle, and $5.59/cwt less for lots of predominantly fed holsteins. Also, packers paid a premium of $0.32/cwt for YG1 cattle over YG2 cattle. They discounted YG3 cattle by $0.15/cwt relative to YG2 cattle. Packers paid $0.11/cwt less for select cattle relative to prime or choice cattle.

With respect to procurement methods, the empirical results indicate that packers paid $0.54/cwt more on average for lots purchased through a marketing agreement than for lots purchased on the spot market. Nevertheless, packer-fed lots of cattle and those purchased through forward contracting cost packers an estimated $0.57/cwt and $1.74/cwt less, respectively, than lots purchased through spot markets.

Lots priced on a formula basis cost packers less by $0.25/cwt than those priced on a liveweight basis. Finally, packers paid $0.18/cwt less for lots priced on a carcass weight basis than for lots priced on a liveweight basis. Thus, packers paid less for lots using procurement and pricing methods corresponding to captive supplies than for those lots procured through spot markets priced on a liveweight basis.

Empirical Results by Region

Results of the hedonic price analysis by region are similar to the overall estimates (Table 5.8). Notable exceptions occur with respect to the impact of procurement and pricing methods largely as the result of the use of different methods across regions.

With respect to pricing methods, key differences from the empirical results across packer regions occur in the impact of carcass weight and formula pricing methods. The upper and lower Midwest were the only regions in which the effect of pricing on a carcass weight basis on the average cost paid by packers for fed cattle was less than that of pricing on a liveweight basis. Only in the Far West did packers pay higher average cost for formula priced cattle.

Few differences in the effect of procurement methods on the average cost paid by packers for fed cattle were found across regions. The effect of packer fed cattle procurement on the average cost paid by packers for fed cattle was higher than that of procurement through the spot market only in the Upper Midwest and Far West (not significant) regions.

Other differences in the regional empirical results from those for all packer regions and firms involved the effects of output beef price, slaughter capacity, and distance. The impact of output beef price on the average cost paid by packers for fed cattle was positive and significant for all regions except the Upper Midwest. Increases in slaughter capacity had an estimated positive effect on the average cost paid by packers for fed cattle in the Midwest and Upper Midwest regions but a negative effect on the average cost paid by packers for fed cattle in the Far West region. The largest impact of slaughter capacity was found in the Upper Midwest region where a one unit increase in capacity led to about a $0.0057/cwt increase in the average cost paid by packers for fed cattle.

Consistent with the results over all packers and regions discussed in the previous section, the empirical results by region also indicate that the farther away cattle sellers are from the purchasing packers, the lower the delivered cost/cwt paid by packers for slaughter cattle. The Upper Midwest was the only region where that result was not the case. Packers in that region were found to have paid $0.09/cwt less for cattle purchased within 100 miles and $0.29/cwt less for cattle purchased between 100 and 300 miles of the plant. This result may indicate very limited exertion of spatial market power by packers on local cattle feeders in that particular region. In both of the other regions, however, packers were found to be paying small *premiums* for locally purchased fed cattle. In the Midwest and Far West regions, packers paid $0.39/cwt and $1.00/cwt more for cattle purchased within 100 miles than for cattle purchased greater than 300 miles away. Packers paid $0.24/cwt and $1.05/cwt more for cattle purchased 100 to 300 miles away in the Midwest and Far West regions than for cattle purchased greater than 300 miles away. Finally, only in the Midwest

did packers pay a premium for YG1 cattle. Packers in the Far West and Upper Midwest discounted YG3 cattle. Only in the Midwest did packers discount select cattle.

Limitations

The principal limitation of this study is the nature of the transactions data collected by PSP and made available for this study. The data are useful for considering the magnitude and direction of effects of lot characteristics, quality characteristics, and the relationship among procurement and pricing methods on prices paid by packers for fed cattle. The data are also useful for considering the *direction* of the effects of changes in output beef price, slaughter capacity, and regional concentration on prices paid by packers for fed cattle. Because they include only one year of information on packer transactions, however, the transactions dataset is not particularly useful for capturing the *magnitude* of those effects. For example, the standard deviation in fed cattle prices is only 4.3 cents/pound on a mean of 75.4 cents/pound. Similarly, variation in output prices, regional concentration, and slaughter capacity is mainly due to cross-sectional differences. If data were available for a longer period of time, say ten years, then variability observed would be much higher, consequently allowing a more accurate measurement of the impacts of changes in those variables on fed cattle prices.

Conclusions

The empirical results do not provide support for the hypothesis that packers are generally exerting spatial monopsony market power and pay less per pound for cattle from nearby feeders. In fact, the results indicate that, on average nationally, packers pay a small premium for nearby cattle likely because cattle shipped shorter distances arrive in better condition than cattle shipped longer distances and because the transactions costs associated with purchasing cattle from more distant sellers may be higher. The possibility of monopsony power leading to a lower delivered cost of cattle was found only for the Upper Midwest region where packers were estimated to be paying an average of $0.09/cwt less for cattle purchased within 100 miles and $0.29/cwt less for cattle purchased between 100 and 300 miles of the plant. In all other regions, however, packers were found to be paying small *premiums* for locally purchased fed cattle, the opposite of what would be expected under monopsony conditions.

The empirical results lead to a number of other conclusions regarding price determination in slaughter cattle procurement, including the following:

- While statistically affected by the output price of beef for most firms and regions, the average delivered cost/lb of fed cattle paid by packers is almost completely insensitive to changes in output price. This result is due primarily to the lack of variability in the largely cross-sectional transactions data as discussed in the study limitations section.

- Increases in slaughter capacity have only a small positive effect on the average delivered cost of fed cattle paid by packers. Again, as with the output beef price, the lack of variability in the data helps explain the limited magnitude of the measured effect. Thus, even though the dominant firm strategy hypothesis cannot be rejected, this result does not support a conclusion that increases in slaughter capacity lead to lower prices paid by packers for fed cattle.

- Increases in the average weight per head results in a lower average delivered cost of fed cattle paid by packers. A 100 lb increase in the average weight per head results in a $0.75/cwt decline in the average delivered cost paid by packers for fed cattle.

- As slaughter cattle procurement within a region becomes more concentrated, as indicated by increasing values of the regional HHI, the average delivered cost of fed cattle paid by packers falls. To put this result in perspective, if the region is captured by a single firm, the average delivered cost of fed cattle would be expected to fall by only 3%. However, this result is conditional on estimates using data for a single year, where most of the variation in fed cattle prices and RHHI results from cross-sectional differences. In addition, while concentration results in a tendency for lower prices to be paid for fed cattle, the competition among the few large packers for available supplies to maintain maximum utilization of their installed capacities tends to mitigate those price effects to some extent. Only in the Far West region do increases in capacity and regional concentration work together to lower average delivered costs paid by packers for fed cattle. In contrast, only in the Upper Midwest region do increases in capacity and regional concentration work together to raise average delivered costs paid by packers for fed cattle.

- Each of the procurement and pricing methods associated with captive supplies (defined as cattle owned by packers, forward contracted by them, and/or formula-priced cattle bought by packers) is associated with a discount in the average delivered cost of fed cattle paid by packers compared to cattle procured through the spot market and priced on a liveweight basis. The highest discount of $1.74/cwt is associated with forward contracting followed by packer-fed cattle (a discount of $0.57/cwt) and formula pricing (a discount of $0.25/cwt).

- Cattle procured through marketing agreements receive premiums of $0.54/cwt while those priced on a carcass weight basis receive discounts of $0.18/cwt compared to cattle purchased in the spot market and priced on a liveweight basis.

- Regionally, the effect of pricing on a carcass weight basis on the average cost paid by packers for fed cattle was less than that of pricing on a liveweight basis only for the upper and lower Midwest regions. Only in the Far West region did packers pay higher average cost for formula priced cattle.

- Few differences in the effect of procurement methods on the average cost paid by packers for fed cattle were found across regions. However, packer fed cattle procurement had a positive

effect on the average cost paid by packers for fed cattle compared to cattle procurement through the spot market in the Far West and Upper Midwest regions.

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Appendix 5.1

Theoretical Basis for the Hedonic Price Model: The Farm - Wholesale Price Spread in an Imperfectly Competitive Processing Industry

This section presents a hedonic model that incorporates quality factors affecting the farm-to-wholesale price margin in an oligopsonistic processing sector. Although cattle in each region are assumed to be supplied by competitive price-taking cattle feeders, each lot sold by feeders is characterized by a vector of quality factors unique to that lot. Under these assumptions, aggregate price dependent supply in each region can be written as the sum of two components: (1) average market price in the region and (2) discounts and/or premiums for quality characteristics associated with each lot.

Aggregate price-dependent supply of fed cattle in each region can be written as: $w = w(x)$, where w is an unobserved "average" regional market price, w(x) represents price dependent supply of the fed cattle, and x is total quantity supplied in the region.

Each lot (j) sold in the region is characterized by a vector of intrinsic quality factors (z_j) that result in different premiums or discounts. The effect of these factors on price can be characterized by the function $g(z_j)$. Combining these two factors, the price of any particular lot can be written as: $w_j = w(x) + g(z_j)$ where w_j is price per pound for live cattle in lot j.

In the slaughter cattle processing sector, processors purchase fed cattle from cattle feeders, transform live cattle into meat and meat products, and sell the products in the wholesale market. Product quality characteristics are assumed to have been established at the fed cattle level. As a result, the price the processor is willing to pay for fed cattle depends on those characteristics. Although the processing industry is assumed to be concentrated and can *potentially* exert monopsony market power in the fed cattle market, processing firms are competitive in the wholesale market.

Following Durham and Sexton (1992), the slaughter cattle processing sector is assumed to be characterized by a quasi-fixed proportions technology that allows no substitution between fed cattle (x) and a vector of non-farm inputs (F) that includes both variable and quasi-fixed inputs. The production function of processor I is given by $q_i = \min [\lambda x_i, h(F_i)]$ where q_i is the processor's output of meat and meat products, x_i is quantity of fed cattle used by the processor, $h(F_i)$ represents the technology associated with variable and quasi-fixed inputs, F_i is a vector of the processor's use of variable and quasi-fixed inputs, and λ is the fed cattle-to-meat product conversion ratio.

Given this production technology, cost minimization requires $q_i = \lambda x_i$. Processor I's profit function is then given by:

$$(1)\ \pi_i = P\lambda x_{ij} - [w(x_{ij} + x_{\_i}) + g(z_j)]\, x_{ij} - c_i(v; k$$

where P is wholesale output price, x_{ij} represents processor I purchases of fed cattle of lot-type j, $x_{\sim I}$ represents fed cattle purchases by other processors in the region, and $c_i(v; k_i)$ is the restricted unit cost function of processor I for costs other than fed cattle and is a function of variable input prices (v) and quantities of quasi-fixed inputs (k).

Profit maximization results in the following first-order conditions:

$$(2)\ \frac{\partial \Pi_i}{\partial x_{ij}} = P\lambda - \frac{\partial w_j}{\partial x_{ij}}\left(1 + \frac{\partial x_{\_i}}{\partial x_{ij}}\right) x_{ij} - w_j - c_i(v; k_i) \equiv 0.$$

Imposing the Cournot conjecture so that $\partial x_{\sim I}/\partial x_{ij} = 0$, then equation (2) can be rewritten as:

$$(2')\ \frac{P\lambda}{w} - \frac{s_i}{\varepsilon} - 1 - \frac{g(z_i)}{w} - \frac{c_i(v; k_i)}{w} \equiv 0$$

where s_i is the regional market share of processor I and $\in$ is the price elasticity of supply in the region.

Aggregating over all processors in the region results in the following market equilibrium condition:

$$(3)\ P\lambda - RHHI \bullet \frac{w}{\in} - w - \overline{g(z_j)} - \overline{c_i(v; k_i}$$

where RHHI is the regional Herfindahl - Hirschmann index,

$\overline{g(z_i)}$ is the weighted average premium and discount over all transactions, and $\overline{c(z_j)}$ is the weighted

average unit cost for all inputs except for fed cattle.

Equation (3) represents the market equilibrium condition over all transactions. To consider purchases of specific lots of fed cattle by specific firms, equation (3) must be rewritten as:

(3′) $w_j = P\,\lambda - RHHI \bullet \frac{w}{\in} - g(z_j) - c_i(v; k_i)$

Equation (3') gives a hedonic price model for effects of quality characteristics and market conditions on the price of a specific lot of fed cattle.

In model estimation, both λ and $w/\in$ are considered to be unknown parameters. The unit cost $c_i(\cdot)$ is assumed to be a function only of maximum slaughter capacity.

From equation (3'), it is possible to determine comparative static effects for changes in exogenous variables:

(4) $\partial w_j / \partial k_i > 0,\ \partial w_j / \partial P > 0,\ \partial w_j / \partial RHHI < 0.$

Figure 5.1. Dominant Firm Strategy: Drive Up Costs to Force Rivals to Exit the Industry

Table 5.1: Packer Regions: Percent of Steer and Heifer Slaughter by Quarter

Packer Region	Percent of Lots Slaughtered by Quarter			
	Jan. - March 1993	April - June 1992	July - Sept. 1992	Oct. - Dec. 1992
	---------- % ----------			
1. Nebraska	23.3	25.6	26.7	24.4
2. Texas	23.9	26.7	25.6	23.8
3. Kansas	24.0	24.5	26.6	24.8
4. Colorado	D	D	D	D
5. California/Arizona	22.9	26.7	25.2	25.2
6. Idaho/Washington/Utah	23.2	25.4	25.1	26.3
7. Iowa/Illinois	23.1	24.1	27.0	25.8
8. Wisconsin/Minnesota	24.0	23.4	25.3	27.3

D = Deleted to avoid disclosure.

Table 5.2: Packer Regions: Packing Plant Characteristics

Packer Region	Average Plant Maximum Slaughter Capacity	Average Output Price
	head/hr	$/lb
1. Nebraska	257.7	1.28
2. Texas	318.5	1.28
3. Kansas	324.1	1.22
4. Colorado	D	D
5. California/Arizona	167.7	1.28
6. Idaho/Washington/Utah	220.8	1.22
7. Iowa/Illinois	268.2	1.31
8. Wisconsin/Minnesota	160.5	1.18

D = Deleted to avoid disclosure.

Table 5.3: Packer Regions: Percent of Lots Purchased by Distance from Plant to Seller

Packer Region	Percent Purchased from Sellers: Within 100 miles of Plant	Between 100 and 300 miles from Plant	Over 300 miles from Plant
	---------- % ----------		
1. Nebraska	47.4	26.8	25.8
2. Texas	76.8	17.6	5.6
3. Kansas	55.4	41.7	2.9
4. Colorado	D	D	D
5. California/Arizona	60.7	27.9	11.4
6. Idaho/Washington/Utah	61.7	21.7	16.6
7. Iowa/Illinois	39.7	39.9	20.4
8. Wisconsin/Minnesota	40.4	44.2	15.4

D = Deleted to avoid disclosure.

Table 5.4: Packer Regions: Characteristics of Cattle Lots Purchased

Region	Average No. of Head	Average Live Weight per Lot	Average Weight per Head	Delivered Cost/lb liveweight	Elapsed Time Purchase to Slaughter
	no.	lb	lb/head	$/pound	days
1 Nebraska	119.5	141,565.3	1,181.3	0.76	13.3
2 Texas	169.6	190,479.3	1,127.8	0.76	15.9
3 Kansas	142.9	164,389.4	1,153.1	0.76	18.5
4 Colorado	D	D	D	D	D
5 California/Arizona	76.6	85,022.9	1,114.2	0.74	7.5
6 Idaho/Washington/Utah	107.2	126,480.1	1,182.7	0.74	5.8
7 Iowa/Illinois	75.7	89,668.2	1,182.8	0.75	7.8
8 Wisconsin/Minnesota	65.8	82,715.1	1,258.0	0.71	5.9

D = Deleted to avoid disclosure.

Table 5.5: Packer Regions: Percent of Lots Purchased by Cattle Type

Packer Region	Percent of Lots Purchased that Were Predominantly:				
	Dairy Cattle	Mixed Cattle	Fed Holsteins	Steers	Heifers
	---------- % ----------				
1. Nebraska	0.3	7.3	0.8	51.1	40.5
2. Texas	5.1	0.5	3.0	61.3	30.3
3. Kansas	8.7	0.6	0.9	56.6	33.2
4. Colorado	D	D	D	D	D
5. California/Arizona	0.6	0	0	87.2	12.2
6. Idaho/Washington/Utah	4.3	0	1.0	55.1	39.6
7. Iowa/Illinois	0	7.5	3.5	57.2	31.8
8. Wisconsin/Minnesota	15.6	22.4	6.0	36.2	19.8

D = Deleted to avoid disclosure.

Table 5.6: Packer Region: Percent of Lots Purchased by Yield and Quality Grade

Region	Yield Grade 1	Yield Grade 2	Yield Grade 3, 4, 5	Prime	Choice	Select
Nebraska	0.2	46.7	53.1	0.06	71.59	28.33
Texas	0.6	60.0	39.4	0.003	74.31	25.68
Kansas	14.2	37.3	48.5	0.005	82.22	17.77
Colorado	D	D	D	D	D	D
California/Arizona	0.0	66.7	33.3	0.0	48.68	51.32
Idaho, Washington, Utah	0.2	47.1	52.7	0.0	76.43	23.57
Iowa, Illinois	4.7	56.5	38.8	0.02	74.60	25.38
Wisconsin, Minnesota	0.6	45.6	53.8	0.0	62.69	37.31

D = Deleted to avoid disclosure.

Table 5.7: OLS Results: Hedonic Price Model Estimates Across All Regions and Packer Firms (182,007 Observations)

RHS Variable	Parameter Estimate $/lb	*t*-ratio	Elasticity Estimates
Constant	0.8310	698.71	----
Output Price	0.0095	23.22	0.0158
Capacity	0.000057	59.63	0.0208
Number of Head	0.000021	29.97	0.0033
Average Weight	-0.000078	-100.34	-0.1217
Regional Herfindahl Index	-0.0000021	-35.69	-0.0109
D1[1]	0.0019	11.06	----
D3[2]	-0.0007	-3.56	----
Quarter 1	0.0373	196.55	----
Quarter 2	-0.00014*	-0.74	----
Quarter 3	-0.0184	-102.07	----
Dairy	-0.0545	-148.26	----
Fed Holsteins	-0.0559	-119.63	----
Heifers	-0.0093	-56.25	----
Mixed	-0.0365	-126.40	----
Yield Grade 1	0.0032	11.11	----
Yield Grade 3, 4, or 5	-0.0015	-11.28	----
Select	-0.0011	-6.91	----
Forward Contract	-0.0174	-63.76	----
Packer-Fed	-0.0057	-14.34	----
Market Agreement	0.0054	17.99	----
Carcass Weight	-0.0018	-5.00	----
Formula	-0.0025	-17.07	----
R-square	0.5401		

[1] Cattle purchased within 100 miles of packer.
[2] Cattle purchased between 100 and 300 miles of packer.
* Denotes not statistically significant at the 0.05 level.

Table 5.8: OLS Results: Hedonic Price Model Estimates by Region

	Regions					
	Nebraska,Texas, Kansas, & Colorado (111,336[1])			California, Arizona, Idaho, Washington, & Utah (17,377)		
RHS Variable	Parameter Estimate	*t*-ratio	Elasticity Estimate	Parameter Estimate	*t*-ratio	Elasticity Estimate
Constant	0.8060	554.95		0.9314	191.50	
Output Price	0.0096	19.46	0.0158	0.0322	18.14	0.0537
Capacity	0.0000075	0.62	0.0031	-0.000090	-19.20	0.0246
Number of Head	0.0000137	19.97	0.0026	0.000028	9.94	0.0036
Average Weight	-0.000049	-54.16	-0.0728	-0.00011	-43.20	-0.1758
Regional Herfindahl Index	5.717E-8*	0.62	0.000025	-0.000020	-42.18	-0.1201
D1[2]	0.0039	18.42		0.0100	15.35	
D3[3]	0.0024	10.78		0.0105	14.85	
Quarter 1	0.0364	172.37		0.0320	53.69	
Quarter 2	-0.0024	-11.86		-0.0033	-5.85	
Quarter 3	-0.0209	-104.65		-0.0188	-34.04	
Dairy	-0.0516	-131.25		-0.0574	-48.15	
Fed Holsteins	-0.0558	-90.32		-0.0694	-28.32	
Heifers	-0.0076	-41.55		-0.0169	-32.17	
Mixed	-0.0131	-31.98		0.0102*	0.40	
Yield Grade 1	0.0057	20.10		-0.0055*	-1.02	
Yield Grade 3, 4, or 5	0.00086	5.59		-0.00075	-1.76	
Select	-0.0011	-6.39		0.0018	4.12	
Forward Contract	-0.0167	-59.32		-0.0245	-15.52	
Packer-Fed	-0.0041	-8.01		-0.0005*	0.68	
Market Agreement	0.0088	24.01		0.0047	6.04	
Carcass Wt.	-0.0019	-5.28		0.0028	3.83	
Formula	-0.0008	-4.64		0.0054	10.26	
R-square	0.5702			0.5233		

(continued on next page)

Table 5.8 (cont.): OLS Results: Hedonic Price Model Estimates by Region

	Regions		
	Iowa, Illinois, Wisconsin, & Minnesota (49,895)		
RHS Variable	Parameter Estimate	*t*-ratio	Elasticity Estimate
Constant	0.7807	200.85	
Output Price	-0.0032	-3.13	-0.0005
Capacity	0.000057	17.69	0.0189
Number of Head	0.000032	12.52	0.0032
Average Weight	-0.000099	-58.88	-0.1604
Regional Herfindahl Index	0.000018	24.91	0.1096
D1	-0.0009	-2.57	
D3	-0.0029	-8.23	
Quarter 1	0.0433	107.15	
Quarter 2	0.0080	19.93	
Quarter 3	-0.0139	-36.14	
Dairy	-0.0487	-48.79	
Fed Holsteins	-0.0534	-73.70	
Heifers	-0.0107	-28.73	
Mixed	-0.0512	-88.04	
Yield Grade 1	-0.0031	-4.16	
Yield Grade 3, 4, or 5	-0.0066	-21.80	
Select	0.0041	12.64	
Forward Contract	-0.0251	-36.65	
Packer-Fed	0.0260	3.08	
Market Agreement	0.0019	2.69	
Carcass Wt.	-0.0006*	-0.74	
Formula	-0.0020	-6.85	
R-square	0.5693		

[1] Number of observations in each region.
[2] Cattle purchased within 100 miles of packer.
[3] Cattle purchased between 100 and 300 miles of packer.
* Denotes variable is statistically insignificant at the 0.05 level.

PRICE DETERMINATION IN SLAUGHTER CATTLE PROCUREMENT

SECTION 6
PACKER AND FEEDER SURVEY DATA: TRADING RELATIONSHIPS IN THE SLAUGHTER CATTLE MARKET

This section describes the methods and reports the results of a survey of packers and feedlots designed and administered by the contractor to obtain additional insight into the particular procurement practices and pricing methods of beef packers. In general, the analysis of the packer transactions records included defining, characterizing, and quantifying the slaughter cattle pricing and procurement behavior of packers to the extent allowed by the information on individual transactions collected from packers. The information gleaned from the packer and feeder surveys, on the other hand, were intended to provide insight into *why* particular procurement practices and pricing methods have been followed by packers and *why* there have been differences in those practices and methods among packers and between packers and the various slaughter cattle suppliers. Because the perspectives of packers and feeders concerning not only the practices followed but also the factors affecting them were potentially quite different, the surveys asked both packers and feeders many of the same questions. Thus, in general, the transaction data provided information on *what* packer procurement and pricing practices were during a particular period of time, while the packer and feeder surveys provided insight into *why* such practices were followed. After discussing the details of the survey methodology, the survey results are then presented and discussed. Conclusions from the survey results are provided at the end.

Methodology

The methodology used for the packer and feeder surveys was summarized in section 1 of the report. The details of the methodology used are presented in this section.

Sampling Procedure

To examine trading relationships in the fed cattle industry, major beef packing and cattle feeding operations were surveyed to determine actual and preferred transaction methods, arrangements, and pricing methods for contracted cattle, including delivery arrangements, weighing conditions, pencil shrink arrangements, packer buyer preferred feedlot characteristics and services, packer buyer reasons for not buying from feedlots, and cattle characteristics for which packer buyers pay price premiums and discounts. Confidential surveys were designed to examine actual and perceived differences in dealings between packers and feedlots by size and region. The packer and the feedlot surveys are included as Appendices 6.1 and 6.2, respectively, of this section.

The questions on each survey were organized into four sections: (1) descriptive information, (2) the actual and preferred methods and arrangements involved in feedlot-packer trading relationships, (3) perceptions regarding the factors affecting the net price for fed cattle paid by packers to feedlots, and (4) perceptions regarding the non-price factors affecting feedlot-packer trading relations. Question I and II of the each survey requested general descriptive information and the total volume of cattle handled. Question III explored the actual and preferred methods of selling/buying fed cattle in 1993. Question III also requested information on the number of contract cattle sold/bought and the respective methods and arrangements used. Question IV identified delivery and weighing terms and shrink arrangements affecting net price. Question V addressed non-price factors affecting purchases and sales of cattle, including the importance of feedlot services and characteristics. Question VI requested information on premiums and discounts.

The packer buyer sample included the 42 largest steer and heifer slaughter plants in the United States, accounting for 93% of total commercial steer and heifer slaughter in 1992 (Grinnell). PSP provided the names and addresses of the 42 steer and heifer packing plants used in the study. These were the same plants from which PSP collected the transactions data analyzed in the preceding sections of this report[2]. A pre-survey letter was sent to each of the packers on the list provided by PSP to solicit the name and address of the primary fed cattle buyer for each plant and to determine the willingness of the plant to participate in the survey. Each letter included a postage-paid, self-addressed card on which the plant could respond. The plants were given 10 days in which to respond. After the 10-day period, each non-responding plant was contacted directly by telephone to solicit the requested information.

The feedlot sample was randomly drawn from a sampling frame of all U.S. feedlots with a one-time capacity of 4,000 head or greater as given in *CF Resources Cattle Industry Reference Guide, 1992*. The publication lists 598 feedlots by town, state, and capacity. Because the feedlot sampling frame included only the name, city, state, and telephone number for each feedlot, addresses of the feedlots in the final sample were obtained from the *Beef Spotter* book or through telephone calls.

The sampling frame was proportionately stratified by geographic location and feedlot capacity. The geographic stratum included the PSP regions having cattle feedlots with a one time capacity of 4,000 head or greater. The feedlot capacity stratum included 4 feedlot capacity size groups of over 4,000 head: (1) 4,000-7,999 head, (2) 8,000-15,999 head, (3)16,000-31,999 head and (4) 32,000 head or over. These particular capacity size categories are also those used by National Agricultural Statistics Service. The proportions used for stratifying the sampling frame were the number of fed cattle in each region and feedlot capacity during 1992. Two of the PSP regions (East North Central and South Atlantic) only had one feedlot each of 4,000 head capacity or more. Because the capacities of those two lots represented less than 1% of the total capacity of all feedlots in the sample, they were excluded from the sampling frame and the sample was adjusted by recalculating the proportions

[2] One plant was inadvertently left off the list of packing plants provided by PSP. Thus, although PSP collected steer and heifer transactions data from 43 plants, the packer survey for this part of the study went to only 42 steer and heifer plants.

among the remaining four PSP regions. As a result, two more feedlots were assigned to appropriate size categories. The procedure maintained the integrity of both the size and location strata of the sample. The final result of the sampling procedure was a two-way stratified sample of 195 feedlots from the population of 598 total feedlots permitting a 95% confidence interval with a ±7% error in response (Table 6.1). Alternate feedlots were also drawn for each feedlot capacity group within each region if some feedlots refused to participate. The alternates were drawn at a 20% rate of the original sample for each capacity size group and region.

The mail surveys were sent to the identified contact individual at each packing plant and feedlot along with a cover letter requesting their assistance in filling out and returning the completed surveys. A two week response time plus three days for mail service was allowed. A reminder letter and another survey were sent to all non-respondents again asking for their assistance. Another two weeks of response time plus 3 days for mail service was allowed. Then all contact individuals at the packing plants and feedlots who had not responded were contacted by telephone to again request their assistance in filling out and returning the surveys. The cutoff date for accepting completed surveys from the original sample was two weeks after the remaining non-respondents were contacted by telephone.

Any remaining non-respondent feedlots were replaced from the alternate list drawn from the sampling frame. Surveys were sent to that list and the same process of reminder letters and phone calls to non-respondents from that list was followed. This process required approximately another 7 weeks. A follow-up attempt was made to estimate the non-response error and determine the effects of non-response on the results.

Analytical Procedures

Cross tabulation contingency tables were produced for the responses to all questions on both surveys as appropriate to generate frequency distributions and relevant summary statistics such as means. An Analysis of Variance (ANOVA) was done for many questions as well to identify statistically significant differences within and between or among multiple classifications of packer and feedlot responses to the same questions. Packer responses were classified into two groups: (1) single vs. multiple plant firms and (2) geographic regions. Feedlot responses were classified into four groups: (1) feedlot capacity, (2) single vs. multiple feedlot firms, (3) feedlot regions, and (4) the number of packer buyers purchasing from each feedlot. To account for differences in the number of observations within and among groups, the Student-Newman-Kuhls (SNK) procedure was utilized to identify statistically significant differences.

A comparison of packer and feedlot mean responses regarding cattle sales/purchases methods and arrangements was often not meaningful due to the nature of the samples. That is, the packers did not buy exclusively from the feedlots in the feedlot sample and the same for feedlots and the packer sample. Comparisons of rating responses between the packers and feeders surveyed, however, are provided. Packer and feedlot ratings for importance of feedlot services/characteristics and reasons for lost sales were compared using a paired *t*-test procedure assuming unequal variances.

Questions regarding ranked preferences for purchase behavior were analyzed using various ranked-sum procedures of the Wilcoxon type. Based upon the data limitations, the most appropriate analytic techniques for assessing potential statistically significant differences was judged to be the Kruskal-Wallis χ^2. This technique utilizes a type of χ^2-statistic to detect differences in ranked preferences between/among groups. The classifications used for both feedlots and packers for these analyses were the same as for the previously discussed analyses.

Feedlot and Packer Response Rates

Of the 195 feedlots in the feedlot sample, 116 returned completed surveys for a 59.5% total response rate. Response by feedlot capacity size and by PSP region are shown in Table 6.2. Of the 42 plants in the packer sample, 26 plants returned completed surveys for a 62% total respondent rate. The central office of one of the packer firms completed the surveys and submitted responses for three regions rather than for specific plants. Only one of the top three packing firms refused to participate in the survey.

Feedlot Survey Results

The feedlot contact individuals (the "feedlot respondents") were asked to respond to questions in 6 general areas: (1) actual and preferred methods of pricing cattle, (2) actual and preferred methods of pricing *contract* cattle, (3) actual and preferred delivery period arrangements for *contract* cattle, (4) cattle ownership arrangements, (5) factors affecting the net price received by feedlots for fed cattle, and (6) the importance of non-price factors in selling fed cattle to packers. The results of the feedlot survey in each of these 6 areas are first presented and discussed. Then, the survey responses, as appropriate, are analyzed using the Analysis of Variance (ANOVA) procedure.

Actual and Preferred Methods of Pricing Cattle

The survey asked each of the feedlot respondents to report actual and preferred methods of pricing fed cattle in 1993 in one of 4 categories: (1) liveweight, (2) carcass weight, (3) carcass weight and grade, and (4) other possible methods as listed by the respondents. Cattle sales by the particular pricing methods were stratified into 10% intervals. For example, if a feedlot reported that only 6% of their cattle sales were priced on a carcass weight basis, that would be reported in the 1-10% interval for that pricing method.

The majority of cattle sold (68.76%) were reported to have been priced on a liveweight basis (Table 6.3). About 78% of the respondents (91 respondents) reported that least some of their cattle were priced on a liveweight basis (Table 6.4). Over 60% of those respondents (55 respondents) reported selling 80% or more of their cattle on a liveweight basis. The larger feedlots (capacities of greater than 16,000 head) tended to sell a higher percentage of their cattle on a liveweight basis compared to the smaller capacity feedlots (less than 16,000 head).

Fed cattle were reported to have been priced on a carcass weight basis by 36.2% of the respondents (Table 6.5). Most of those respondents (23 out of 42) reported that less than 20% of their fed cattle sales were priced on carcass weight basis. The feedlots with less than 16,000 head capacity appeared to sell a higher percentage of their cattle on a carcass weight price basis than feedlots of larger capacities. The larger capacity feedlots tended to sell less than 20% of their cattle on a carcass weight price basis.

At least some fed cattle of about 53% of all respondents were priced on a carcass weight and grade basis (Table 6.6). The majority of respondents across all feedlot capacity sizes reported that less than 20% of their fed cattle were priced on a carcass weight and grade basis. In fact, 47 of the 61 responses received across all capacity levels indicated that less than 20% of fed cattle were sold on a carcass weight and grade basis.

Respondents were asked to list other price methods that were used for selling fed cattle. Only 16.4% of the respondents listed "other" methods (Table 6.7). The "other" methods listed included contracts, formula, and rail. Contracts made up 40% of the "other" responses, formula 55%, and rail 5%. Only nine respondents indicated that they sold less than 20% of their fed cattle using one of the "other" methods. The feedlots with capacities of 16,000 head or greater were clearly those making the most use of these "other" methods.

Respondents were also asked to rank the 4 methods of pricing cattle in order of preference as opposed to the order in which they were actually used. In actuality, more cattle were reported by the respondents to have been priced on a liveweight basis than on any other basis as discussed earlier. Liveweight pricing also appeared to be the *preferred* method across all sizes of feedlots. More respondents across all feedlot sizes ranked liveweight pricing first in order of preference than any other pricing method (Table 6.8). However, other pricing methods such as forward contracts and formula ran a close second for some of the larger capacity feedlots. Over all feedlots, "other" pricing methods appeared to be preferred over either the carcass weight or the carcass weight and grade methods of pricing cattle.

Actual and Preferred Methods of Pricing Contract Cattle

The survey requested the respondents to report the percentages of their 1993 fed cattle marketings sold on forward contract. About half (60) the respondents (51.7%) reported selling at least some fed cattle on a forward contract basis in 1993 (Table 6.9). Nearly 45 of those 60 respondents, however, reported selling less than 10% of cattle on a forward basis for a total of only 439,578 head of cattle (6.8% of fed cattle marketings) sold on forward contract basis in 1993.

Nearly 40% of the respondents reported pricing at least some contract[3] cattle on a liveweight basis (Table 6.10). Of the 46 respondents, 39 indicated that 80% or more of contract cattle were priced on a liveweight basis. Feedlots of 8,000 head or more capacity were the only ones to report pricing contract cattle on a liveweight basis.

[3] The use of the term "contracted" cattle for some questions in part III of the feedlot survey may have caused some confusion. The term was not defined on the survey so that some respondents may have thought this term included only forward contracted cattle while others may have interpreted the term more broadly.

Only 9.3% of the respondents reported pricing at least some contract cattle on a carcass weight basis (Table 6.11). All but one of those were large feedlots with capacities of 16,000 head or more. Half the large feedlots, however, reported that less than 10% of their contract cattle were priced on a carcass weight basis.

Over 30% of the respondents (36 respondents) reported that at least some of their contract cattle were priced on a carcass weight and grade basis with half of those respondents using that method for more than 90% of their contract cattle (Table 6.12). The feedlots of greater than 32,000 head capacity reported pricing contract cattle on a carcass weight/grade basis more often than feedlots of any other size capacity.

The respondents were also asked to list other ways they priced contract cattle. Formula pricing was the only other method of selling listed. Only 3.4% of the respondents indicated any sales of contract cattle on a formula basis.

Although a majority of contract cattle were priced on either a liveweight or a carcass weight basis, liveweight pricing was clearly the *preferred* method of pricing contract cattle, particularly among the smaller capacity feedlots. More respondents across all feedlots sizes ranked liveweight pricing first in order of preference than any of the other pricing method (Table 6.13). Carcass weight and carcass weight and grade were tied for second as preferred methods for pricing contract cattle.

Actual and Preferred Delivery Period Arrangements for Contract Cattle

The feedlot survey respondents were asked to identify the delivery period arrangements for all contract cattle in 1993 according to one of 5 categories: (1) less than 10 day delivery, (2) 10-30 day delivery, (3) greater than 30 day delivery, (4) open delivery, and (5) other delivery arrangements. The majority of the contract cattle (53.9%) were reported to have been sold with a delivery arrangement of more than 30 days (Table 6.14).

Over 37% of the respondents sold at least some contract cattle with delivery arrangements of less than 10 days (Table 6.15). A majority of those respondents in each feedlot capacity group and in total reported selling over 90% of their contract cattle with such delivery arrangements.

Only 13% of the respondents reported selling contract cattle with delivery arrangements of 10 to 30 days (Table 6.16). Of those, 40% (6 respondents) reported selling 10% or less of their contract cattle with such delivery arrangements. Feedlots with capacities of 16,000 head or more accounted for 80% of those reporting sales of cattle with delivery arrangements of 10 to 30 days.

Over 30% of all respondents reported selling cattle with delivery arrangements of more than 30 days (Table 6.17). The feedlots with capacities of over 16,000 head accounted for nearly 90% of those feedlots reporting sales with delivery arrangements of over 30 days. Nearly 60% of the feedlots that reported such sales had capacities of over 32,000 head.

Only about 13% of the feedlot survey respondents reported selling contract cattle with open delivery date arrangements (Table 6.18). Of those respondents, 60% (9 respondents) reported selling more than 90% of their contract cattle with open delivery date arrangements. Feedlots with capacities of 16,000 head or more accounted for 7 of the 9 respondents reporting that they sold more than 90% of their cattle with open delivery date arrangements.

A few other types of delivery date arrangements were reported. A seven day period delivery arrangement was reported by 5 respondents for some sales. One respondent reported using whatever delivery period was specified in the contract. The other respondent reported selling cattle with a specified month for delivery.

Over two-thirds of the cattle (67.3%) were reported to have been sold by the respondents for delivery in less than 10 days or in more than 30 days (see Table 6.14). The feedlot respondents also indicated a preference for those two types of delivery period arrangements (Table 6.19).

Cattle Ownership Arrangements

The survey requested respondents to report the percentage of fed cattle sold in 1993 that were custom fed or owned by someone not associated with the feedlot. Most of the respondents (100 of 116 respondents or 86.2%) reported custom feeding at least some cattle in 1993 (Table 6.20). Of those respondents, 70% reported that more than 40% of the cattle they sold in 1993 were custom fed and nearly half (49%) reported that more than 60% were custom fed.

Factors Affecting Net Price for Fed Cattle Received by Feedlots

The survey also examined the factors affecting the net price received by feedlots for fed cattle. Factors considered were: (1) the actual and preferred delivery payment arrangement (i.e., arrangements for paying the cost of transporting cattle from the feedlot to the packing plant), (2) weighing conditions, and (3) shrink arrangements. The survey also requested respondents to report the characteristics for which packers pay price premiums or take discounts for fed cattle.

Delivery Payment Arrangements

The feedlots responding to the survey were asked to report whether they or packers paid the cost of transporting cattle from the feedlots to the packing plants and the percentages of the fed cattle sold in 1993 for which they or the packer paid for the transportation costs. The feedlot respondents reported that they paid transportation costs for a little over half of the cattle they sold (52.4%) while packers paid the costs for about 45% of the cattle sold (Table 6.21). Two "other" types of arrangements for payment of transportation costs were also reported pertaining to only 1.1% (69,000 head) of the fed cattle that feedlots reported selling in 1993 (Table 6.21). In one arrangement, the feedlot paid transportation costs except if the packer preferred the cattle to go somewhere other than that firm's closest plant in which case the packer paid the difference in transportation cost for

delivery to the more distant plant. In the other, the feedlot was required to pay the transportation either at the time of hauling or later as a deduction from revenues received from the packer.

Nearly 70% of feedlots (81 respondents) reported that they paid the transportation costs for at least some of the fed cattle they sold in 1993 (Table 6.22). About two-thirds of those respondents (52 respondents or 44.8% of all respondents) reported paying the transportation costs on more than 80% of the cattle they sold in 1993.

About half (51.7%) of the respondents reported that the packer paid the transportation costs for at least some of the cattle they sold in 1993 (Table 6.23). Of those feedlots, 55% (33 respondents or 28.4% of all respondents) reported that the packer paid the transportation costs on more than 80% of the cattle sold. The results indicate that transportation costs were paid for a larger share of cattle sold by the large feedlots than those sold by the small feedlots. About 83% of those feedlots reporting that packers paid the transportation costs on at least some of their cattle had capacities of 16,000 head or more. No feedlot of less than 8,000 head capacity reported that packers paid transportation costs for any of the cattle they sold in 1993.

The respondents were asked to rank the delivery payment methods (packer pays, feedlot pays, other) in order of preference. The preference across all feedlot capacities was, not surprisingly, for the packer to pay transportation costs (Table 6.24) even though the feedlots themselves actually paid the transportation on more cattle they sold in 1993 than did the packers (Table 621).

Weighing Method

Question IV.B of the feedlot manager survey requested that the respondents: (1) indicate the actual percentage of the cattle they sold in 1993 using various weighing methods and (2) rank the various weighing methods in order of preference. The respondents were given 7 choices of weighing method: (1) standing liveweight at the feedyard, (2) on truck liveweight at the feedyard, (3) standing liveweight away from the feedyard, (4) on truck liveweight away from the feedyard, (5) hot carcass weight, (6) chilled carcass weight, and (7) other possible methods to be specified by the respondent.

By far the most common method of weighing fed cattle was reported by feedlot respondents to be standing liveweight at feedyard. This method of weighing cattle was used for at least some of the fed cattle sold by nearly 71% of the respondents (82 respondents) (Table 6.25). Of those respondents, two thirds (55 respondents) sold more than 90% of their cattle using this weighing method (Table 6.26). The use of this weighing method appeared to be unrelated to the size of the feedlot.

The second most common method of weighing fed cattle was reported to be hot carcass. Nearly 40% of the respondents (46 respondents) reported that at least some of the fed cattle they sold were weighed by this method (Table 6.25). About 35% of the respondents (16 respondents) indicated that more than 90% of their cattle were weighed using the hot carcass method (Table 6.27). Another 35% reported that less than 20% of the fed cattle they sold were weighed using this method. Nearly 24% of the respondents (11 respondents) reported that between 21% and 60% of their cattle were

weighed using the hot carcass method. Again, the use of this weighing method appeared to be unrelated to the size of the feedlot.

The weighing method used most often (liveweight standing at feedyard) was also ranked highest in order of preference on average across all feedlot sizes (Table 6.28). Tied for second in order of preference were on truck liveweight at feedyard and hot carcass. Ranked last in order of preference on average was on truck liveweight away from feedyard. Little difference in preferences was apparent for the different weighing methods by large versus small feedlots.

Shrink Arrangements

Question IV.C of the feedlot manager survey requested that the respondents: (1) indicate the actual percentage of the cattle they sold in 1993 using various shrink arrangements and (2) rank the various shrink arrangements in order of preference. The respondents were given 6 choices of shrink arrangements: (1) liveweight overnight stand *without* feed, (2) liveweight overnight stand *without* feed and water, (3) liveweight overnight stand *with* feed and water, (4) hot carcass weight, (5) chilled carcass weight, and (6) other shrink arrangements as specified by the respondents.

The shrink arrangement reported by the feedlot respondents to be used most frequently for the fed cattle they sold in 1993 was liveweight overnight stand *with* feed and water (60.3% of respondents) (Table 6.29). A larger percentage of the large capacity feedlots reported that this shrink arrangement was used than was the case for the smaller feedlots. The arrangement reported to be used the next most frequently was the hot carcass shrink arrangement (31.9% of respondents) followed by other shrink methods (10.3%), liveweight *without* feed (5.2%), and chilled carcass (4.3%). None of the feedlot respondents reported that a liveweight overnight stand *without* feed and water shrink arrangement was used for the fed cattle they sold.

Of the feedlots reporting that the liveweight *with* feed and water shrink arrangement was used for at least some of the fed cattle they sold in 1993, 73% (51 respondents) reported that this method was used for over 90% of the fed cattle sold (Table 6.30). Over 60% (31 respondents) of those respondents were feedlots in the over 32,000 head capacity size group.

Of the feedlot respondents reporting that the hot carcass shrink arrangement was used for at least some of the cattle they sold in 1993, nearly 38% (14 respondents) reported that over 90% of they cattle they sold used that shrink arrangement while nearly 46% (17 respondents) reported that the hot carcass shrink arrangement was used for 20% or less of the fed cattle they sold (Table 6.31).

The shrink arrangement used most often (liveweight *with* feed and water) was also ranked highest in order of preference on average across all feedlot sizes (Table 6.32). On average, the few "other" shrink arrangements listed by the respondents (such as a 4% pencil shrink) were ranked second in order of preference for shrink arrangement followed by hot carcass and then liveweight *without* feed. Ranked lowest in order of preference by the feedlot respondents was liveweight *without* feed and water.

Premiums and Discounts Related to Fed Cattle Characteristics

The net price a feedlot receives for fed cattle is affected by the premiums and discounts paid by the packer for the various characteristics of the cattle sold. The feedlot respondents were asked to indicate whether premiums are paid or prices are discounted for any of a long list of possible characteristics associated with fed cattle sold to packers. "Higher quality grades" was the only characteristic listed for which a majority of respondents reported that premiums are paid (Table 6.33). Over 40% of the responding feedlots reported that premiums are paid for "shorter distance from the plant" and for "uniformity of lot." Only about 25% of responding feedlots reported that premiums are paid for "cattle available weekly" and for "lower yield grade."

A majority of feedlots reported that prices are discounted for only 2 of the characteristics listed: (1) "dark cutters" (57% of responding feedlots) and (2) "muddy coat" (53% of responding feedlots) (Table 6.33). Between about 30% and 40% of the responding feedlots reported that prices are discounted for "inconsistent quality," "excessive ear/loose skin," "large framed cattle," "high yield grade," "abscesses," "bruises," "small framed cattle," and/or "days on feed."

Non-Price Factors Affecting Feedlot Sales

To determine the importance of non-price factors in sales of fed cattle as perceived by the feedlots, the feedlot respondents first were asked to score the importance of a series of possible factors in the sales of their cattle on a scale of 1 ("not important") to 5 ("very important"). Then, the feedlot respondents were asked to indicate which of a series of possible factors were important reasons for which sales are lost on a scale of 1 ("not important") to 5 ("very important).

Importance of Feedlot Service/Characteristics for Sales

The non-price factors scored by the feedlot respondents as "important" or "very important" (mean scores of 4 or 5 on the scale of 1 to 5) in their ability to make sales of fed cattle to packers included the following in order starting with the factor with the highest mean score: (1) "honesty," (2) "reliability," (3) "dependable delivery dates," (4) "feedlot ability to determine proper finish," (5) "show lists with pens," and (6) "feedlot scales" (Table 6.34). Those non-price factors that the feedlot respondents considered to be of "little importance" (mean scores of about 2 on the scale of 1 to 5) included the following in order starting with the factor with the lowest mean score: (1) "feedlot willingness to negotiate pencil shrink," (2) "feed mostly heifers," (3) "feedlot willingness to pay transportation," and (4) the feedlot's "willingness to contract." None of the listed factors was scored as "not important" on average. The responses were fairly uniform across all feedlot sizes with perhaps two exceptions. The smallest size feedlots in the sample (4,000-7,999 head) scored the importance of "show lists with pens" and "feedlot scales" noticeably lower in importance than the larger feedlots.

Important Reasons for Which Feedlots Lose Sales

On average, the feedlot respondents did not score any factor as "very important" as a reason for lost sales and scored only 1 factor ("cattle often priced too high") as "important" (Table 6.35). The large feedlots (16,000 head capacity or greater) scored "cattle often priced too high" lower than smaller feedlots. In fact, the largest feedlots (over 32,000 head capacity) scored "type of cattle" slightly higher than "cattle often priced too high" as a reason for lost sales. Factors that feedlot respondents scored as of "little importance" as reasons for lost sales included the following in order starting with the factor scored the lowest: (1) "unwilling to pay transportation," (2) "show list not always complete," (3) "unwilling to sell on grade basis," (4) "feedlot medication/growth hormone practice," (5) "unwilling to sell on a carcass basis." Again, the scoring of the importance of factors responsible for lost sales was fairly uniform across all feedlot capacities.

Analysis of Variance of Responses to Feedlot Survey

The Analysis of Variance (ANOVA) procedure was used to analyze the feedlot respondent responses to appropriate questions on the feedlot survey[4]. Only ANOVA models which yielded F-values with a level of significance greater than 95% ($\alpha < 0.05$) are reported (Tables 6.36 through 6.54). To account for differences in the number of observations within and among categories, the Student-Newman-Kuhls (SNK) procedure was utilized to identify statistically significant differences. The categories were then ordered by their means, and categories with means which were not statistically different from one another were indicated with the same letter (A, B, C and/or D as needed). Feedlots were categorized into 3 different groups for each analysis: (1) multiple and single feedlot firms, (2) geographic regions, and (3) number of packer buyers to which the feedlots sold cattle in 1993. For those questions in which the feedlot respondents were asked to rank various cattle sales methods and arrangements in order of preference, the Kruskal-Wallis χ^2 test statistic generated utilizing Wilcoxon rank sums was used to determine those groupings of feedlots for which the ranked preferences were statistically different. The same groupings of feedlots were used for the analysis of the ranked preference questions as were used for the analysis of the other questions. Again, only those groupings of the various methods or arrangements for which statistically significant differences were found among the ranked preferences of the feedlot respondents are presented here.

Differences in Cattle Marketings

[4] The number of feedlots included in the ANOVA analysis in this section may be different for some questions than reported in the preceding sections. When the total number of feedlot respondents included in the ANOVA analysis is smaller, the reason is generally that some feedlots did not answer all questions. Thus, a given feedlot might not have been included in the totals for the ANOVA analysis of, for example, cattle sold on a liveweight basis even if the feedlot answered that question if it did not also indicate the number of packer buyers to which it sold or answer other questions used for stratifying the responses. On the other hand, when the total number of feedlot respondents included in the ANOVA analysis is larger, the reason is generally that the feedlots reporting that 0% of their cattle were marketed by a given method were *not* included in the totals reported in the preceding sections but *are* included in the ANOVA analysis.

Multiple plant firms marketed a significantly greater number of cattle than single plant firms in 1993 (Table 6.36). In terms of seller regions, the South Plains feedlots marketed an average of 74,756 head in 1993, a statistically greater number than the West North Central, Mountain, and Pacific regions, respectively. Two groupings resulted with respect to the number of packer buyers to which feedlots sold cattle. This can be interpreted as meaning that the number of cattle marketed by feedlots selling to six or more buyers (70,030 head) was significantly greater than those selling to three buyers (41,422 head). The four remaining packer buyer classifications were not statistically different from one another.

Differences in Number of Packer Buyers Used

Feedlots with capacities of 20,000-39,999 head and 40,000-59,999 head used significantly more buyers (4.19 and 4.33, respectively) than those with capacities of less than 20,000 head and greater than 80,000 head (3.74 and 3.50, respectively) (Table 6.37). Similarly, sellers in the West North Central region utilized significantly more buyers (4.42) than those in the South Plains, Mountain, and Pacific regions (4.02, 3.56, and 3.00, respectively). The number of packer buyers used by feedlots is statistically different for each region.

Differences in Pricing Methods

Statistically significant differences were found for only the carcass weight and the carcass weight/grade methods of pricing cattle sold by feedlots. For fed cattle sales priced on a *carcass weight basis*, feedlots with capacities of less than 20,000 head and those with capacities of greater than 80,000 sold 56.42% and 47.50%, on average, using this pricing method (Table 6.38). These percentages are statistically greater than the 3.29% of the cattle priced by feedlots using this pricing method with capacities of 40,000-79,999 head but are not statistically greater than the 22.3% priced using this method by feedlots with capacities of 20,000-39,999 head. With respect to the number of buyers to which feedlots sold cattle priced using the carcass weight basis method, the average 89.5% of the cattle priced in this manner and sold to only one buyer by two different feedlots was statistically greater than the percentages sold in this manner by all other firms. The percentages of the cattle priced using this method by the remaining groups of feedlots which sold cattle to more than one buyer were not found to be significantly different from one another.

Statistically significant differences for cattle marketings on a *carcass weight/grade basis* were found to exist by seller region and number of packer buyers (Table 6.39). Feedlots in the Pacific and Mountain regions reported pricing 46.39% and 33.11%, respectively, of all the cattle they sold in 1993 using this method. Feedlots in the Pacific region priced a significantly greater percentage of the cattle they sold using this method than those in either the South Plains or West North Central regions (14.37% and 10.83%, respectively). The number of cattle sold by feedlots in the Mountain region that were priced using this method was not significantly greater than those sold by the feedlots in either the South Plains or West North Central regions. The percentages of cattle sold using the carcass weight/grade pricing method by feedlots using only 1 or 2 packer buyers (64.1% and 65.83%, respectively) were statistically greater than those of feedlots using 3, 4, 5, or 6 or more packer buyers (14.34%, 12.21%, 8.50%, and 5.30%, respectively).

Differences in Custom Fed Cattle Sales

With respect to custom fed cattle or those sold but not owned by the responding feedlots, statistically significant differences were found between single and multiple feedlot firms (Table 6.40). An average of 58.74% of the cattle sold by the 97 single feedlot firms were custom fed or not owned by the feedlot, a significantly greater percentage than the average for the 10 multi-plant firms (31.0%). Once again, the number of packer buyers used significantly impacted the percentage of cattle sold, with feedlots using 3 or more buyers selling a significantly greater percentage of cattle that were custom fed or not owned by the feedlot than those using less than three buyers. On average, feedlots using 5 buyers sold the highest percentage of this type of cattle (73.07%) compared to those using either 1 or 2 buyers (37.14% and 41.50%, respectively).

Differences in Feedlot Payment of Transportation Costs

Those feedlots with capacities of less than 20,000 head reported paying the transportation costs for an average of 86.35% of all cattle sold in 1993, a statistically greater mean percentage than for those feedlots with capacities of 40,000-79,999 head (43.62%)(Table 6.41). The mean percentages of the cattle sold by feedlots with capacities of 20,000-39,999 head or more than 80,000 head for which they paid the transportation costs were not statistically different from one another (72.77% and 62.34%, respectively). The 9 feedlots using only 2 buyers reported paying the transportation costs for an average of 98.33% of the cattle they sold in 1993. Conversely, the 14 feedlots using 6 or more buyers reported paying the transportation costs on only 38.86% of the cattle they sold in 1993.

Differences in Weighing Methods

Statistically significant differences in the percentages of cattle sold by the various weighing methods among feedlots resulted only for the hot carcass, on-truck liveweight at feedyard, standing liveweight away from feedlot, and chilled carcass weight methods. No statistical differences in the percentages of cattle sold by feedlots using the *standing liveweight at the feedyard* weighing method, the one used by most feedlots, were found by feedlot capacity, by region, by number of buyers used, or by firm type. For the *hot carcass weight* weighing method, feedlots in the Pacific region had the greatest average percentage of cattle sold (83.17%), a statistically greater average percentage than the 42.14% and 23.56%, respectively, sold using this weighing method by feedlots in the West North Central and South Plains regions (Table 6.42). Feedlots in the Mountain region sold 66.10% using the hot carcass weighing method, a statistically greater percentage than sold using that method by feedlots in the South Plains region. Feedlots using only 2 packer buyers reported selling an average of 99.67% of their fed cattle on a hot carcass weight basis which was statistically different from the 33.33%, 31.85%, and 32.5% of their cattle that feedlots using 3, 4, or 6 or more packer buyers, respectively, reported selling using that weighing method. These differences were statistically significant whereas differences between the percentages of the cattle sold using this method by feedlots using either 1 or 4 buyers were not. For the other 3 weighing methods (*on-truck liveweight at feedyard, standing liveweight away from feedlot, and chilled carcass weight*), the percentages

feedlots sold by each method were nearly all statistically different by feedlot capacity, by region, by number of buyers used, or by firm type (Tables 6.43 through 6.45).

Differences in Shrink Arrangements

For the percentages of cattle that the feedlot respondents sold by the various shrink methods, statistically significant differences were found only for cattle sold by feedlots using the hot carcass weight and the chilled carcass weight shrink methods. No statistical differences were found among the percentages that feedlots sold using the most commonly reported shrink arrangement (*with feed and water*). The mean percentage of cattle sold using a *hot carcass weight* shrink arrangement for feedlots of capacities over 80,000 head (97.5%) was statistically greater those for feedlots with capacities of 20,000-39,999 head (35.33%) and of 40,000-79,999 head (25.78%) (Table 6.46). Single plant firms marketed a significantly greater percentage of their cattle (50.24%) using the hot carcass weight shrink arrangement than did multiple plant firms (20.33%). Feedlots from the Mountain region sold 88.75% of their cattle using a hot carcass weight shrink arrangement, a significantly greater percentage than those in the West North Central region (49.5%) or the South Plains region (12.47%). Pacific feedlots reported that they sold 68.4% of their cattle using this shrink arrangement, significantly greater than the 12.47% sold by those in the South Plains region using this shrink arrangement. Feedlots using only 1 or 2 packer buyers reported that 100% of their cattle were sold using the hot carcass weight shrink method, statistically greater than the 27.78% reported to be sold using this shrink arrangement by feedlots using 6 or more buyers. The percentages of cattle sold using the hot carcass weight shrink method by feedlots using 3 or more buyers were not statistically different from one another. The percentages of cattle sold by feedlots using the chilled carcass weight shrink arrangement were all statistically different across most categories of feedlot capacity, region, number of buyers used, and firm type (Table 6.47).

Differences in the Importance of Feedlot Characteristics and Services

As discussed earlier, the feedlot respondents indicated their perceptions of the importance of various feedlot services and characteristics in their ability to make sales of fed cattle to packers on a scale of 1 (not important) to 5 (very important). For all those services/characteristics with mean scores across all respondents of 4 (important) and 5 (very important), the ANOVA results indicated no statistical differences in those scores by feedlot capacity, region, number of buyers used, or firm type. The only services/characteristics for which the mean scores by various groupings different significantly from one another were: (1) "willingness to contract," (2) "feedlot capacity of 20,000 head or more," (3) "feedlot willingness to pay transportation cost," and (4) "feedlot sorts pens so pens finish evenly."

A *willingness to contract* was considered by feedlots with capacities of greater than 80,000 head to be of some importance (3.18) in making sales to packers, a statistically greater rating than indicated by feedlots with capacities of either 40,000-79,999 head or less than 20,000 head (2.00 and 1.84, respectively) (Table 6.48). With regard to seller region, the mean score for willingness to contract by feedlots in the Pacific region (3.25) was statistically greater than the mean score by feedlots in the Mountain, South Plains, or West North Central regions (2.46, 2.23, and 2.02, respectively).

Not surprisingly, the mean rating for *importance of feedlot capacity* was over 3 for feedlots in all capacity groups except those in the less than 20,000 head group, which had a significantly lower mean of 1.75 (Table 6.49). Similarly, multiple plant firms rated this characteristic as statistically higher (mean rating of 3.7) than single plant firms (mean rating of 2.6).

Those feedlots using 2 packer buyers considered *willingness of the feedlot to pay transportation costs* to be statistically more important (mean rating of 3.2) than those using only 1 buyer (mean rating of 1.5) (Table 6.50). No statistically significant differences were found among the ratings for this characteristic for feedlots using 3 or more packer buyers.

Feedlots in the Pacific and Mountain regions rated the importance of *sorting pens for even finish* significantly higher than those in the West North Central region (mean ratings of 4.0 and 3.67 versus 2.74, respectively) (Table 6.51). The same was found for feedlots using 1 packer buyer (mean score of 4.17) compared with those using 3, 4, 5 or 6 or more (mean ratings of 3.24, 2.70, 2.84, 3.21, respectively).

Differences in Reasons for Lost Sales

The *type of cattle* was the only reason for lost sales with a mean score of 3 or greater across all respondents for which there were significant differences in mean ratings among any of the different groupings of feedlots (Table 6.52). Geographic region was the only feedlot grouping for which significant differences existed for type of cattle as a reason for lost sales. The mean rating of 4.0 by feedlots in the Pacific region for this reason for lost sales was statistically higher than the 2.78 mean rating by feedlots in the West North Central region. The ratings of the Mountain and South Plains regions were not significantly different from any other region.

The only two other reasons for lost sales for which significant differences existed among some feedlot groupings were: (1) "unwilling to sell on a carcass basis" and (2) "feedlots unwilling to pay transportation costs." For the *unwilling to sell on a carcass basis* reason for lost sales, the mean rating of 3.43 by feedlots in the Pacific region was statistically greater than the 2.26 mean rating by feedlots in the West North Central region and the 1.79 mean rating by feedlots in the South Plains region (Table 6.53). Feedlots with capacities of 20,000-39,999 head rated this reason for lost sales significantly higher (mean rating of 2.81) than did feedlots with capacities of either 40,000-79,999 head or over 80.000 head (mean ratings of 1.63 and 1.82, respectively). Also, single feedlot firms rated this reason for lost sales significantly higher (mean rating of 2.35) than did multiple feedlot firms (mean rating of 1.25).

The Pacific region feedlot respondents also placed a significantly higher level of importance on *unwillingness to pay transportation costs* as a reason for lost sales (mean rating of 3.0) than feedlots in the Mountain, West North Central, and South Plains regions (mean ratings of 2.0, 1.8, and 1.67) (Table 6.54). Also, feedlots with capacities of 20,000-39,999 head rated this reason significantly higher (mean rating of 2.44) than feedlots with capacities of 40,000-79,999 head (mean rating of 1.45). The ratings of all other capacity groups for this reason were not significantly different.

Differences in Ranked Preferences

Statistically significant differences in ranked preferences among feedlot respondents were detected for only one grouping of feedlot respondents (number of packer buyers) for only one question (pricing methods for fed cattle) (Table 6.55). The results suggest that feedlots selling cattle to 3 or more buyers have a higher preference for pricing their cattle on a liveweight basis than feedlots selling to only 1 or 2 buyers. At the same time, those feedlots selling cattle to only 1 or 2 buyers tend to have a higher preference for pricing their cattle on a carcass weight and grade or chilled carcass weight basis than do feedlots selling to 3 or more buyers.

Packer Survey Results

The beef packing plant contact individuals (the "packer respondents") were also asked to respond to questions in 6 general areas: (1) actual and preferred methods of pricing cattle, (2) actual and preferred methods of pricing *contract* cattle, (3) actual and preferred delivery period arrangements for *contract* cattle, (4) cattle ownership arrangements, (5) factors affecting the net price paid to feedlots for fed cattle, and (6) the importance of non-price factors in decisions concerning the seller from which to purchase fed cattle.

Actual and Preferred Methods of Pricing Cattle

The survey asked each of the packer respondents to report actual and preferred methods of pricing fed cattle in 1993 in one of 4 categories: (1) liveweight, (2) carcass weight, (3) carcass weight and grade, and (4) other possible methods as listed by the respondents. As with the feedlot responses, cattle purchases by the particular pricing methods were stratified into 10% intervals. For example, if a packer reported that only 6% of their cattle purchases were priced on a carcass weight basis, that would be reported in the 1-10% interval for that pricing method.

All packers reported pricing at least some fed cattle on liveweight basis in 1993 (Table 6.56). However, 77% of the packer respondents (20 respondents) reported pricing 60% or less of the cattle they purchased on that basis. All but 3 packers reported pricing at least some fed cattle on a carcass weight basis and all but 2 reported pricing at least some fed cattle on a carcass weight and grade basis. At the same time, about 80% of the packer respondents (21 packers) reported pricing 40% or less of their cattle on a carcass weight basis. Finally, 73% of the packers reported pricing 20% or less of their cattle on a carcass weight and grade basis.

The packer respondents were also asked to rank the 4 methods of pricing cattle in order of their preference as opposed to the order in which they were actually used. On average, the packer respondents ranked liveweight pricing first in order of preference, followed by carcass weight pricing, carcass weight and grade pricing, and miscellaneous "other" pricing methods last (Table 6.57).

Actual and Preferred Methods of Pricing Contract Cattle

The packer survey also asked respondents to report the percentage of 1993 fed cattle that were purchased on forward contract (Question III.B of the packer survey). Thirteen packer respondents (50%) reported purchasing at least some fed cattle on forward contract in 1993. Of those packer respondents, 12 reported purchasing less than 10% of their 1993 cattle on forward contract.

Packer respondents were asked to report the actual and preferred pricing methods used to purchase contract[5] cattle in 1993 (Question III.F of the packer survey). Liveweight pricing was reported to have been used for at least some contract cattle by 18 of the 26 packer respondents (69.2%), carcass weight and grade pricing by 16 packer respondents (61.5%), and carcass weight pricing by 13 packer respondents (50%) (Table 6.58). The majority of the packer respondents reported using each of the three pricing methods (liveweight, carcass weight, and carcass weight/grade) to purchase 40% or less of their cattle in 1993. No "other" pricing methods were cited by the packer respondents.

The packer respondents were also asked to rank the 4 methods of pricing *contract* cattle in their order of preference as opposed to the order in which they were actually used. On average, the packer respondents ranked liveweight pricing first in order of preference for *contract* cattle, followed by carcass weight pricing, and carcass weight and grade pricing (Table 6.59).

Actual and Preferred Delivery Period Arrangements for Contract Cattle

The packer survey respondents were asked to identify the delivery period arrangements for all contract cattle in 1993 according to one of 5 categories: (1) less than 10 day delivery, (2) 10-30 day delivery, (3) greater than 30 day delivery, (4) open delivery, and (5) other delivery arrangements (question III.C in the packer survey).

Nearly half of the packer respondents (12 of the 26 packer respondents) reported purchasing at least some cattle with delivery period arrangements of more than 30 days (Table 6.60). Of those packer respondents, all but 1 reported purchasing over 80% of their cattle with delivery period arrangements of over 30 days. About 27% of the packer respondents (7 of the 26 packer respondents) reported purchasing at least some fed cattle using either a 10 to 30 day or a less than 10 day delivery period arrangement. Of those respondents, all but 1 reported purchasing less than 20% of their fed cattle using either method. Also, about 27% of the packer respondents reported purchasing more than 80% of their fed cattle using an open delivery period arrangement. No "other" delivery period arrangements were listed by the packer respondents.

[5] As was the case for the feedlot survey, the use of the term "contracted" cattle for some questions in part III of the packer survey may have caused some confusion. The term was not defined on the survey so that some respondents may have thought the term included only forward contracted cattle while others may have interpreted the term more broadly.

The packer respondents were also asked to rank the 5 alternative delivery period arrangements in order of preference as opposed to the order in which they were actually used. The packer respondents reported a clear preference for a greater than 30 day delivery period arrangement (Table 6.61). On average, packers ranked the 10 to 30 day delivery period arrangement second in order of preference with the 10 day or less delivery period arrangement in third place and the open delivery period arrangement in last place. No preference for any "other" delivery period arrangement was reported.

Cattle Ownership Arrangements

The survey requested packer respondents to report the percentage of fed cattle purchased in 1993 that were custom fed or owned by someone not associated with the feedlot from which the cattle were purchased. Only half of the packer respondents (13 packer respondents) reported purchasing at least some custom fed cattle in 1993 (Table 6.62). Of those respondents, 5 (38%) reported that more than 70% of the cattle they purchased in 1993 were custom fed while 6 (46%) that 40% or less were custom fed.

Factors Affecting Net Price for Fed Cattle Paid by Packers

The survey also examined the factors affecting the net price paid by packers for fed cattle. Factors considered were: (1) the actual and preferred delivery payment arrangement (i.e., arrangements for paying the cost of transporting cattle from the feedlot to the packing plant), (2) weighing conditions, and (3) shrink arrangements. The survey also requested the packer respondents to report the characteristics for which they pay price premiums or discount prices for fed cattle.

Delivery Payment Arrangements

The packers responding to the survey were asked to report whether they or the seller paid the cost of transporting cattle from the feedlots to the packing plants and the percentages of the fed cattle purchased in 1993 for which they or the feedlot paid for the transportation costs. All packer respondents reported that they paid the transportation costs for at least some of the cattle they purchased in 1993 (Table 6.63). All but 3 packer respondents reported that the feedlot paid the transportation costs for at least some of the fed cattle they purchased in 1993. At the same time, however, 17 of the 26 packer respondents (65%) reported that they paid the transportation costs on less than 40% of the cattle they purchased in 1993. About 73% of the packer respondents reported that the feedlots paid the transportation costs on more than 40% of the cattle they purchased in 1993.

The packer respondents were also asked to rank the two alternative delivery payment arrangements (packer or feedlot pays transportation costs in order of preference. They indicated a slight preference for the feedlot to pay the transportation costs. That is, slightly more packer respondents ranked the option of feedlots paying the transportation cost first than ranked the option of the packer paying for transportation costs first.

Weighing Method

Question IV.B of the packer survey requested that the packer respondents: (1) indicate the actual percentage of the cattle they sold in 1993 using various weighing methods and (2) rank the various weighing methods in order of preference. The respondents were given the same 7 choices of weighing methods that were given to feedlot respondents: (1) standing liveweight at the feedyard, (2) on truck liveweight at the feedyard, (3) standing liveweight away from the feedyard, (4) on truck liveweight away from the feedyard, (5) hot carcass weight, (6) chilled carcass weight, and (7) other possible methods to be specified by the respondent.

About the same number of packer respondents (16 or 17) reported purchasing cattle using the weighing methods of standing liveweight at the feedyard, on truck liveweight at the feedyard, and hot carcass weight (Table 6.64). Nevertheless, nearly 70% of those using the standing liveweight at the feedyard method (11 respondents) reported purchasing more than 40% of their cattle using that method. In contrast, only 50% of those using the hot carcass method reported purchasing more than 40% of their cattle using that method. At the same time all of those respondents using the on truck liveweight at the feedyard method reported purchasing *less* than 40% of their cattle using that method.

The packer respondents were asked to rank the 7 alternative weighing methods in order of preference. They indicated the strongest preference for the standing liveweight away from the feedlot method (Table 6.65). Preferences for the other weighing methods were quite diverse so that the mean rank for each of those alternatives was between 3 and 4.

Shrink Arrangements

Question IV.C of the packer survey requested that the packer respondents: (1) indicate the actual percentage of the cattle they purchased in 1993 using various shrink arrangements and (2) rank the various shrink arrangements in order of preference. As with the feedlot survey, the packer survey provided respondents with 6 choices of shrink arrangements: (1) liveweight overnight stand *without* feed, (2) liveweight overnight stand *without* feed and water, (3) liveweight overnight stand *with* feed and water, (4) hot carcass weight, (5) chilled carcass weight, and (6) other shrink arrangements as specified by the respondents.

Nearly 60% of the packer respondents (15 of the 26 packer respondents) reported that they purchased at least some cattle in 1993 using the hot carcass shrink arrangement although more than half of them (8 packer respondents) reported purchasing less than 20% of their cattle using that shrink arrangement (Table 6.66). Only 9 of the packer respondents reported purchasing any fed cattle using the liveweight overnight stand with feed and water shrink arrangement. Only 4 packer respondents reported purchasing cattle using the liveweight overnight stand without feed and water shrink arrangement. Also, only 4 packer respondents reported using the liveweight overnight stand without feed shrink arrangement. None reported purchasing any cattle using the chilled carcass weight or any "other" shrink arrangements.

The packer respondents were asked to rank the 6 alternative shrink arrangements in order of preference. On average, the packer respondents ranked the hot carcass and the liveweight overnight stand without feed and water as the first and second preferred shrink arrangements, respectively (Table 6.67). Not surprisingly, the chilled carcass weight shrink arrangement was ranked in last place on average in order of preference.

Premiums and Discounts

The net price a packer pays for fed cattle is affected by the premiums paid and discounts taken for the various characteristics of the cattle sold. The feedlot respondents were asked to indicate whether premiums are paid or prices are discounted for any of a long list of possible characteristics associated with fed cattle sold to packers. As was the case for feedlot respondents, the only factor listed on the survey for which a majority packer respondents (13 of the 25 responding to the question) reported that premiums are paid was "higher quality cattle" (Table 6.68). Between about 25% and 40% of the packer respondents also listed "uniformity of lot, "lower yield grade," "sorting privileges," and "shorter distance from plant" as characteristics for which premiums are paid. A large number of packer respondents also reported that they pay premiums for at least one factor not listed on the survey - "flexibility."

A majority of the packer respondents reported that prices paid for cattle are discounted for the following 9 characteristics of the cattle they purchase: (1) "dark cutters," (2) "muddy coat," (3) "inconsistent quality," (4) "high yield grade," (5) "large framed cattle," (6) "small framed cattle," (7) "excessive ear/loose skin," (8) "weighing conditions," and (9) "reputation of cattle" (Table 6.67). Recall that the majority of the feedlots reported that they believed prices to be discounted for only the first two of those characteristics (compare Table 6.33).

Non-Price Factors Affecting Fed Cattle Purchases

To determine the importance of non-price factors in purchases of fed cattle by packers, the packer respondents first were asked to score the importance of various factors that might affect their choices of the sellers from which they purchase fed cattle on a scale of 1 ("not important") to 5 ("very important"). Then, the packer respondents were asked to score the importance of various possible reasons for which fed cattle might not be purchased from a particular feedlot, again on a scale of 1 ("not important") to 5 ("very important).

Importance of Feedlot Services/Characteristics in Packer Choice of Feedlot

All 26 packers scored "honesty" as a "very important" factor affecting their choices of sellers from which to purchase fed cattle (Table 6.69). Two packers listed "integrity" as one "other" very important factor affecting their choice of fed cattle sellers. All but one packer also scored "reliability" as a "very important" factor in their fed cattle seller choices. The packer respondents scored 4 other factors as "important" in their seller selection decisions: (1) "dependable delivery dates," (2) "the feedlot sorts pens so pens finish evenly," (3) "show lists with pens," and (4) "feed mostly non-Brahman cattle." On average, the 4 factors scored by the packer respondents as "not

important" or of "little importance" included the following, starting with the factor scoring the lowest: (1) "feedlot capacity of 20,000 head or greater," (2) "willingness to contract," (3) "feedlot willingness to pay transportation," and (4) "feedlot scales."

Important Reasons for Not Purchasing from a Feedlot

"Honesty" was the reason for not buying cattle from a particular feedlot that packers scored the highest but was not even listed on the survey (Table 6.70). Half of the packers (13 packer respondents) wrote in "honesty" as an "other" reason and scored it as "very important." No other reason was rated as "very important" on average. The only reason clearly rated by the packer respondents as important on average across all respondents was "type of cattle." Those rated as "not important" or of "little importance" included the following, starting from the reason rated least important on average: (1) "feedlot unwilling to pay transportation" with a mean rating of 2.00, (2) "feedlot unwilling to sell on grade basis" with a mean rating of 2.04, (3) "feedlot unwilling to sell on a carcass basis" with a mean rating of 2.12, (4) "frequency of availability" with a mean rating of 2.15, and (5) "showlist not always complete" with a mean rating of 2.27.

Analysis of Variance of Responses to Packer Survey

The Analysis of Variance (ANOVA) procedure was also used to analyze the packer respondent responses to appropriate questions on the packer survey. Due to the small sample size for packers (n=26), a limited number of comparisons proved to have statistically significant differences. As with the ANOVA analysis of the feedlot survey responses, only models which yielded F-values with a level of significance greater than 95% ($\alpha < 0.05$) are reported (Tables 6.71 through 6.74). To account for differences in the number of observations within and among categories, the Student-Newman-Kuhls (SNK) procedure was utilized to identify statistically significant differences. The categories were ordered by their means. Categories with means which are not statistically different from one another are indicated with the same letter (A, B, C and/or D as needed). Packers were categorized into 3 different groups for each analysis: (1) multiple and single plant firms, (2) geographic regions, and (3) the number of feedlots from which the packer purchased slaughter cattle in 1993. While plants in the North Atlantic region were included in all analyses, results for the North Atlantic region have been excluded from all tables which provide regional results. For those questions in which the packer respondents were asked to rank various cattle sales methods and arrangements in order of preference, the Kruskal-Wallis χ^2 test statistic generated utilizing Wilcoxon rank sums was used to determine those groupings of packers for which the ranked preferences were statistically different (Table 6.75). The same groupings of packers were used for the analysis of the ranked preference questions as were used for the analysis of the other questions. Again, only those groupings of the various methods or arrangements for which statistically significant differences were found among the ranked preferences of the packer respondents are presented here.

Differences in the Importance of Feedlot Service/Characteristics

For all regions, packers rated *reliability* to be a "very important" feedlot service/characteristic in their decisions regarding the feedlots from which to purchase fed cattle with mean rating of 5.0 in all but the Pacific region where it received a 4.5 mean rating (Table 6.71). Only one packer in the

entire sample rated reliability anything other than "very important." Single plant firms rated a feedlot's *ability to determine proper finish* statistically more important (mean rating of 4.33) than did multiple plant firms (mean rating of 2.94) (Table 6.72). Also, the mean rating for a feedlot's ability to determine proper finish was statistically higher for packers in the East North Central, Pacific, and Mountain regions than in the South Plains region (4.00 or greater vs. 2.33). Also, single plant firms rated both *feedlot pays transportation costs* and *feedlot willingness to negotiate shrink* as statistically more important than did multiple plant firms (3.00 vs. 2.00 and 4.44 vs. 2.29, respectively) (Table 6.73).

Differences in Delivery Period Arrangements for Contract Cattle

The percentage of purchases of contract cattle by packers using different delivery period arrangements differed significantly depending upon whether the firm had single or multiple plant locations (Table 6.74). Single plant firms purchased significantly more contract cattle on average for delivery in less than 10 days (31.67%) than multiple plant firms (0.31%). Similar behavior was evidenced in the 10 to 30 day delivery period where single plant firms purchased an average of 9.33% of their contract cattle with that delivery arrangement compared with the average 2.81% purchased by multiple plant firms with the same delivery period. The implication is that the vast majority of contract cattle were purchased for delivery in excess of 30 days for multiple plant firms. Also, most multiple plant firms contracted for cattle for delivery in excess of 30 days.

Differences in Ranked Preferences

Statistically significant differences in ranked preferences among packer respondents were detected for only two groupings of packer respondents (multiple vs. single plant firms and geographic regions) for only one question (weighing methods for fed cattle) (Table 6.75). Unfortunately, the results in both cases are rather uninteresting. In the first case, both multiple plant and single plant firms ranked the "on truck liveweight away from the feedyard" weighing method quite low in order of preference but the single plant firm average ranking of about fourth (average rank of 4.29) was determined to be significantly higher than the average ranking of sixth for that weighing method by multiple plant firms. In the second case, the packer respondents in both the West North Central and the South Plains regions ranked the "on truck liveweight at feedyard" weighing method significantly higher than packer respondents in the Pacific and Mountain regions. In fact, on average, packer respondents in the West North Central region ranked this method of weighing cattle as first in order of preference. For the "chilled carcass" weighing method, the result was the opposite. That is, packer respondents in both the Pacific and Mountain regions ranked the "chilled carcass" weighing method significantly higher than did the packer respondents in both the South Plains and West North Central regions. Finally, packer respondents in the South Plains region ranked the "liveweight overnight stand without feed" weighing method significantly higher than packer respondents in the West North Central region who ranked this weighing method significantly higher than packer respondents in the Mountain region.

Comparison of Feedlot and Packer Survey Responses

Many of the questions on the two surveys were the same to facilitate a comparison of packer and feedlot responses. In this section, the results from each survey are summarized and compared to determine areas of similarity and differences.

Actual and Preferred Methods of Pricing Cattle

Feedlot and packer perceptions regarding various aspects of selling/buying fed cattle were the focus of question III.A of both the feedlot manager and the packer buyer surveys. The surveys first requested each of the respondents to report the actual percentages of their cattle sold/purchased in 1993 that were priced on a liveweight basis, carcass weight basis, carcass weight and grade basis, and other methods as specified by the respondents. They were also asked to rank those pricing methods in order of their preference.

Approximately 78% of the feedlot respondents reported that at least some of their cattle were priced on a liveweight basis with 60% of those respondents reporting that more than 80% of the cattle they sold were priced on that basis. At the same time, only 36% and 52% of the feedlot respondents reported selling cattle priced on either a carcass weight or a carcass weight and grade basis, respectively. In both cases, most feedlots selling cattle priced either of the latter two ways reported selling less than 20% of their cattle priced on either basis. In contrast, nearly all 26 packer respondents reported pricing at least some of the cattle they purchased using all three of those pricing methods. About 80% of the packer respondents reported pricing less than 60% of the cattle they sold on a liveweight basis. Also, 80% reported pricing less than 40% of the cattle they purchased on a carcass weight basis. Finally, over 70% reported pricing less than 20% of the cattle they purchased on a carcass weight and grade basis. On average, however, both feedlot and packer respondents ranked the liveweight pricing method first in order of preference.

Actual and Preferred Methods of Pricing Contract Cattle

About half of both the packer and feedlot respondents reported using forward contracts for at least some sales/purchases of cattle in 1993. In each case, however, most reported using forward contracts for less than 10% of the cattle they sold/ purchased. Clearly more feedlot respondents reported selling contract cattle priced on a liveweight basis than on any other basis. In contrast, the packer respondents reported a more uniform use of the three pricing methods for the contract cattle they purchased with slightly more reporting the use of liveweight pricing. The feedlot and the packer respondents, however, ranked the three pricing methods for contract cattle in the same order of preference on average with liveweight pricing first, carcass weight pricing second, and carcass weight and grade pricing last.

Actual and Preferred Delivery Period Arrangements for Contract Cattle

Nearly 40% of the feedlot respondents reported selling at least some contract cattle for delivery within 10 days while 30% reported selling at least some contract cattle for delivery in more than 30 days. In contrast, 46% of the packer respondents reported purchasing at least some contract cattle for delivery in more than 30 days with 92% of those respondents reporting that 80% or more of their contract cattle were purchased with that delivery period arrangement. Also, although a little over 25% of the packer respondents reported purchasing contract cattle for delivery within either 10 days or 10 to 30 days, about 85% of those respondents reported purchasing less than 20% of their contract cattle with either one of the two latter delivery period arrangements. Finally, about 13% of the feeder respondents and 27% of the packer respondents reported selling/purchasing contract cattle with an open delivery date. The delivery period preferred by the feedlot respondents was the period preferred last by the packer respondents. The clear preference of packers was a greater than 30 day delivery period followed by delivery within 10 to 30 days and then delivery within 10 days. The feedlot respondents, in contrast, reported a clear preference for a delivery period of 10 days or less followed by delivery in more than 30 days and then delivery within 10 to 30 days.

Cattle Ownership Arrangements

Although 86% of the feedlot respondents reported custom feeding at least some cattle in 1993, only half of the packer respondents reported purchasing any custom fed cattle that year.

Factors Affecting Net Price Between Feedlot and Packer

The survey examined packer and feedlot perceptions regarding 3 factors that may affect the net price paid by packers to feedlots for fed cattle: (1) delivery (transportation) cost arrangements, (2) weighing methods, and (3) shrink arrangements. With regard to delivery cost arrangements, the survey results suggest that feedlots are more likely to pay the transportation costs than packers. About 70% of the feedlot respondents reported that they paid the transportation costs on at least some of the cattle they sold in 1993 with 67% of those respondents reporting that they paid the costs on more than 80% of those cattle. About half of the feedlot respondents also reported that the packer paid the transportation costs on at least some of the cattle they sold in 1993 with a little over half of those respondents reporting that the packer paid the charges on more than 80% of the cattle they sold. At the same time, about 65% of the packer respondents reported paying the transportation costs on less than 40% of the cattle they purchased in 1993. Also, 73% of the packer respondents reported that feedlots paid the transportation costs on more than 40% of the cattle they purchased in 1993. Not surprisingly, the feedlot respondents reported a preference for packers to pay the transportation costs while the packer respondents reported a slight preference for just the opposite.

Feedlot respondents reported that the most common method of weighing fed cattle was standing liveweight at feedyard. Nearly 71% of the feedlot respondents reported that at least some of their

fed cattle were sold using that weighing method with 67% of those respondents reporting that more than 90% of their cattle were sold using that method. About the same number of packer respondents (16 or 17) reported purchasing cattle using the standing liveweight at the feedyard, on truck liveweight at the feedyard, and hot carcass weighing methods. Nevertheless, nearly 70% of those using the standing liveweight at the feedyard method reported purchasing more than 40% of their cattle using that method. The feedlot respondents ranked the weighing methods they used most often (liveweight standing at feedyard) first in order of preference on average. Although the weighing method preference of the packer respondents was less clear, the standing liveweight *away* from the feedyard method was ranked higher on average in order of preference.

The shrink arrangement reported by the feedlot respondents to be used most frequently for the fed cattle they sold in 1993 was liveweight overnight stand *with* feed and water (60.3% of respondents). Nearly 60% of the packer respondents reported that they purchased at least some cattle in 1993 using the hot carcass shrink arrangement although more than half of them reported purchasing less than 20% of their cattle using that shrink arrangement. Only 9 of the 26 packer respondents reported purchasing any fed cattle using the liveweight overnight stand *with* feed and water shrink arrangement. The feedlot and packer respondents reported a preference for the respective shrink arrangement that they reported to be used most often. The liveweight *with* feed and water shrink arrangement was ranked first in order of preference on average by feedlots across all feedlot sizes. On average, the packer respondents ranked the hot carcass and the liveweight overnight stand *without* feed and water as the first and second preferred shrink arrangements, respectively. Despite the fact that more packer respondents reported actually purchasing cattle using the liveweight overnight stand *with* feed and water shrink arrangement than any other except the hot carcass arrangement, they ranked that shrink arrangement next to last on average in order of preference.

"High quality grade" was the only characteristic associated with fed cattle for which a majority of either packer or feedlot respondents reported that a premium was paid by packers (Table 6.76). The percentages of packer and feedlot respondents reporting that premiums are paid or are not paid for other characteristics were roughly similar except for "sorting privileges" and "shorter distance from plant." A larger percentage of packer than feedlot respondents (32% and 12.1%, respectively) reported that premiums are paid for "sorting privileges." The reverse was the case for "shorter distance from plant" where only 24% of the packer respondents reported that premiums are paid compared with 41.7% of the feedlot respondents.

A majority of packer respondents reported that prices are discounted for a larger number of characteristics associated with the fed cattle they buy than was the case for a majority of feedlot respondents. A majority of feedlot respondents reported that fed cattle prices are discounted for only 2 characteristics - "dark cutters" and "muddy coats" (Table 6.76). A majority of packer respondents, however, reported that prices are discounted for 9 of the characteristics listed on the survey, including the 2 reported by a majority of feedlot respondents.

Non-Price Factors Affecting Trade Between Feedlots and Packers

Using a scale of 1 ("not important") to 5 ("very important"), packer respondents and feedlot respondents rated the same 3 feedlot service/characteristics the highest in importance in purchases/sales of fed cattle and in the same rank order: (1) "honesty," (2) "reliability," and (3) dependable delivery dates (Table 6.77). They also rated the same three reasons for lost sales as highest in importance as well but in different rank order Table 6.78). The packer respondents rated "type of cattle" highest as a reason for lost sales while feedlot respondents rated "type of cattle" second highest in importance. The feedlot respondents rated "cattle often priced too high" highest as a reason for lost sales while packer respondents rated "cattle priced too high" as third highest. Packer respondents rated "quality of cattle" second highest as an important reason for lost sales while feedlots rated "quality of cattle as third highest.

Statistical Comparison of Packer and Feedlot Responses

Statistical tests were conducted where possible to compare the responses of packers and feedlots. First, paired *t*-tests were conducted to compare feedlot and packer ratings of the importance of desired feedlot services/characteristics and reasons for lost sales. All desired services and characteristics as well as all reasons for lost sales listed on the surveys were analyzed to detect statistically significant differences between feedlots and packers. Only paired *t*-tests having significant results are reported (Table 6.79). Second, the Kruskal-Wallis χ^2 test statistic generated utilizing Wilcoxon rank sums was used to determine those cases for which the ranked preferences of packer and feedlot respondents were statistically different. Unfortunately, no differences in rankings between packers and feedlots were found to be significant at the 0.05 level for any method or arrangement for which packers and feedlots ranked their preferences. Thus, only the paired *t*-test results comparing the rankings of the importance of feedlot services and characteristics which were statistically different at the 0.05 significance level were reported here.

Even though both the feedlot and packer respondents rated "reliability" and "honesty" high in terms of importance, the packer respondents rated those characteristics significantly higher than did feedlot respondents (Table 6.79). Similarly, the packer respondents rated the importance of "feed primarily non-Brahman cattle" (cattle of 25% or less Brahman bloodlines), "feed mostly steers," "feed mostly heifers," "dependable delivery dates by feedlots," and "sorting pens to finish evenly" as more important than did feedlot respondents. The most dramatic differences in the rating levels were characteristics dealing with pen uniformity, especially sorting pens for even finishing (a difference of 1.15 in the importance rating). Conversely, feedlots rated the importance of "feedlot capacity greater than 20,000 head," the presence of "feedlot scales," and the "feedlot's ability to determine proper finish" more highly than did the packers. The magnitude of differences in the ratings were quite large for "feedlot capacity greater than 20,000 head" (1.37) and the presence of "feedlot scales" (1.69) characteristics. Interestingly, the packers rated feedlot size to be of little importance.

The ratings for 5 possible reasons for lost sales were significantly different between feedlot and packer respondents: (1) "type of cattle," (2) "weighing conditions," (3) "feedlot delivery practices," (4) "inconsistent cattle quality," and (5) overall "quality of cattle" (Table 6.79). In all instances, the responses by the packer respondents indicated that they placed a higher level of importance on these factors than did the feedlots. Unfortunately, the specific meaning of reasons such as "type of cattle,"

"weighing conditions," and "feedlot delivery practices" were not clear and, thus, left to interpretation by the individual respondents. Consequently, some of the reasons listed may have been considered to be related or even not substantively different by some respondents. For example, the quality-based reasons may have been interpreted by packer respondents as referring to negative quality practices by feedlots. Thus, the "quality of cattle" reason may have been interpreted by the packer respondents as the same as "inconsistent quality of cattle."

Conclusions

The intent of the packer and feedlot surveys was to obtain insight on the differences in the perceptions and preferences of feedlots and packers regarding various key aspects of the trading relationships between and among the two groups. For some trading methods and arrangements, the differences in those perceptions and preferences were statistically significant. For many others, however, they were found to be not significantly different. For the feedlots and packers that responded to the survey, the more specific, major conclusions of this study include the following:

- Feedlots reported that the fed cattle they sold in 1993 were priced primarily on a liveweight basis in 1993. Packers reported more uniform use of the various pricing methods. Nevertheless, both the feedlots and the packers prefer the liveweight pricing method.

- Although forward pricing was used by about half of both the packer and feedlot respondents, relatively few cattle were purchased on forward contact in 1993. Forward contracts were used for less than 10% of the cattle sold or purchased in 1993.

- More feedlots reported selling contract cattle priced on a liveweight basis than on any other basis. Packer respondents again reported a more uniform use of the various pricing methods for contract cattle. As before, both feedlots and packers tend to prefer liveweight pricing for contract cattle.

- Feedlots reported that the bulk of their contract sales were for delivery either within 10 days or in 30 days or more in 1993. The largest percentage of packers indicated that most of the contract cattle they purchased were for delivery in more than 30 days. The delivery period preferred most by feedlots is preferred least by packers. The packers reported a clear preference for a delivery period of more than 30 days while feedlots clearly preferred a delivery period of 10 days or less.

- According to both feedlot and packer respondents, feedlots were more likely to pay the transportation costs in 1993 than were packers. Not surprisingly, the feedlots tend to prefer that packers pay the transportation costs. The packers tend to prefer just the opposite.

- By far, "standing liveweight at feedyard" was the most common method of weighing fed cattle in 1993 according to feedlots. According to packers, there was more uniformity in the use of that weighing method along with several alternative methods. Feedlots prefer the

weighing method they reported using most often (liveweight standing at feedyard). The preference of packers is less clear.

- According to feedlots, the shrink arrangement most frequently used in 1993 was "liveweight overnight stand *with* feed and water." Packers reported using the "hot carcass" shrink arrangement most frequently. Both feedlots and packers tend to prefer the respective shrink arrangement that they perceive to be used most often (i.e., "liveweight *with* feed and water" by feedlots and "hot carcass" by packers).

- "High quality grade" is the only characteristic associated with fed cattle for which a majority of either packers or feedlots perceive that a premium is paid.

- A majority of packers perceive that prices are discounted for a larger number of characteristics associated with the fed cattle they buy than is the case for a majority of the feedlots. A majority of feedlots perceive that fed cattle prices are discounted for only 2 characteristics - "dark cutters" and "muddy coats." A majority of packers perceive that prices are discounted for those and 7 other of the characteristics listed on the survey.

- Packers and feedlots rate the same 3 feedlot services/characteristics the highest in importance in purchases/sales of fed cattle and in the same rank order: (1) "honesty," (2) "reliability," and (3) dependable delivery dates. Even though both feedlots and packers tend to rate "reliability" and "honesty" high in terms of importance, packers rate those characteristics significantly higher than do feedlots.

- Regarding other feedlot services/characteristics, packers rate the importance of the feedlot feeding primarily steers, heifers, or non-Brahman cattle, being dependable in delivering cattle on schedule, and sorting pens to finish their cattle evenly as more important than do feedlots.

- Feedlots perceive that having a feedlot of capacity greater than 20,000 head, having a scales at the feedlot, and having the ability to determine proper finish to be significantly more important in their ability to make sales to packers than do the packers themselves. Packers perceive feedlot size to be of little importance.

- Packers and feedlots also rate the same three reasons for lost sales as highest in importance as well but in different rank order. The packers perceive that the type of cattle offered by the feedlot is the primary reason for lost sales. In contrast, feedlots perceive that cattle often being priced too high is the primary reason.

- Packers place a statistically higher level of importance than do feedlots on the following 5 reasons that some feedlots lose sales to other feedlots: (1) the type of cattle offered, (2) the weighing method desired, (3) the delivery practices of the feedlot, (4) inconsistent quality of the cattle offered, and (5) the overall quality of the cattle offered.

- There are no statistically significant differences in the preferences between feedlots and packers for any of the methods or arrangements involved in selling/buying fed cattle.

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