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Cattle Feedlot Placement, Feeding, and Marketing Strategies Under Alternative Price Relationships

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Acknowledgment

This publication is based primarily on Gregory M. Clary's, "An Analysis of Cattle Feedlot Placement, Feeding and Marketing Strategies Under Alternative Price Relationships," unpublished MS Thesis, Texas A&M University, May 1978.

Highlights

The cattle feeding industry operated within a volatile economic environment during 1971-75 with respect to price relationships for feeder cattle, feed grains, and fed slaughter cattle. Cattle feeders operated in an atmosphere of much uncertainty during this period, at great capital risk, with generally large financial losses for almost all cattle placed on feed. Such uncertainty and resultant large financial losses suggest a need for more accurate decision models relative to optimum placement, feeding, and marketing strategies.

This study was designed to develop a decision model for cattle feeders relative to optimum strategies concerning feeder cattle placements, feeding and marketing programs under existing and projected prices for fed slaughter cattle during 1971-75. Also analyzed were alternative futures trading strategies for use by cattle feeding management under variable price relationships existing for feeder cattle, major feed grains, and slaughter cattle during 1971-75. The primary source was cattle feeding lot close-out data from four selected Texas Panhandle feedlots for 1972-75.

Basic models developed in this study are designed for demonstration purposes only. Decision models by the cattle feeding industry as well as other industries must be constantly updated for optimum strategy and decision making. In addition, some firms have developed and are using models more detailed and sophisticated than the basic demonstration models presented here.

This study developed optimum decision models by focusing on projections of net returns above variable costs. However, the accuracy of such projected net returns in the daily changing economic environment of the feedlot industry is dependent upon the accuracy of models derived to project fed slaughter cattle prices.

Optimum decision models developed in this study accurately projected profits or losses for nearly 80 percent of the feedlot data (lots) sampled. By using the strategies suggested by these models, average net returns above variable costs would have increased from −$18.52 to $33.08 per head during 1972-75. The development of such decision models would allow cattle feeders to plan feeding programs prior to expenditures for feed and/or especially feeder cattle.

This study also revealed that when projected slaughter cattle prices are compared with beef cattle futures prices, cattle feeders can increase their hedging efficiency. Losses incurred by cattle feeders during 1972-75 would generally have been minimized by using selective hedging strategies for the lot data sampled. Selective hedging strategies can provide price-risk protection and allow for feeding unhedged cattle during periods of anticipated fed slaughter cattle price increases.

These results imply that the use of more accurate decision models by cattle feeders can remove much of the risk associated with decision making in cattle feeding. Timely and accurate decision models can serve as tools for cattle feeders to more nearly optimize feeder cattle placement, feeding, and marketing strategies under constantly changing price relationships.

Cattle Feedlot Placement, Feeding, and Marketing Strategies Under Alternative Price Relationships

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Profitable cattle feeding in an atmosphere of fluctuating input price relationships and a highly competitive environment requires careful analysis and development of decision models depicting such relationships. Optimum decision making is critical to the success of the cattle feeding industry and has economic ramifications for all sectors of the livestock and meat industry as well as the consumer sector. Ranchers, feed and grain companies, slaughtering and meat distribution firms, and financial firms and private investors, in addition to feedlots, are either directly or indirectly involved in cattle feeding and are affected by feedlot management decisions.

The ultimate success or failure of any cattle feeding enterprise depends on the ability of the cattle feeder or feedlot manager to analyze available information and to assess the expected profitability of feeding cattle. Highly volatile relationships during 1971-75 produced much uncertainty relative to prices for feeder cattle, feedgrains, and slaughter cattle. Feedlot management personnel suggested that cattle feeders could find few reliable variables on which to base decision strategies, especially during 1973-75. Information essential for such decision making from a feedlot manager's perspective includes estimates of price and supply relationships for feeder cattle, feedgrains, and fed cattle, as well as the potential performance of cattle placed on feed.

The Problem

Prior to the volatile economic environment evident in 1973, price relationships for feedlot input items and fed cattle remained at levels insuring a profit for most cattle placed on feed. A series of events subsequently occurred during 1973-76 which resulted in economic disaster for the cattle feeding industry, as witnessed by losses of $100 or more per head for cattle placed in the feedlots studied during this period.

Some contributing factors to the cattle feeders' economic woes included a spiraling inflation and a temporary drop in real income which made the housewife more price conscious at the retail counter. Consumers vented their frustration to price increases by selecting beef as the object of a consumer boycott. A presidential executive order for ceilings on prices hampered normal beef marketings. Merchandizing problems arose at the retail level when consumers resisted over-fed beef, and housewives attempted to stretch their meat dollar by purchasing lower priced non-fed beef.

In addition, feed grain prices moved up sharply during 1973-75, and the cattle numbers cycle approached a peak in the United States and other major beef producing countries. These factors, along with temporary consumer resistance to rising prices, resulted in sharply declining fed and non-fed cattle prices. The net result was that many cattle feeders incurred large financial losses from the fall of 1973 through 1977 with the exception of a short period during 1975. These large financial losses emphasize the importance of cattle feeders' decision-making processes. Losses incurred can be attributed to errors in purchasing, feeding and marketing strategies under prevailing economic relationships, and to the misinterpretation of available data on which decisions were based.

The purpose of this study was to develop decision models which could be used by cattle feeders as an aid in decision making relative to optimum placement, feeding and marketing strategies. More specifically, the objectives of this study were to (1) analyze feeder cattle placement, feeding and marketing strategies employed by selected Texas Panhandle Cattle feedyards under price relationships which existed during 1972-75; (2) develop a decision model for cattle feeders relative to optimum strategies concerning feeder cattle placement, feeding, and marketing programs under projected prices for fed slaughter cattle, and (3) determine optimal strategies for use in future trading by cattle-feeding management under

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variable price relationships for feeder cattle, major feed grains, and slaughter cattle.

Source of Data

The primary source of data for this study was lot close-out data for 25 percent of the lots fed and closed out on a monthly basis from four selected feedlots in the Texas Panhandle during 1972-75. The four feedlots represented feedlot size groups and management levels existing in the Texas Panhandle cattle feeding industry during 1972-75. Two of the feedlots were corporate-owned facilities of 30,000 and 45,000 head one-time capacity. The other two feedlots were family-owned with 10,000 to 15,000 head one-time capacity. Feedlot close-out data obtained on a lot basis included (1) name of feedlot, (2) date lot closed, (3) lot number, (4) sex of placements, (5) number of placements, (6) number of deaths, (7) total animal weight purchased, (8) total cost of feeder cattle, (9) total weight of animals sold less four percent shrink, (10) total revenue from sale of fed cattle, (11) total head days on feed, (12) total feed consumed, dry matter basis, (13) total feed cost, and (14) total non-feed costs.

Data concerning feed costs and prices for feeder cattle and fed cattle were obtained from statistics published by the U.S. Department of Agriculture and from feedlot industry sources as required. Since interest rates on borrowed funds were not available from feedlot close-out records, interest was applied at the rates specified by banks for short term (less than one year) feeder cattle loans (20).

Characteristics of Cattle Fed by Selected Feedlots

Total feeder cattle placements by the four selected Texas Panhandle feedlots represented about 1 percent of all cattle placed on feed in Texas from July 1971 to June 1975. Steers comprised approximately 70 percent of all cattle placed on feed by these feedlots (Table 1). This placement pattern was typical of the Texas cattle feeding industry for that period (18). However, individual feedlots surveyed varied somewhat from this average figure. Two feedlots fed nearly 88 percent steers, one fed 64 percent steers, and another fed only 41 percent steers during 1971-75. Such differences were due to local slaughter facilities, type and price of feed sources available, personal preferences of cattle feeders, and perceived profit potential.

Heifers were placed on feed at generally lighter weights than steers. About 86 percent of all heifers weighed less than 600 pounds, and 64 percent of all steers weighed more than 600 pounds (Table 2). Heifers are normally weaned at lighter weights and reach market weight and grade earlier than steers.

TABLE 2. WEIGHT OF CATTLE PLACED ON FEED BY SEX AND AVERAGE PLACEMENT WEIGHT, FOUR TEXAS PANHANDLE FEEDLOTS, 1971-75

Placement Weight (lbs.)	Steers	Heifers
	percent	
Under 199	a	0.3
200-299	a	1.4
300-399	0.5	14.4
400-499	6.7	34.5
500-599	28.7	35.2
600-699	44.2	13.2
700-799	16.0	1.0
800-899	2.0	a
900 and over	1.9	a
Total	100.0	100.0

[a]Weight group not represented by lot data sampled.

Average placement weights of steers increased from 600 pounds per head in 1971 to 661 pounds in 1975 (Table 3). Heifer average placement weights increased from 442 pounds in 1971 to 578 pounds in 1975. These increased placement weights were mainly due to sharply rising feedgrain costs from 1971 to 1975, resulting in increased costs of gain in feedlots relative to cost of gain for stockers on pasture or forage. A positive feeder-fed cattle price margin also contributed to heavier placement weights. Such a margin encourages stocker producers to retain animals and sell at heavier weights.

Length of feeding period depends upon several factors including type and amount of feed fed, age and weight of cattle placed on feed, and degree of finish desired at time of sale. Steers and heifers were fed an average of 176 and 154 days per head, respectively (Table 4). As expected, the number of days fed

TABLE 1. PLACEMENTS BY SEX, FOUR TEXAS PANHANDLE FEEDLOTS, 1971-75

Year	Steers	Heifers	Total
	percent		
1971	71.1	28.9	100.0
1972	72.2	27.8	100.0
1973	69.1	30.9	100.0
1974	70.0	30.0	100.0
1975	63.1	36.9	100.0
Average[a]	69.1	30.9	100.0

[a]Weighted average.

TABLE 3. AVERAGE PLACEMENT WEIGHTS BY SEX AND YEAR, FOUR TEXAS PANHANDLE FEEDLOTS, 1971-75

	Sex		
Year	Steers	Heifers	Average[a]
	lbs./head		
1971	600	442	554
1972	630	491	592
1973	635	475	585
1974	630	507	593
1975	661	578	630
Average[a]	631	493	589

[a]Weighted average.

TABLE 4. LENGTH OF FEEDING PERIOD BY SEX AND AVERAGE PLACEMENT WEIGHT, FOUR TEXAS PANHANDLE FEEDLOTS, 1972-75

Placement weight (lbs.)	Sex	
	Steers	Heifers
	---------- days/head ----------	
Under 199	a	183
200-299	a	182
300-399	238	173
400-499	208	156
500-599	192	150
600-699	172	137
700-799	161	91
800-899	139	a
900 and over	83	a
Average[b]	176	154

[a]Weight group not represented by lot data sampled.
[b]Weighted average.

decreased as placement weight increased. Heavier placement weights generally do not require as many days on feed to reach market weight and grade. Heifers remained on feed for a fewer number of days than steers of similar average placement weights. This is due to the earlier maturation and lighter fed marketing weights of heifers.

The average market weight of all cattle marketed by four Texas Panhandle feedlots was 1,014 pounds (Table 5). Steers and heifers averaged 1,084 and 846 pounds, respectively, during the same period. Average marketing weights for selected feedlot data were generally representative of Texas Panhandle area feedlots as shown by Texas Cattle Feeders weekly reports.[1] Market weights of steers and heifers increased rapidly during 1972-74. Some cattle feeders held cattle on feed for almost 300 days in expectation of higher fed slaughter cattle prices, thus significantly increasing market weights. Lot close-out data proved this strategy unprofitable.

Average feed conversion ratios for all steer and heifer lot data sampled were 9.52 and 8.85 pounds of feed per pound of gain, dry matter basis, respectively (Table 6). As placement weight of feeders increased,

TABLE 5. WEIGHT OF FED CATTLE MARKETED, BY SEX, FOUR TEXAS PANHANDLE FEEDLOTS, 1972-75

Year	Sex		
	Steers	Heifers	Average
	---------- lbs./head ----------		
1972	1062	795	982
1973	1077	844	1010
1974	1124	885	1051
1975	1079	885	1019
Average[a]	1084	846	1014

[a]Weighted average.

[1]Average market weight reported for steers fed in the Texas Panhandle area was 1,086 pounds during 1973-75 (*TCFA, Cattle Feeders Report*).

TABLE 6. FEED CONVERSION RATIO BY SEX AND AVERAGE PLACEMENT WEIGHT ON AN AS-FED BASIS, FOUR TEXAS PANHANDLE FEEDLOTS, 1972-75

Placement weight (lbs.)	Sex	
	Steers	Heifers
	------- lbs. feed[a]/lb. gain -------	
Under 199	b	5.12
200-299	b	7.23
300-399	8.75	8.07
400-499	8.63	8.45
500-599	9.10	9.27
600-699	9.63	10.00
700-799	9.88	10.61
800-899	10.59	b
900 and over	11.74	b
Average[c]	9.52	8.85

[a]Calculated on dry matter basis
[b]Weight group not represented by lot data sampled.
[c]Weighted average.

the marginal efficiency of added gain decreased. Heavier cattle require a larger proportion of feed intake for maintenance than do lighter cattle. Each increment of weight gained contains more fat and hence is metabolically more expensive to achieve.

Most daily weight gains (Table 7) were higher for steers than heifers, especially at heavier average placement weights. Steers and heifers averaged daily gains of 2.49 and 2.16 pounds, respectively. Such gains were calculated with *deads included*. The nature of the data precludes calculations with deads out which would result in higher average daily gains than those reported. Average daily gains generally increased as average placement weight increased.

TABLE 7. DAILY GAINS BY SEX AND AVERAGE PLACEMENT WEIGHT, FOUR TEXAS PANHANDLE FEEDLOTS, 1972-75

Placement weight (lbs.)	Sex	
	Steers	Heifers
	----------lbs./day ----------	
200-299	a	1.91
300-399	1.96	1.96
400-499	2.45	2.18
500-599	2.41	2.21
600-699	2.57	2.23
700-799	2.50	2.25
800-899	2.65	a
900 and over	2.36	a
Average[b]	2.49	2.16

[a]Weight group not represented by lot data sampled.
[b]Weighted average.

Costs and Prices for Cattle Fed by Selected Feedlots

Cattle Costs and Prices

Laid-in cost of feeder animals represents the purchase price plus all costs prior to delivery at the feedlot. These costs may include commissions, transportation, feed, and preconditioning expenses, added to the agreed upon initial price. Tables 8 and 9

TABLE 8. LAID-IN COST OF STEERS, BY AVERAGE PLACEMENT WEIGHT, FOUR TEXAS PANHANDLE FEEDLOTS, 1971-75

Year	Placement weight (lbs.) 300-399	400-499	500-599	600-699	700-799	800-899	900 and over	Average[a]
	$/cwt.							
1971	b	35.40	35.63	34.39	29.94	b	28.24	33.37
1972	45.96	44.96	42.17	40.54	38.68	32.78	32.04	39.63
1973	51.93	52.07	52.92	52.94	48.69	46.19	53.50	51.35
1974	39.01	48.31	46.98	36.79	38.14	40.00	37.00	41.50
1975	b	b	32.27	32.96	29.75	30.00	34.50	31.81

[a]Weighted average.
[b]Weight group not represented by lot data sampled.

TABLE 9. LAID-IN COST OF HEIFERS, BY AVERAGE PLACEMENT WEIGHT, FOUR TEXAS PANHANDLE FEEDLOTS, 1971-75

Year	Placement weight (lbs.) 200-299	300-399	400-499	500-599	600-699	700-799	Average[a]
	$/cwt.						
1971	b	35.91	32.89	29.48	31.69	b	32.89
1972	b	41.78	38.77	36.25	35.94	b	38.19
1973	50.63	54.82	51.12	46.32	45.61	43.48	48.99
1974	b	47.58	39.82	38.47	43.48	b	40.70
1975	b	21.84	25.05	26.11	29.16	24.96	26.72

[a]Weighted average.
[b]Weight group not represented by lot data sampled.

present the monthly average laid-in cost for feeder steers and heifers fed in four Texas Panhandle feedlots. Laid-in costs of heifers were generally lower than steers of similar placement weight.

A negative relationship existed between average placement weight and laid-in cost per hundredweight. As the average placement weight of feeder animals increased, laid-in cost per pound decreased. Negative correlation coefficients supported this general trend.

Prior to 1975, average fed heifer prices remained at only a slight discount to steers (Tables 10 and 11). Heifers are generally discounted because they produce lighter carcasses, often with less desirable yield grades [14], and they quality grade slightly lower.

Feeding Costs and Prices

A study during 1972 revealed that 87 percent of the cattle fed by custom clients were assessed feeding charges on the basis of feed costs plus a mark-up to cover operational costs such as handling, milling, and labor. Feedlot managers surveyed suggested that mark-ups generally varied from 10 to 20 percent of the total cost per ton of the feed ration. Total cost of feed fed on a dry matter basis in this study includes mark-ups charged by feedlot. Charges for such items as vaccination, medication, dehorning, and dipping were normally assessed as non-fed costs on a per head basis.

Feed costs increased over 105 percent from 1971 to 1974, then dropped slightly in 1975 (Table 12). This rise in feed costs was due primarily to increases in prices of all feedstuffs and especially feedgrain prices. Also, increases in energy and labor prices resulted in higher milling costs.

Ration costs depend mainly on the price paid for major feedgrains. Corn, milo, or a combination of the two, usually comprised 75 to 80 percent of the finishing rations of Texas Panhandle feedlots during 1971-75.

Positive coefficients of correlation between major feedgrain prices and cost per pound of ration (0.87 for steers and 0.82 for heifers) indicate that as the price of feedgrains increases so does the price of feed.

Variable costs (those affected by daily management decisions and volume) accounted for 95 percent of the total feeding costs during the period 1971-75. Feed costs comprised 80 percent of variable costs. Total feedlot costs per pound of gain are shown in Table 13.

Correlation coefficients of 0.27 for steers and 0.36 for heifers indicate that total feedlot cost per pound of gain generally increases as average placement weight increases. Such increases are due to a larger proportion of feed intake required for maintenance or heavier weights. As the cost per pound of gain in feedlots increases relative to cost per pound of gain on forage programs, cattle are generally allowed to attain heavier weights on pasture prior to placement on feed.

Since feed costs constituted such a high proportion of total cost of gain, a strong positive correlation existed between ration prices and total cost of gain. The trend for cost of gain to increase as the price of

TABLE 10. FED SLAUGHTER STEER PRICE, ALL WEIGHTS, FOUR TEXAS PANHANDLE FEEDLOTS, QUARTERLY, 1972-75

Year	Quarter I	II	III	IV	Average[a]
	$/cwt.				
1972	34.21	34.45	34.61	34.73	34.50
1973	41.56	44.61	47.04	40.38	43.39
1974	44.84	39.93	44.10	38.67	41.88
1975	36.25	48.19	46.88	46.03	44.34

[a]Weighted average.

TABLE 11. FED SLAUGHTER HEIFER PRICE, ALL WEIGHTS, FOUR TEXAS PANHANDLE FEEDLOTS, QUARTERLY, 1972-75

Year	Quarter I	II	III	IV	Average[a]
	$/cwt.				
1972	34.41	33.70	34.10	33.78	34.00
1973	40.21	42.91	46.61	40.95	42.67
1974	45.40	41.70	41.71	38.10	41.73
1975	34.11	43.92	43.55	41.71	40.58

[a]Weighted average.

TABLE 12. RATION COSTS, FOUR TEXAS PANHANDLE FEEDLOTS, QUARTERLY, 1971-75

Year	Quarter I	II	III	IV	Average[a]
	$/ton[b]				
1971	c	52.00	52.27	52.07	52.20
1972	51.53	53.73	56.20	62.20	56.00
1973	68.00	82.00	90.30	114.60	79.20
1974	98.53	109.13	96.20	106.47	107.20
1975	95.53	101.07	94.00	c	97.60

[a]Weighted average.
[b]Calculated on dry matter basis.
[c]Quarter not represented by lot data sampled.

feed increased is supported by correlation coefficients of 0.93 for steers and 0.92 for heifers.

Estimated Net Returns Above Variable Costs Under 1971-75 Price Relationships for Selected Feedlot Data

Cattle feeder's ability to correctly estimate net returns above variable costs is essential for optimum placement strategies. Multiple linear regression techniques were used to determine the accuracy of Model I, derived to estimate net returns above variable costs and to identify and develop parameters for variables having the greatest impact on net returns during 1972-75 using data obtained from selected feedlots.[2]

[2]The linear function used in this study was $Y=b_o+b_1x_1+b_2x_2+\ldots+b_nx_{n+e}$, where Y = observed values as returns above variable cost for cattle fed in selected feedlots, b_o = constant, and $b_1 \ldots b_n$ = coefficients of selected characteristics used in estimation of observed values as net returns above variable costs. The t-values of the estimated parameters are directly below each coefficient.

TABLE 13. TOTAL FEEDLOT COST PER POUND OF GAIN, BY SEX AND AVERAGE PLACEMENT WEIGHT, FOUR TEXAS PANHANDLE FEEDLOTS, 1972-75[a]

Placement weight (lbs.)	Sex: Steers	Heifers
	$/lb. gain	
Under 199	b	.1890
200-299	b	.2836
300-399	.3223	.3223
400-499	.3429	.3397
500-599	.3487	.3815
600-699	.3740	.4822
700-799	.4198	.4340
800-899	.4280	b
900 and over	.4827	b
Average[c]	.3728	.3377

[a]Total feedlot cost of gain does not include laid-in cost of feeder steers or heifers.
[b]Weight group not represented by lot data sampled.
[c]Weighted average.

Model I was designed to estimate net returns above variable costs for steers and heifers under existing price relationships from 1972-75 feedlot close-out data. This relationship was developed for both steers and heifers to allow for differences in basic feeding characteristics and performance. Variables identified as estimating net returns per head for both steers and heifers were (1) fed slaughter price, (2) laid-in cost, (3) feeding cost per head per day, and (4) days on feed. These variables were statistically significant in explaining the variation associated with changes in net returns for steers and heifers (Appendix Tables 1 and 2, respectively).

Results indicate that daily feedlot cost per head per day and current fed slaughter price contributed most in explaining variation in net returns above variable costs for both steers and heifers. These were followed in order of importance, by laid-in cost, days on feed, and total gain. Estimated coefficients revealed negative relationships between daily feedlot cost, laid-in cost, and days on feed with net returns per head as expected. A positive relationship was exhibited between current fed slaughter price and net returns.

The prediction accuracy of Model I was tested by comparing observed net returns with values estimated by Model I for steers and heifers. The steer equation predicted with 95 percent accuracy, as compared to 92 percent accuracy for the heifer equation, the 1972-75 profit and loss situations for the lots of cattle analyzed. Incorrect estimates can be attributed to extreme values in the data such as high death losses, extreme conversion ratios, or extremes in feeder-fed cattle price margin.

Data for this model is not totally representative of information actually available to cattle feeders at the time placement strategies are formulated. Cattle feeders make placement decisions in the absence of precise future fed slaughter steer and heifer prices which are not available until the end of the feeding

period. Therefore, the usefulness of this model in the establishment of optimum decision strategies depends upon the accuracy of estimating fed slaughter cattle prices. This is accomplished in the following section.

Model For Forecasting Slaughter Steer and Heifer Prices

Model II, which projects fed slaughter steer and heifer prices using data available to cattle feeders and feedlot managers prior to placing feeder cattle on feed, is an essential ingredient for profitable placement and marketing decisions. Estimates of future fed slaughter cattle prices are critical in the purchasing decision since a three-to-six month forecast is required to coincide with length of time on feed. Cattle feeders often base future profit expectations on current prices even though current prices are often a poor indicator of future price levels.

The equation developed in Model II to project steer and heifer prices is shown in Appendix Tables 3 and 4, respectively. All data were on a quarterly basis and were lagged two time periods to represent the average feeding interval of approximately 180 days. The variables used in Model II to project slaughter steer and heifer prices were (1) expected monthly feedlot marketings (18), (2) total U.S. commercial beef production in the previous three months (22), (3) average retail price of U.S. Choice beef (22), and (4) cold storage holdings of U.S. red meat supplies (22). All of the above variables were statistically significant with respect to changes in projected slaughter steer and heifer prices. However, Model II is limited in its ability to precisely predict changes in slaughter steer and heifer prices during the period studied since the variables used in the steer equation explain only 39 percent of the variation in slaughter steer prices and only 44 percent of the variation in slaughter heifer prices.

Average retail price of U.S. Choice beef was the most significant variable in Model II and exhibited a positive relationship with projected fed slaughter steer and heifer prices. More specifically, as the average retail price of beef increased (decreased), future fed slaughter steer and heifer prices increased (decreased). Expected marketings and quarterly meat holdings displayed a negative relationship with projected fed slaughter cattle prices.

Steer and heifer equations derived for Model II were not perfect price predictors. However, based on the magnitude of losses incurred during the period studied, this model more accurately forecast price changes and future price levels than did many cattle feeders as evidenced by their management decisions. The effectiveness of the equations became more apparent when these forecasted slaughter steer and heifer prices were incorporated into the model for estimating net returns above variable costs in the following section.

Decision Model for Cattle Feeders Under Projected Fed Slaughter Steer and Heifer Prices

Information for optimum decision making in the cattle feeding industry, as in other industries, must be timely and accurate. Model III, which estimates net returns above variable costs, was developed using data available to cattle feeders and managers on a daily basis in the feedlot industry. Equations from Model I and projected fed slaughter steer and heifer prices from Model II were incorporated into Model III to estimate net returns above variable costs for use in optimum decision making relative to placing cattle on feed. Net returns above variable costs in Model III are specified as a function of (1) laid-in costs of feeder steers (heifers), (2) estimated fed slaughter steer (heifer) price from Model II, (3) daily feedlot cost per head for steers (heifers), (4) length of feeding period for steers (heifers), and (5) total gain for steers (heifers).

Data concerning laid-in costs of feeder steers and heifers and total gain per head are readily available to feedlot managers. Ration prices charged to cattle feeders are normally increased or decreased on a periodic basis as required. Most experienced cattle feeders can estimate conversion ratios and average daily gains with considerable accuracy. This study assumed that errors associated with cattle feeder's estimates were distributed about the true value with a very small variance and on a random basis. Data concerning daily cost per head and length of feeding period are readily available to cattle feeders. Future slaughter steer and heifer prices were the most crucial unknown variable in the development of Model III. The accuracy of Model III, therefore, is dependent to a large degree upon the accuracy of slaughter cattle prices predicted by Model II.

Regression coefficients for Model III for steer and heifer equations are shown in Appendix Tables 5 and 6, respectively. All of the variables used in this model were statistically significant and therefore considered important in the estimation of net returns above variable costs under projected fed slaughter cattle prices.

Steer and heifer equations for Model III correctly projected a profit or loss for nearly 80 percent of the lots sampled. These projections appeared to be an improvement over strategies used by many cattle feeders during 1971-75. For example, if cattle had been placed on feed only when a profit was predicted, average net returns above variable costs, as represented by the lot data sampled, would have increased from −$18.52 per head to $33.08 per head or a net increase of $51.60 per head. Equations for Model III were accurate in estimating net profit or loss positions for each lot, but they were not able to estimate exact net profits or losses realized from feeding a given lot of cattle.

Incorrect projections of net returns by Model III were primarily due to the inability of the variables in

Model II to predict precise sudden increases or decreases in slaughter cattle prices at the time cattle were placed on feed. More specifically, the price prediction model, Model II, was accurate unless prices suddenly fluctuated during the feeding period.

These results suggest that cattle feeders could have used Model III to predict, with nearly 80 percent accuracy, positive or negative net returns above variable costs from feeding cattle for the price relationships which existed during 1971-75. Cattle feeders can use this model or models of this type to determine the feasibility of feeding cattle with greater accuracy than in the past by analyzing available costs, prices, and data relevant to their individual operations. Models such as Model III allow decisions to be made prior to making expenditures for feed and/or feeder cattle.

Hedging Strategies for Cattle Fed by Selected Feedlots

Hedging provides cattle feeders the opportunity to use future contracts as protection from unfavorable decreases in slaughter cattle prices during the feeding period. Hedging offers the cattle feeder an opportunity to establish, within limitations of basic fluctuations, the fed slaughter steer and heifer price he receives prior to the sale of fat cattle.

Previous studies of the Texas cattle feeding industry indicate that only a small proportion of cattle fed were hedged. During 1972, approximately one fifth of the custom clients in the Texas Panhandle-Plains feedlots participated in fed cattle hedging operations (21). However, less than 7 percent of the cattle fed by custom clients were hedged during 1972. No measure of the extent cattle feeders utilized the futures market during 1971-75 could be obtained from selected Texas Panhandle feedlots, but feedlot managers suggested that cattle were rarely hedged.

A fed cattle hedge is initiated by selling live cattle futures contracts at some time before or during the feeding period. Contracts must be closed by either buying an offsetting contract or delivering live cattle to a stated delivery terminal according to futures contract specifications. Retaining a contract after the cash sale of the live cattle, shifts the cattle feeder's position in the futures market from hedger to speculator.

Three alternative hedging strategies were applied to all lots of cattle sampled. Table 14 shows the average net returns above variable costs which would have been realized under each strategy.

No hedge (feeding all unhedged cattle) must be considered a viable strategy by cattle feeders depending upon anticipated price trends. Cattle hedged during periods of increasing fed slaughter cattle prices do not realize increased net returns because of the associated loss on the futures market. Such increases in slaughter cattle prices generally mean that futures contracts, initially sold, must be repurchased at relatively higher prices. For example, slaughter cattle prices rose steadily during 1971-72 and most of 1975. Hedging all lots of cattle would have decreased average net returns per head by $53 in 1971, $42 in 1972, and more than $68 from January to June during 1975.

TABLE 14. HEDGING STRATEGIES APPLIED TO ALL LOTS OF CATTLE FED, FOUR TEXAS PANHANDLE FEEDLOTS, 1971-75

Year	Strategy		
	No hedge	Hedge all lots	Selective hedge
	$/head		
1971[a]	31.27	−22.18	b
1972	18.59	−23.33	b
1973	−61.35	−39.80	−24.99
1974	−91.20	−35.36	−26.73
1975[c]	62.62	−6.02	54.19
Average[d]	−18.55	−33.17	2.32

[a]Includes July - December placements.
[b]No hedges initiated during this period for lots sampled.
[c]Includes January - June placements.
[d]Weighted average.

Periods of decreasing slaughter cattle prices, such as during 1973-74, are conducive to profitable hedging strategies. Under such price relationships, contracts generally may be bought back for less than their initial selling price. Losses would have been decreased by about $22 per head in 1973 and $56 per head in 1974 by hedging all cattle placed on feed compared to a "no hedge" position.

The selective hedging strategy would have further minimized losses incurred by cattle feeders during 1973-74 (Table 15). This strategy was developed to alleviate indiscriminate hedging of all lots of cattle without regard for future price expectations. Prior to placing cattle on feed, a comparison was made between projected slaughter cattle price and local beef cattle futures price. The slaughter cattle price for the month fed cattle were expected to be sold was estimated by the regression model, Model II, previously developed in this study. Local beef cattle futures price for the month fed cattle were expected to be sold was the mid-monthly quoted live beef cattle futures price, Chicago, less the Texas Panhandle area

TABLE 15. HEDGING STRATEGIES APPLIED TO LOTS OF CATTLE WITH PROFIT PROJECTED BY MODEL III, FOUR TEXAS PANHANDLE FEEDLOTS, 1971-75

Year	Strategy		
	No hedge	Hedge all lots	Selective hedge
	$/head		
1971[a]	30.89	−22.51	30.89
1972	18.88	−12.79	18.88
1973	56.85	−41.28	55.30
1974	40.14	32.60	50.31
1975[b]	68.73	4.82	58.18
Average[c]	33.08	−14.56	31.73

[a]Includes July - December placements.
[b]Includes January - June placements.
[c]Weighted average.

basis or estimated transportation cost to the nearest established local delivery point. If the projected slaughter cattle price was greater than the current local futures price, futures prices were assumed to be rising and no hedge was initiated such as in 1971-72 and most of 1975. If the projected slaughter cattle price was less than the current local futures price, futures prices were assumed falling and contracts nearest the anticipated fed cattle marketing date were sold to hedge the specific lot of cattle placed on feed. If such a strategy had been applied to all lots sampled for 1973 and 1974, losses incurred by cattle feeders would have decreased nearly $15 and $9 per head, respectively, as compared to hedging all lots of cattle fed.

Selective hedging provides for price risk protection only when it appears necessary and still allows flexibility for capturing cash price increases. Results of the selective hedging strategy revealed that few lots would have realized great net returns above variable costs by not following such a strategy.

Conclusions

Results of this study suggest that cattle feeders in four selected feedlots could have used maximizing models to predict, with nearly 80 percent accuracy, positive or negative net returns above variable costs from feeding cattle for the price relationships which existed during 1971-75. Cattle feeders can use prediction models to determine the feasibility of feeding cattle with greater accuracy by analyzing available costs, prices, and data relevant to their individual operation.

A selective hedging strategy developed in this study indicates that cattle fed by four selected feedlots under such a strategy system (not using profit projections by Model III) would have realized a $20.87 per head greater return compared to a "no hedge" policy or $35.49 more per head compared to automatically hedging all cattle fed. Few lots of cattle would have realized greater net returns above variable costs by not following the selective hedge strategy.

Three types of prediction models were developed in this study to depict the 1971-75 price relationships for feeder cattle, feed grains, and slaughter cattle. Model I was designed to estimate net returns above variable costs for steers and heifers under existing price relationships for 1971-75 from actual feedlot data. Daily feedlot cost and the fed slaughter price contributed most to predicting net returns above variable costs for both steers and heifers. Other important variables for predicting net returns above variable costs were laid-in costs, length of feeding period, and total gain per head.

Model III was developed to project fed slaughter steer and heifer prices using data available to cattle feeders prior to placing feeder cattle on feed. Average retail price of U.S. choice beef exhibited a positive relationship with fed slaughter cattle prices and was the most important variable in projecting such prices. Expected fed cattle marketings and quarterly total U.S. beef production also demonstrated a positive relationship with fed slaughter cattle prices. Total red meat cold storage holdings displayed a negative relationship with projected fed slaughter cattle prices. Steer and heifer equations derived for Model II were not perfect price predictors. However, large losses reported by feedlots surveyed, generally indicated that Model II more accurately projected fed slaughter cattle prices than did cattle feeders. The effectiveness of these equations became more apparent when projected slaughter steer and heifer prices were incorporated into the model for estimating net returns above variable costs.

Model III was designed to project net returns above variable costs for steers and heifers using those data available to cattle feeders when feeder cattle are placed on feed. Steer and heifer equations for Model III correctly projected a profit or loss for nearly 80 percent of the lots sampled. These projections appeared to be an improvement over strategies used by many cattle feeders during 1971-75. For example, if cattle had been placed on feed only when a profit was predicted, average net returns above variable costs per head for cattle represented by lot data sampled would have increased from −$18.52 to $33.08. Such a strategy benefits the cattle feeder, but custom feedlots must attempt to maintain at least breakeven capacity on an annual basis. Variables used to project net returns above variable costs, which were all statistically significant, included laid-in cost of feeder steers (heifers, estimated fed slaughter steer (heifer) price from Model II, daily feedlot cost per head for steers (heifers), average days on feed for steers (heifers), and total gain for steers (heifers).

The selective hedging strategy developed in this study would have minimized losses incurred by cattle feeders during 1971-75. Selective hedging provides for price risk protection only when it appears necessary and still allows flexibility for capturing cash price increases. Few lots would have realized greater net returns above variable costs by not following the selective hedging strategy.

Future use of decision models may affect many sectors of the livestock and meat industry. Employment of decision models by cattle feeders to more accurately predict profits and losses can remove much of the uncertainty associated with decision making in cattle feeding. Decision models, such as those presented in this study, not only provide cattle feeders with a vehicle to more nearly optimize management decisions in cattle feeding, but may also have a significant effect upon decision making by cow/calf producers, feed grain producers and grain companies, financial institutions, slaughtering firms, and meat wholesalers and retailers.

Appendix Tables

APPENDIX TABLE 1. REGRESSION ANALYSIS OF THE RELATIONSHIP BETWEEN NET RETURNS ABOVE VARIABLE COSTS IN CATTLE FEEDING AND SELECTED INDEPENDENT VARIABLES, FOUR SELECTED FEEDLOTS, TEXAS, 1972-75 (MODEL I - STEERS)[a]

Variable[b]	Regression coefficient	Standard error
Intercept	10.749 (1.47)	7.299
LC	−685.362 (−63.74)**	10.752
SP	1168.158 (70.13)**	16.657
CPH	−200.069 (−71.28)**	2.807
DAYS	−1.283 (−35.09)**	.037
TG	.453 (27.87)**	.016
R^2	0.97	
F-ratio	2352.29**	
d′	1.90[c]	

[a] (*) and (**) denote statistical significance at the .05 and .01 probability levels, respectively.

[b] Intercept = constant, in dollars per head.
LC = laid-in costs of feeder steers, dollars per pound.
SP = fed slaughter steer price, dollars per pound.
CPH = daily feedlot cost per head, dollars per head.
DAYS = length of feeding period, days per head.
TG = total gain, pounds per head.

[c] Insignificant auto correlation at the .01 probability level.

APPENDIX TABLE 2. REGRESSION ANALYSIS OF THE RELATIONSHIP BETWEEN NET RETURNS ABOVE VARIABLE COSTS IN CATTLE FEEDING AND SELECTED INDEPENDENT VARIABLES, FOUR SELECTED FEEDLOTS, TEXAS, 1972-75 (MODEL I - HEIFERS)[a]

Variable[b]	Regression coefficient	Standard error
Intercept	−17.597 (−1.35)	12.988
LC	−474.019 (−24.41)**	19.416
SP	898.121 (25.88)**	34.707
CPH	−170.939 (−29.97)**	5.704
DAYS	−1.168 (−17.55)**	.067
TG	.481 (14.25)**	.034
R^2	0.89	
F-ratio	326.83**	
d′	1.59[c]	

[a] (*) and (**) denote statistical significance at the .05 and .01 probability levels, respectively.

[b] Intercept = constant, in dollars per head.
LC = laid-in costs of feeder heifers, dollars per pound.
SP = fed slaughter heifer price, dollars per pound.
CPH = daily feedlot cost per head, dollars per head.
DAYS = length of feeding period, days per head.
TG = total gain, pounds per head.

[c] Insignificant auto correlation at the .01 probability level.

APPENDIX TABLE 3. REGRESSION ANALYSIS OF THE RELATIONSHIP BETWEEN FED STEER SLAUGHTER PRICE AND SELECTED INDEPENDENT VARIABLES, FOUR SELECTED FEEDLOTS, TEXAS, 1972-75 (MODEL II - STEERS)[a]

Variable[b]	Regression coefficient	Standard error
Intercept	−.141 (−3.09)**	.046
EM	.015 (4.06)**	.004
BS	.067 (10.38)**	.006
RP	.186 (14.04)**	.020
CSH	−.150 (−8.14)**	.020
R^2	.39	
F-ratio	91.11**	
d′	.95[c]	

[a] (*) and (**) denote statistical significance at the .05 and .01 probability levels, respectively.
[b] Intercept = constant, dollars per pound.
EM = expected monthly U.S. feedlot marketings, thousand head.
BS = commercial U.S. beef production, previous 3 months, billion pounds.
RP = monthly U.S. retail price of U.S. choice beef, dollars per pound.
CSH = cold storage holdings, U.S. red meat, by months, billion pounds.
[c] Significant auto correlation at the .01 probability level.

APPENDIX TABLE 4. REGRESSION ANALYSIS OF THE RELATIONSHIP BETWEEN FED HEIFER SLAUGHTER PRICE AND SELECTED INDEPENDENT VARIABLES, FOUR SELECTED FEEDLOTS, TEXAS, 1972-75 (MODEL II - HEIFERS)[a]

Variable[b]	Regression coefficient	Standard error
Intercept	−.062 (.95)	.065
EM	.025 (5.88)**	.004
BS	.047 (4.86)**	.010
RP	.175 (11.03)**	.020
CSH	−.150 (6.86)**	.020
R^2	.44	
F-ratio	55.09**	
d′	1.18[c]	

[a] (*) and (**) denote statistical significance at the .05 and .01 probability levels, respectively.
[b] Intercept = constant, dollars per pound.
EM = expected monthly U.S. feedlot marketings, thousand head.
BS = commercial U.S. beef production, previous 3 months, billion pounds.
RP = monthly U.S. retail price of U.S. choice beef, dollars per pound.
CSH = cold storage holdings, U.S. red meat, by months, billion pounds.
[c] Significant auto correlation at the .01 probability level.

APPENDIX TABLE 5. REGRESSION COEFFICIENTS FOR PROJECTING NET RETURNS ABOVE VARIABLE COSTS, FED STEERS, FOUR SELECTED FEEDLOTS, TEXAS, 1972-75 (MODEL III - STEERS)[a]

Variable[b]	Regression coefficient	Standard error
Intercept	−33.443 (−.98)	34.153
LC	−608.670 (−17.88)**	34.042
ESP	1239.382 (13.04)**	95.066
CPH	−217.497 (−21.32)**	10.202
DAYS	−1.493 (−12.97)**	.115
TG	.539 (10.09)**	.053
R^2	.70	
F-ratio	177.19**	
d′	1.06[c]	

[a] (*) and (**) denote statistical significance at the .05 and .01 probability levels, respectively.
[b] Intercept = constant, in dollars per head.
LC = laid-in costs of feeder steers, dollars per pound.
ESP = estimated fed slaughter price, dollars per pound (Model II)
CPH = daily feedlot cost per head, dollars per head.
DAYS = length of feeding period, days per head.
TG = total gain, pounds per head.
[c] Significant auto correlation at the .01 probability level.

APPENDIX TABLE 6. REGRESSION COEFFICIENTS FOR PROJECTING NET RETURNS ABOVE VARIABLE COSTS, FED HEIFER, FOUR SELECTED FEEDLOTS, TEXAS, 1972-75 (MODEL III - HEIFERS)[a]

Variable[b]	Regression coefficient	Standard error
Intercept	12.582 (.35)	35.667
LC	−401.858 (−10.22)**	39.312
ESP	730.289 (6.69)**	109.176
CPH	−159.714 (−13.52)**	11.810
DAYS	−1.182 (−9.46)**	.125
TG	.382 (7.47)**	.065
R^2	.61	
F-ratio	64.97**	
d′	1.69[c]	

[a] (*) and (**) denote statistical significance at the .05 and .01 probability levels, respectively.
[b] Intercept = constant, in dollars per head.
LC = laid-in costs of feeder heifer, dollars per pound.
ESP = estimated fed slaughter price, dollars per pound (Model II)
CPH = daily feedlot cost per head, dollars per head.
DAYS = length of feeding period, days per head.
TG = total gain, pounds per head.
[c] Significant auto correlation at the .01 probability level.

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