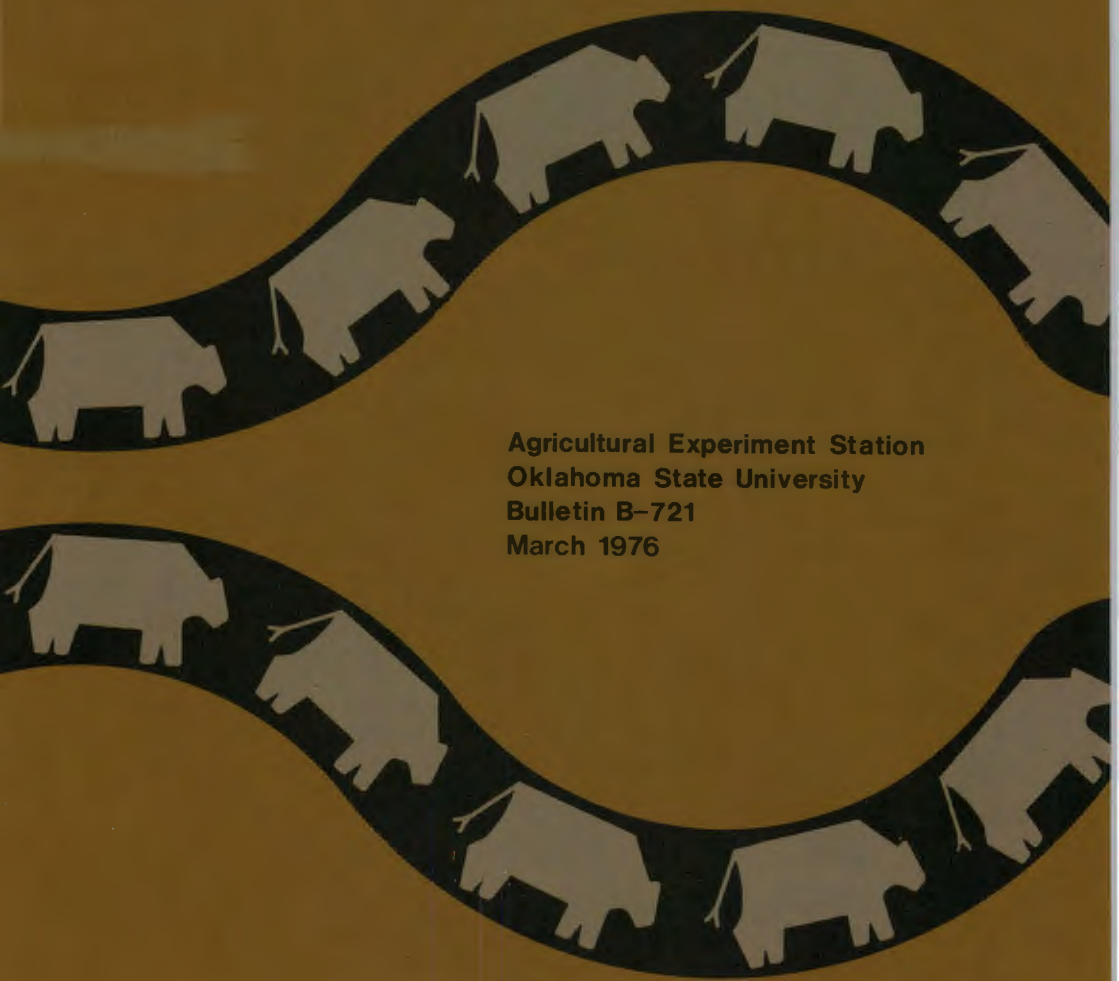
The Beef Cycle of the 1970's

Analysis, Behavioral Dimensions, Outlook and Projections



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Analysis, Behavioral Dimensions, Outlook and Projections

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In 1974 the cattle industry began to feel the effects of production decisions made during the 1970-73 period. The large increases in beef cow numbers during those years eventually led to a significant increase in the numbers of cattle ready for slaughter. The excess supply of cattle available for slaughter, forcing prices downward, has caused cattlemen to become painfully aware of their situation.

A surplus in cattle numbers is not an unusual condition for the cattle industry. It is, in fact, only one phase in the cycle of cattle production which recurs every 10-12 years. Because of the dampening effect this interval of the cycle exerts on cattle prices, however, it is the phase most deserving of study and analysis.

Nature of the Problem

Production decisions in the cattle-raising business are based primarily on price outlook for a future 1-2 year period. Given the current condition of low feeder cattle prices and much uncertainty as to when recovery is expected, producers face a difficult time for production decisions. To analyze the cattle price outlook for 1975 and 1976 requires knowledge of the probable level and seasonal pattern of slaughter for the next two years. With a smaller number of cattle on feed, future slaughter levels have become more dependent on cow-calf and stocker operators' behavior and decision-making. There is little information available concerning this behavioral aspect of the cattle cycle. More definitive knowledge of relationships which must exist before and as herd liquidation begins could provide a base for policy recommendations, more effective marketing decisions and assist in establishing the outlook for the late 1970's.

Purpose of the Study

The main objective of this study was to develop a model predicting quarterly per capita beef production for 1975 and 1976, and to project

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significant behavioral reactions involved in the current beef cycle. More specifically the objectives were:

(1) To isolate and identify key elements in behavior of the cow-calf sector of the beef industry during past cyclical disturbances;
(2) To estimate quarterly per capita availability of beef over the 1975-76 period;
(3) To estimate the average quarterly market-clearing price of slaughter and feeder steers, 1975-76, given the estimate of per capita availability of beef; and
(4) To infer behavioral reactions within the cow-calf sector of the beef industry to the estimated average prices for feeder steers.

Procedure

To outline the behavioral dimension of the cattle cycle, two analyses were conducted. First, a questionnaire was prepared for the Oklahoma cow-calf man and was directed toward developing a better understanding of probable occurences in the near future for the industry. Second, actual slaughter levels during 1949-1973 were compared to slaughter which normally would be expected—ie, potential slaughter—given the inventory of brood cows in the U.S. Through comparison of these two series, behavioral influences during past cycles were isolated.

Projections for beef production per capita were developed by first predicting quarterly slaughter levels. Next, average weights and slaughter percentages of the various classes were estimated from analysis of recent trends and past comparable periods. From the estimates on these three variables, total quarterly beef production was calculated and was then divided by population projections to estimate per capita production for 1975-76.

Average quarterly slaughter steer prices for the 1975-76 period were estimated by a single-equation model utilizing the estimated levels of per capita beef production. From the projected slaughter steer prices, estimated feeding costs were subtracted to arrive at estimates of feeder steer prices over the same period. Inferences were then drawn as to the future situation and outlook for the industry at the cow-calf level of production.

Theoretical Dimensions of the Cattle Cycle

In traditional economic theory, the basic price-determining relationship is that of a supply schedule for producers and a demand schedule for consumers. In Figure 1 the upward sloping supply function indicates producers' willingness to supply more of a good at high prices. The de-

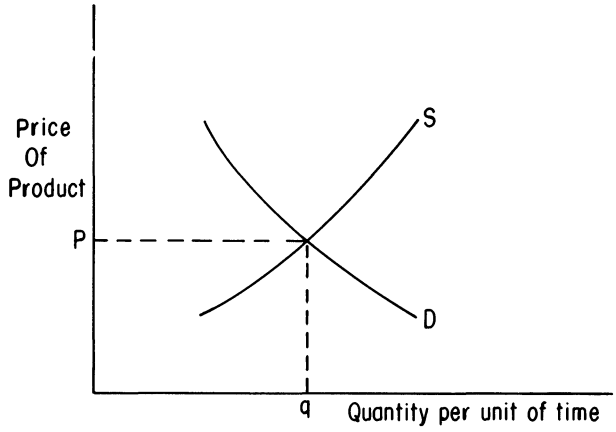


Figure 1: Basic Supply, Demand and Equillibrium Price Concepts.

mand function illstrates consumers' willingness to purchase more of a good at lower prices. The common point of the two functions represents an equilibrium price and quantity satisfying both producers and consumers of the good.

The basic difference between the market shown in Figure 1 and the real-world market of beef production and consumption is brought on by biological limitations. To maintain an equilibrium price and quantity within a market, quantity supplied must adjust instantaneously to any changes in demand. In the cattle industry, beef which is available for consumption at one point in time is largely determined by cattle prices in some previous period.

The supply of beef in some period 2-3 years later is, therefore, largely predetermined by current production decisions. Therefore, the supply schedule shown in Figure 1 does not accurately describe the conditions surrounding beef production. A better approximation of the situation is shown in Figure 2. Suppose that the quantity of beef currently in the market is at the level q_1. If the price p_1 allows cow-calf operations a profitable margin, more cows will be bred and more heifers held back to prepare for increases in future beef production. As female stock are held back, price increases to P_2 due to the decreased level of beef availability, q_2. Given adequate time, the progeny of the new brood cows reach slaughter age and the quantity supplied increases, q_3. Reflecting larger supplies, prices start a gradual decline. Prices fall even further when cow-calf men become convinced of the unprofitability of their operation and begin selling production stock.

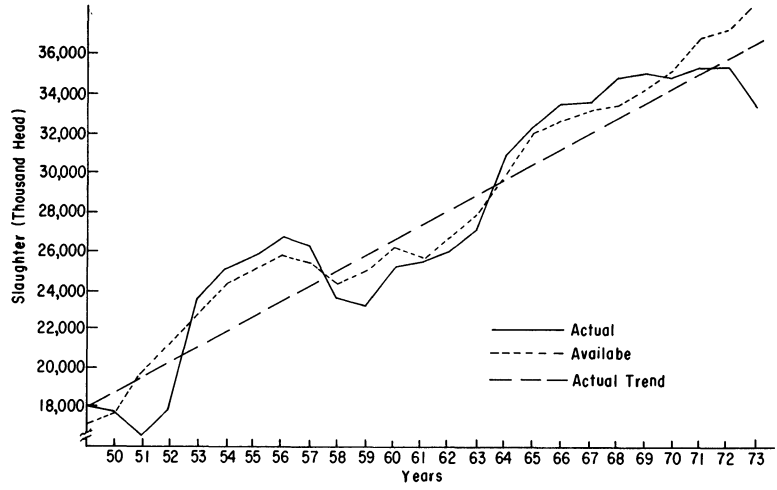


Figure 2: Dynamics of Beef Production

The slaughter of cows ultimately results in fewer animals available for slaughter in some future period. Cattle prices gradually gain strength from the lower supplies and the process repeats itself. Thus, the cycle in cattle production causes the slaughter cattle market to be dominated by successive intervals of relative shortages and surpluses.

Behavioral Dimensions of the Cattle Cycle

Given that production changes in response to past price movements are responsible for the perpetuation of the cattle cycle, the producer's role in the cattle cycle is one of importance. The behavior of cow-calf and stocker men largely determine the length of time involved and the level of prices during each recurrence of the cycle. Considering the importance of this dimension of the cycle, two separate analyses were conducted to isolate the behavioral component.

Questionnaire Results

A mailed questionnaire survey was sent in August, 1974, to 925 cow-calf men in Oklahoma and a few bordering counties in Kansas and Texas. [1] The percentage breakdown of respondents by cow herd size was as follows: 31 percent had 1-25 cows; 43 percent had 26-100 cows; 26 percent had a herd containing greater than 100 brood cows. Response to the questionnaire was 15 percent of the number mailed, a total of 139 returns. Insights into the current situation as seen from the cattleman's viewpoint were acquired via the survey.

Two of the questions were directed toward determining cow-calf men's understanding of causal factors involved in the current depressed price situation. Cow-calf men were first questioned on their knowledge of beef cow numbers in the U.S. and whether the total had increased or decreased from 1969 to 1974. Seven choices were suggested as possible answers. Results from this question, displayed in Table 1, were tabulated according to the herd size of the individual reporting.

With actual data showing beef cow numbers increasing some 20.8 percent during the five-year period, only 35.4 percent (sum of bottom two rows) were familiar with the magnitude of recent developments. Another point worth noting is that none of the operators with herds containing more than 100 brood cows thought there had been a decrease in U.S. beef cow numbers. This seems to indicate that those with larger operations are better informed.

The respondents were next asked to choose among several alternatives those factors they considered to have had the greatest impact in depressing cattle prices during 1974. Six choices were listed, and respondents were requested to rank the alternatives (1-most important, 2-next most important, etc.) according to relative importance. Table 2 gives the tabulation of results for this question.

The cow-calf men envisioned the price freeze instituted by the government in the summer of 1973 as having the greatest impact on cattle prices. The most interesting statistic from Table 2 is the number of times 'too much beef produced' was selected. This answer was given little emphasis by respondents, ranking fourth out of all the possible factors depressing cattle prices.

Another question attempted to measure the price expectations which cow-calf operators maintained during the midst of an apparent cyclical price decline. Five possible alternatives were offered in this question.

Table 1. Percentage Change in U.S. Beef Cow Numbers, 1969-1974, (As Estimated by Reporting Cow-Calf Men)

Change in Cow Numbers	Size of Respondent's Operation (no. cows)				
	1-25	26-100	>100	Total	% of Total
Decreased More than 20%	2	1	0	3	2.7
Decreased 20%	1	1	0	2	1.8
Decreased 10%	2	5	0	7	6.2
No Change	3	1	1	5	4.4
Increased 10%	16	25	15	56	49.6
Increased 20%	7	12	8	27	23.9
Inreased more than 20%	4	4	5	13	11.5

Table 2. Factors Listed by Respondents as Causing Low Cattle Prices in 1974

Rankings	High Beef Imports	Seasonal Price Variation	Too Much Beef Produced	Last Summer's Price Freeze	Heavier Slaughter Weights	High Grain Prices	Consumer Resistance	Other
one's	34	2	25	42	8	12	3	4
two's	27	2	10	29	34	5	4	2
three's	14	3	11	15	18	3	3	1
four's	10	4	10	5	12	0	2	0
five's	2	18	8	3	2	0	1	0
six's	2	6	1	0	0	1	0	3
Simple Total	89	35	65	94	74	21	13	10

Table 3. Cow-Calf Men's Opinion of Most Probable Developments in Cattle Industry, Next 3-5 Years

Possibilities	Number of Producers Responding	Percent of Total
Prices should recover by late 1974 to early 1975	24	19.7
Prices to remain stable for 1½ years and recover late 1975	59	48.4
High production will cause prices to remain at present levels 2-3 years	31	25.4
Prices will sprial downward for the next 3-5 years	3	2.5
Other	5	4.1

Table 3 shows future developments the respondents deemed as the most likely ones.

From a summation of the percentages choosing the first two possibilities, 68.1 percent of those polled felt recovery of prices would come no later than the end of 1975. Very few operators chose the extremely pessimistic view of prices falling further for 3-5 years more.

The results shown in Table 1, 2, and 3 have much to offer in way of explaining why cow-calf men as a group are so vulnerable to the low price phase of the cattle cycle. Table 1 indicates that most cow-calf men are not well-informed with regard to developments in the industry on a national scale. The results in Table 2 imply a reluctance on the part of cow-calf men to admit that their own collective decisions to increase production in past years is largely responsible for current low cattle prices. Answers listed in Table 3 may only further substantiate the point that cow-calf operators are basically unaware of significant changes in the beef industry. However, Table 3 also seems to portray the cow-calf man as an unrelenting optimist.

Predicting Slaughter Numbers from Inventories

Changes in the number of cattle available for slaughter, as previously indicated, are mostly dependent on production decisions made 2-3 years earlier. Assuming this is true, with a given brood cow herd, a certain number of slaughter animals may be expected in slaughter markets after a two-year period. Using this concept, annual cattle numbers available for slaughter were calculated from cow inventories over the 25-year period, 1949-1973.

Equations 1 and 2 were utilized for an approximation of commercial cow slaughter from milk and beef herds.

$$\text{(1) Milk Cow Slaughter}_t = \left\{ .2935 - \frac{\frac{MCH_{t+1} - MCH_t}{MCH_t}}{2} \right\} \times MCH_t - .014MCH_t$$

$$\text{(2) Beef Cow Slaughter}_t = \left\{ .1611 - \frac{\frac{BCH_{t+1} - BCH_t}{BCH_t}}{2} \right\} \times BCH_t - .014BCH_t$$

where:

MCH is the number of milk cows on hand January 1;
BCH is the number of beef cows on hand January 1;
t+1, t, and t—1 as subscripts denote next year, the current year, and last year, respectively.

In constructing equations 1 and 2 several assumptions were used. By supposing that increases (decreases) in inventories of cows were caused by equal proportions of decreased (increased) cow slaughter and increased (decreased) holdings of replacement heifers, the relative change in inventory was divided by two to measure the change attributable to cow slaughter. The constants, .2935 and .1611, were the estimated average replacement rates required to keep cow numbers constant. The figure .014 was used as an approximation of the annual death rate.

Equations 3 and 4 were utilized in estimating mature males and heifers available for slaughter in a given year.

(3) $\text{Heifer Slaughter}_{t+1} = [(.50 \bullet \text{calving rate}_t \bullet CH_t) - (\text{replacement heifers}_t) - (\text{heifer calf slaughter}_t + \text{heifer calf deaths}_t)] \bullet .99$

(4) $\text{Mature Male Slaughter}_{t+1} = [(.50 \bullet \text{calving rate}_t \bullet CH_t) - (\text{male calf deaths}_t + \text{male calf slaughter}_t)] \bullet .99$

By summing the annual estimates from equations 1-4 for 1949-1973, annual estimates of total cattle available for slaughter were obtained. When this generated series of available slaughter was compared to actual commercial slaughter over the same time frame, a pattern in the differences between the two series became obvious. At low points in the slaughter cycle available or potential slaughter was consistently above actual slaughter. At high points in the slaughter cycle, available slaughter was consistently below actual slaughter.

Figure 3 shows a plot of actual and computed or potential slaughter for the 1949-1973 period. The pattern of the two plots has some important implications in analyzing cattlemen's behavior in the cycle. During years of favorable prices and building of inventory numbers, the average age of all cattle apparently increases. Thus, cattlemen hold steers and heifers destined for slaughter for longer periods as prices move

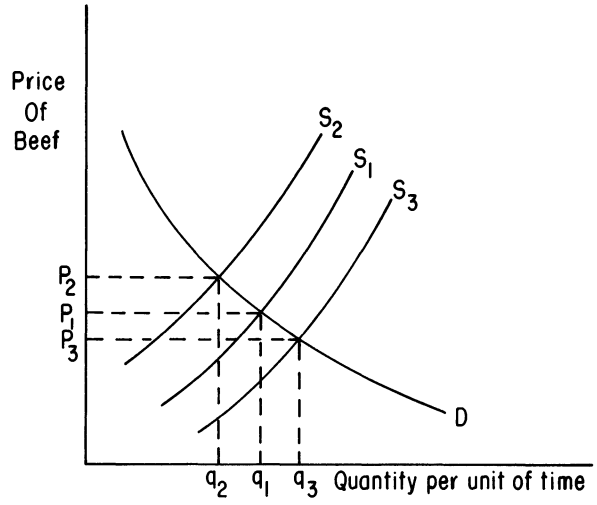


Figure 3. Comparison of Actual Commercial Cattle Slaughter and Available Slaughter, 1949-1973

upward. The opposite reaction on the part of cattlemen occurs when prices are in the low phase of the cycle; the average age of slaughter steers and heifers decline as cattle are held for shorter periods.

Outline of the Behavoiral Dimension of the Cattle Çycle

In this section, results of the questionnaire, derivation of available slaughter estimates from cow inventories, and other statistical analyses of slaughter and inventory data are combined to outline some behavioral elements in the cattle cycle:

(A) As cattle prices begin a cyclical upswing, cow and heifer slaughter decline causing an increase in the cow inventory. The growth rate of cow inventories normally accelerates as prices rise to higher levels. Cow numbers continue to grow at a slower pace after prices begin a cyclical downswing.

(B) Since slaughter steers and heifers are held for longer periods as prices increase and are held for shorter periods as prices decrease, average production lags between birth and slaughter vary within the cycle. Hypothetically, if production lags remained constant throughout the cattle cycle, excess production would not result in such extreme price declines.

(C) When cattle prices begin a cyclical downturn, the immediate reaction of cow-calf operators is one of cutting production costs

to a minimum. Uncertainty as to the future profitability of their operation leads many cow-calf men to maintain their entire herd of cows until prices drop to such low levels that eventual losses become evident. An example of this action came during the early 1950's. In 1952, cattle prices started to fall. Cow and heifer slaughter did not increase significantly until the fourth quarter of 1953. Even with high levels of cow and heifer slaughter for 1954-55, beef cow inventories did not decrease until 1956.

(D) When lower prices force cow-calf operators to sell cows and replacement heifers a number of factors determine whether a decrease in cow inventory occurs. The two factors probably most important in determining the impact of low prices on the cow inventory is the duration of the low price phase and the absolute level of prices during that period. Cow slaughter normally maintains a distinctive seasonal pattern with the largest number of cows being slaughtered after summer pastures have been depleted. There is evidence from past cattle cycles that this seasonal pattern may be amplified during the low price phase. This relationship would indicate that as annual cow slaughter increases, a larger than normal proportion of the total is slaughtered during fall and winter months.

(E) When prices are increased, cattlemen hold steers and heifers destined for slaughter for longer periods in anticipation of further price boosts. Understandably, there is some maximum length of time in which cattle can be reasonably detained from slaughter. This reaction by cattlemen results in a glut of slaughter steers at some point in the subsequent price downswing.

(F) Because the average age of slaughter cattle varies within the cycle, average weights of slaughter steers and heifers also vary cyclically. During low price periods, weights tend to diminish relative to high price periods. Thus, slaughter weights normally are positively related to the price cycle. The major exception to this positive relationship comes during a short interval following the peak in price when weights continue to rise after the initial major decline in price.

Quarterly Beef Production, 1975-76

Quarterly projections of beef production were made through the use of three single-equation models. Coefficients for the equations were estimated on time series data from 1949 to 1974, inclusive. [2] As a starting

point in estimating beef production, equation 5 was utilized to predict quarterly commercial cattle slaughter numbers. [5]

Quarterly Commercial Cattle Slaughter, 1975-76

$$\begin{aligned}(5)\ SLATR_t = {} & 5027.44 + .2581\ HSB_t - .1586\ TOTH_t - 40.333\ STFI_{t-4} \\ & \quad (6.46) \quad (38.42) \quad\quad (3.09) \quad\quad\quad (5.32) \\ & - 83.2280\ CPRC_{t-4} + 57.9502\ SLST_{t-8} \\ & \quad\ (8.97) \quad\quad\quad\quad (4.50) \\ R^2 = {} & .9582 \quad\quad\quad\quad\quad\quad\quad\quad S = 334.92\end{aligned}$$

where:

$SLATR_t$ = Total commercial cattle slaughter in quarter t;

HSB_t = Jan. 1 inventory of heifers, steers and bulls under 500 lbs. of the year for which slaughter is being estimated;

$TOTH_t$ = Jan. 1 inventory of total heifers;

$STFI_{t-4}$ = Percent of total federally inspected cattle slaughter consisting of steers in quarter t–4;

$CPRC_{t-4}$ = Average utility grade cow price per cwt. in Omaha for quarter t–4;

$SLST_{t-8}$ = Average choice grade (900-1100 lbs.) slaughter steer price per cwt. in Omaha for quatrer t–8;

( ) = Calculated *t* test statistic and

S = Standard error of estimate

Quarterly seasonal indices were calculated for the years 1949 to 1974 and were used as weights for the HSB_t and $TOTH_t$ explanatory variables. The seasonal multipliers used for the transformation were .97528, .98782, 1.02803, and 1.00888 for the first through fourth quarters, respectively.

January 1, 1976 inventories for HSB_t and $TOTH_t$ were not available at the time slaughter predictions were made. Therefore, these two variables were projected so that equation 5 could be used for 1976 commercial slaughter estimates. Equations 6 and 7 were the ones chosen for projections of the two explanatory variables.

$$\begin{aligned}(6)\ TOTH_{t+1} = {} & 12784.64 + 96.3917\ KCF_{t-1} + .2888\ \Delta HSB3_t \\ & \quad (29.23) \quad\quad (9.52) \quad\quad\quad (7.79) \\ & - .0737 CS_{t-1} + 32.7750\ SLST_{2-t} \\ & \quad (3.51) \quad\quad (1.6884) \\ R^2 = {} & .917 \quad\quad\quad\quad\quad\quad\quad\quad S = 277.07\end{aligned}$$

$$(7)\quad HSB_{t+1} = \underset{(1.37)}{1707.05} + \underset{(40.06)}{.9528}\ HSB_t\ \underset{(1.98)}{.1512}\ \Delta HSB3_t + \underset{(2.94)}{205.398}\ CPRC_{t-1} - \underset{(1.80)}{129.465}\ SLST_{t-1}$$

$R^2 = .993$ $\qquad$ $S = 556.26$

where:

$TOTH_{t+1}$ = Total heifer inventory January 1, year t+1;

KCF_{t-1} = Average price per cwt. of good and choice feeder steers in Kansas City for the last 6 months of year t—1;

$\Delta HSB3_t$ = Change in the number of heifers, steers, and bulls under 500 lbs. over the last 3 years;

$SLST_{t-2}$ = Average price per cwt. of choice grade (900-1100 lbs.) slaughter steers in Omaha for the last 6 months of year t—2;

HSB_{t+1} = Total heifers, steers, and bulls under 500 lbs. Jan 1, year t+1;

$CPRC_{t-1}$ = Average price per cwt. of utility grade cows in Omaha for the last 6 months of year t—1; and

CS_{t-1} = Calf slaughter in year t—1

Only two observations for 1975 average quarterly price of utility grade cows in Omaha were available at the time 1976 slaughter projections were made. Estimates for the value of this explanatory variable for the last two quarters of 1975 were made with the assumption that low feeder calf prices would force many cow-calf operators to sell a substantial number of cows after summer pastures began to recede. The percentage of slaughter consisting of steers was estimated through analysis of recent trends in this variable and past cyclical behavior in comparable periods.

Estimated explanatory variables and the original estimates of quarterly slaughter given by equation 1 for 1975-76 are listed in Table 4.

Actual commercial cattle slaughter for the first quarter of 1975 was 9.720 million head [10]. However, weekly slaughter levels in the first

Table 4. Estimated Explanatory Variables and Quarterly Cattle Slaughter Projections, 1975-76

Quarter	HSB_t	$TOTH_t$	$STFI_{t-4}$	$CPRC_{t-4}$	Slaughter 1975	Slaughter 1976
1st	35,007,000	17,948,000	50.8	18.15	9,735,000	11,221,000
2nd	35,457,000	18,179,000	52.3	22.57	10,147,000	10,546,000
3rd	36,910,000	18,919,000	48.3	20.50	11,246,000	11,447,000
4th	36,213,000	18,565,000	45.8	19.00	11,185,000	11,286,000
					42,313,000	44,500,000

two months of the second quarter indicated the 10.147 million head estimate would be too large by some .55 million head. Several reasons might be offered for the upward bias of the second quarter estimate.

First, the coefficients of the model were estimated over a time period involving increasing numbers of cattle on feed. In 1974, cattle on feed began to decline significantly. This structural change in the industry has undoubtedly caused marketing patterns of slaughter cattle to change. During the second quarter of 1975, cattle on feed numbers began to increase again, funneling cattle and calves back into feedlots which might otherwise have been slaughtered.

Second, a model such as equation 5 can at time give projections which are not consistent with probable real-world occurrences. Because not all the variables which affect slaughter numbers were included in this model, the magnitude of the variables used for calculations may give inaccurate projections.

Given that the second quarter estimate was too large, a closer inspection was made of the projections for the last six quarters. Latest estimates of the 1975 calf crop range from 52.7 to 53.0 million head. [10] Death loss of cattle and calves will probably approximate 7 million head, up over expected normal death loss because of 1975 winter weather conditions. Current calf slaughter indicates the 1975 slaughter level of calves to be 4 to 5 million head. With the 1975 cattle slaughter estimate of 42.3 million head, cattle inventories for January 1, 1976, could decrease .6 to 1.6 million head.

During the period in the cycle of the 1950's most comparable to the current one, cattle inventories did not decrease until four years after the initial decrease in price. Assuming that three to four years are needed to stop inventory growth, present cattle inventories would not be expected to show a decline until 1977 or 1978. Utilizing this reasoning and the probability that the second quarter slaughter estimate given in Table 4 is too large, the original slaughter estimates were adjusted.

Table 5 shows the adjusted estimates for 1975-76 quarterly commercial cattle slaughter. The estimates for 1975 allow for a zero to one percent increase in cattle inventories for January, 1976, depending on the level of calf slaughter.

Table 5. Adjusted Commercial Cattle Slaughter by Quarters, 1975-1976

1st	9,720,000	10,400,000
2nd	9,590,000	10,400,000
3rd	10,800,000	11,050,000
4th	10,700,000	10,800,000
	40,810,000	42,650,000

Quarterly Average Dressed Weights, 1975-76

The method used for projecting average dressed weights of each class was one of first predicting weights of steers, the largest class of slaughter. Average dressed weights of heifers, cows, and bulls were then estimated as functions of estimated steer weights. Although some of the factors affecting weights of the different classes are not the same, relationships between classes were assumed to remain constant through comparable cyclical periods. Given the estimated average weights for each class, the percentages of each class in the slaughter mix were estimated through comparisons of the current period with the 1952-54 interval.

The factor deemed most important in determining dressed steer weights was feeding costs. The beef steer-corn price ratio, Omaha basis, was used as a proxy for feeders' willingness to feed slaughter stock to heavy weights. A drop in the ratio reflects an increase in feeding costs relative to cattle price. Noting that this ratio declined continuously from the first quarter of 1973 to the fourth quarter of 1974, slaughter steer weights were projected to be downward trending through 1975 and most of 1976. The average dressed weights of cows, heifers, and bulls were derived as functions of average dressed steer weights. These derivations were not made from formal equations but rather were based on recent trends of the relationships and economic judgement.

The percentages of each class in the slaughter mix for 1975-76 were also estimated somewhat subjectively by noting the recent seasonal patterns of each class. The cyclical effect on slaughter percentages during the 1951-54 period was analyzed and used to weight the seasonal coefficients.

By multiplying the average dressed weights by the appropriate slaughter percentages and summing, average dressed weights over all classes were obtained. These estimates for 1975-76 are listed in Table 6.

Given the slaughter number estimates from Table 5 and average dressed weight estimates from Table 6, total domestic beef production estimates were calculated. Since beef which is produced during any period must be largely consumed during that same period, little other data was required to project per capita consumption.

Per capita consumption is affected by two other factors besides total domestic production, namely population changes and beef imports. Quarterly imports of beef were estimated at 287 million pounds over the two-year period. This quarterly figure was derived from an annual estimate given by the U.S.D.A. for 1975 of 1150 million pounds in import beef [10]. Growth in the U.S. resident population for 1975-76 was estimated to average 400,000 persons per quarter [13].

Calculated total beef production, projected imports, and subsequent

predictions for per capita consumption of beef during 1975 and 1976 are listed in Table 7.

Table 6. Average Dressed Weights of Slaughter Cattle, By Quarters, 1975-1976

Year	1	2	3	4	Annual Average
1975	610	595	590	583	594.5
1976	588	579	580	570	579.3

Table 7. Estimated Quarterly Domestic Beef Production, Imports and Per Capita Consumption, 1975-76

Item	Year	Quarters 1	2	3	4	Total
Domestic Beef Production (mil. lbs.)	1975	5938	5712	6372	6122	24,144
	1976	6115	6022	6409	6156	24,702
Imports (mil. lbs.)	1975	287	287	287	287	1150
	1976	287	287	287	287	1150
Population Estimates	1975	212.4	212.8	213.2	213.6	------
	1976	214.0	214.4	214.8	215.2	------
Per Capita Beef Consumption	1975	29.3	28.2	31.2	30.0	118.7
	1976	29.9	29.4	31.2	29.9	120.4

Quarterly Predictions of Slaughter and Feeder Steer Prices, 1975-76

Price projections in this section were based on the assumption, as supported by economic theory, that live cattle prices are derived prices. That is, live cattle prices depend primarily on supply, demand and price of beef at the retail level. Given this assumption, the price of slaughter cattle should be largely determined by per capita beef supplies and consumers' willingness to purchase beef.

Quarterly Slaughter Steer Price Projections

A single-equation model utilizing the estimates of quarterly per capita availability of beef and estimated personal disposable income was used to project average quarterly price of choice grade slaughter steers at Omaha for 1975-76. Per capita supply of beef was divided into two classifications: (1) cow, bull, and import beef; and (2) steer and heifer beef. This division approximates supplies of beef in the form they are marketed at retail. Three dummy variables were used in the model to account for seasonal variation between quarters not explained by the

supply and demand variables. The equation was estimated in logarithmic form so that coefficients could be compared to those estimated in a previous study [3]. Regressions were run on quarterly time series data over the 1959-1974 period to estimate the parameters given in equation 8.

$$
\begin{aligned}
(8)\quad \text{LOG (SLST)} = {} & -.9629 - 1.7935 \underset{(4.71)\ (14.43)}{\text{LOG (SHPROD)}} - .2857 \underset{(5.29)}{\text{LOG (BCPROD)}} \\
& + 1.8089 \underset{(14.76)}{\text{LOG (DPI)}} - .0137 \underset{(3.14)}{\text{DM1}} + .0304 \underset{(6.89)}{\text{DM3}} \\
& - .0158 \underset{(3.44)}{\text{DM4}} \\
R^2 = .810 \qquad & S = .0193
\end{aligned}
$$

where:

SLST = Average quarterly price per cwt. of choice slaughter steers, Omaha, deflated by CPI (1967=100)

SHPROD = (Per capita quarterly supplies of steer and heifer beef) X 4

BCPROD = (Per capita quarterly supplies of cow, bull, and import beef) X 4

DPI = Per capita disposable income (annual basis), deflated by CPI (1967=100)

DM1 = Dummy variable (0 in second, third, and fourth quarters; 1 in first quarter)

DM3 = Dummy variable (0 in first, second, and fourth quarters; 1 in third quarter)

DM4 = Dummy variable (0 in first, second, and third quarters; 1 in fourth quarter)

Estimated per capita availability of beef (SHPROD and BCPROD) was taken from the projections in the previous section. Disposable personal income estimates used in the price projections were based on an economic study of the national economy [4]. The projected quarterly average price of choice slaughter steers at Omaha for 1975 and 1976 given by equation 8 are listed in Table 8.

Average price of choice slaughter steers in Omaha for the first quarter of 1975 was $35.72 per cwt., or some $6.00 under the projected figure. Average price for the second quarter will likely fall in the $47.00-$48.00 range, or some $2.00 over the projected figure. The accuracy of

Table 8. Estimated Quarterly Average Price of Choice Slaughter Steers, Omaha, 1975-76

Year	1	2	3	4
1975	41.32	46.34	41.28	40.69
1976	42.38	45.07	45.03	44.68

the predictions given by equation 8 have no doubt been affected by structural changes in the cattle industry during 1974 and early 1975. The declining number of cattle on feed caused the supply of choice beef to decline substantially. During the first quarter of 1975, non-fed slaughter maintained slaughter at a level 1.7 million head over the first quarter of 1974.

In the second quarter, cattle numbers placed on feed began to increase, decreasing the supply of cattle available for slaughter. Given the lower number of cattle on feed in the first quarter and increasing placements in the second quarter (and assuming placements will continue to increase throughout 1975), the original average quarterly slaughter steer price estimates were adjusted in an attempt to account for the changes in the industry not taken into consideration by the model. The adjusted estimates are listed in Table 9.

Table 9. Adjusted Estimates of Quarterly Choice Slaughter Steer Prices, Omaha, 1975-76

Year	1	2	3	4	Yearly Average
1975	35.72	47.50	43.00	40.00	41.55
1976	39.50	43.00	42.50	42.00	41.87

Quarterly Feeder Steer Price Projections

If price differentials between segments of the marketing chain depict the costs involved with each step of production, the value of a slaughter steer less the cattle feeder's input costs per head should provide a rough approximation of a feeder steer's value. On this basis projections of average quarterly 600 pound choice feeder steer prices were made.

The cattle feeder's input costs per animal were categorized into cost of grain, other feed costs, and non-feed costs. Over the 1975-76 interval, other feed costs and non-feed costs were estimated at $126.00 per head. The average quarterly corn price was estimated from past seasonal behavior and recent price trends [12]. A range was then placed around the mean such that ranges in projected feeder steer prices were obtained. Table 10 lists the range in corn price per bushel used and the deprived average quarterly choice feeder steer prices for the last half of 1975 and 1976.

Table 10. Projections for Average Quarterly Choice Feeder Steer Prices, 1975-76

Item	Year	1	2	3	4
Corn Price	1975	------	------	2.40-2.80	2.10-2.60
Feeder Steer Price		------	------	33.00-36.00	29.00-33.00
Corn Price	1976	2.20-2.70	2.35-2.85	2.25-2.75	2.05-2.55
Feeder Steer Price		28.00-32.00	32.00-36.00	31.00-35.00	31.00-35.00

Implications of Price Projections

Given the 1975-76 expected cattle price levels, the cattle industry is obviously confronting a period in which changes are needed. The most urgent need is for a reduction in the cow inventory to prevent the continuance of low prices into 1977. To accomplish this will require significant increases in cow and heifer slaughter at a time when slaughter of all classes of cattle are near record levels. These existing conditions will result in burdensome financial problems for the cow-calf sector. The extent to which cattle prices fall and the time span involved in the phase ultimately depend on four variables: (1) The general financial position of cattle producers; (2) Weather and pasture conditions; (3) The behavior of cow-calf men in marketing cattle and calves; and (4) Average slaughter weights.

Annual net farm income during 1973-74 averaged 32.9 billion dollars, representing more than a 100 percent increase over the 1971-72 annual average [6]. These figures imply that farmers, many of whom are also cattlemen, are probably in a financial position to further complicate the situation by refusing to market their cows at low price levels. In 1975, however, relatively lower prices of cotton, wheat, and feed grains as well as cattle will hamper the financial liquidity of many producers.

Weather and pasture conditions are variables which remain unpredictable but are extremely important. As pastures and ranges are more heavily stocked, slaughter levels become more dependent on forage conditions. Thus, cattle prices in 1975-76 will be very sensitive to weather changes.

To predict the behavior of the cow-calf man during low price periods, reliance must be placed on past behavior during periods of similar conditions. Two problems associated with this approach are that no two periods are exactly alike, and very few periods are appropriate for comparison. Although there is no assurance that past behavioral tendencies will be repeated, recent developments in slaughter levels, average weights, and percentages of slaughter classes are similar to those occurring during past cycles.

Average slaughter weights of cattle fell through most of 1974 and early 1975. Reports of average weights of cattle slaughtered in June, 1975, indicate that weights may decline more than was previously projected in Table 6 [11]. Calf slaughter in the first five months of 1975 displayed a 75 percent increase over 1974 levels. If average slaughter weights continue to decline and calf slaughter remains high, the increased cattle slaughter which is needed will not have as much depressing influence on price.

Cattle Inventory Projections, 1976-77

Given the expected slaughter levels for 1975-76, and by making some assumptions about death loss of cattle and calves, cattle inventories for 1976 and 1977 were projected. During the low-price phase in the 1950's, cattle inventories responded slowly and did not show an actual decrease for three years following the bottom in cattle prices. Several factors indicate that decreased inventories may occur sooner in the current situation.

The change in the inventory of all cattle and calves for January, 1976, could range between —1.0 to +1.5 percent of the 1975 inventory. This would place a range on the 1976 inventory of 130.51 to 133.80 million head. The four principal variables determining where the actual inventory eventually lies within this range are: (1) Death loss in 1975, estimated at between 6.7 and 7.5 million head; (2) Calf slaughter, estimated at 4.0 to 5.0 million head; (3) Inshipments and outshipments of cattle, which depend mostly on pasture conditions; and (4) The number of cattle and calves in feedlots carried into 1976. Given the projected cattle slaughter of 40.8 million head, if 1975 calf slaughter is below 4.5 million head and death loss is below 7.4 million head, 1976 cattle inventories will likely show a small positive growth.

The critical inventory variable for 1976 and 1977 in terms of future herd growth or decline is the brood cow inventory. The number of cows on hand for production purposes in any one year is largely dependent on cow and heifer slaughter in the previous year. Because no data on cow and heifer slaughter in commercial slaughter which is not federally inspected is available, the cow inventory is difficult to project.

Using recent annual data on slaughter numbers of cows and heifers and resulting change in the cow numbers, an estimated 18.5 million head of cows and heifers would need to be slaughtered under federal inspection in 1975 to force inventory growth to a zero level for 1976. Table 11 helps illustrate the likelihood of this estimated slaughter figure occurring.

Table 11. Federally Inspected Slaughter of Cows and Heifers

Year	1st 6 months	2nd 6 months	Annual Slaughter
1973	6,423,000	6,881,000	13,304,000
	(48.3%)	(51.7%)	
1974	6,468,000	8,287,000	14,755,000
	(43.8%)	(56.2%)	
1975	8,381,000		

Slaughter in the first half of 1974 was 43.8 percent of annual slaughter for that year. If female slaughter in the first half of 1975 displays the same relation to annual slaughter as in 1974, annual cow and heifer slaughter would reach 19.1 million head. This figure is quite possible and would cause an estimated .6 million head decrease in the cow inventory for January, 1976.

This method of calculation can be misleading, however, because of the abnormal seasonal variation in heifer slaughter in 1974. Heifer slaughter normally increases in the last half of the year, but in 1974 heifers slaughtered in the last six months constituted some 58.7 percent of the annual total. This percentage compares to an average of 52.4 percent slaughtered in the last halves of 1972 and 1973.

Given that female slaughter was unusually large in the last half of 1974, 1975 slaughter in the July to December period is not expected to increase by as much over the January to June period. If 46.0 percent of annual cow and heifer slaughter occurred in the first half of 1975, total slaughter for the year would be 18.2 million head, allowing a growth in brood cow numbers of 300,000 head.

Slaughter of cows and heifers should continue at high levels into 1976. Thus, if cow numbers do not show a decrease in 1976 inventories, 1977 inventories should decrease if the projected feeder prices prevail. Cow numbers in 1977 could decrease by as much as 1.0 to 2.0 percent.

The amount by which production herds need to be liquidated to promote general price recovery in the industry depends largely on average slaughter weights. If feed grain prices average above $2.40 to $2.50 per bushel for the next 18 months, weights should decline enough such that further decreases in cow numbers would not be necessary. If, however, feed grains become plentiful, heavy cow slaughter would need to continue in 1977, causing all cattle prices to remain depressed for a longer period.

The Cycle: Preventive Medicine

In the questionnaire results reported earlier in this bulletin, cow-calf men showed a tendency to be unaware of developments in recent years in the cattle industry. Cattlemen do seem to form their opinion

about future cattle prices primarily on the basis of prices in the past 1-2 years, and rapidly climbing prices, therefore, lead to a general consensus of high prices for the future. Basing production decisions on recent past prices alone leaves many cow-calf men vulnerable to the consequences of the cattle price cycle.

Several key factors can be noted which may aid the cattle producer in determining when cyclical peaks in prices have occurred. Once a cyclical peak in prices has been encountered and identified by a producer, a suitable course of action in terms of production and related marketing decisions can then be established.

Cattle Inventory Growth

Table 12 displays a growth period in the inventory of total cattle and calves in the U.S. during an upswing in the cattle price cycle (normally involving a 5 to 8 year span), cattle numbers grow slowly at first and then accelerate to more rapid expansion. The key factor to watch is the rate of expansion in cattle numbers at higher price levels. Seemingly, a growth rate greater than 2.0 percent for 2 or 3 successive years is a signal warning of future problems in terms of low prices and surplus slaughter numbers.

Table 12. Growth in Cattle Numbers in Relation to Price

Year	Cattle Nos.	Percent growth	Kansas City Feeder Steer Price
1968	109,371		29.10
1969	110,015	+ .6	32.89
1970	112,369	+ 2.1	36.73
1971	114,578	+ 2.0	36.84
1972	117,862	+ 2.9	46.54
1973	121,990	+ 3.5	59.73
1974	127,670	+ 4.7	39.23
1975	131,826	+ 3.3	

Relationship of Available and Actual Slaughter

Figure 3 displayed a relationship between the calculated number of cattle available for slaughter and actual slaughter for a 25-year period. The plots in Figure 3 can be very helpful in determining whether a fall in cattle prices will be short-lived or is a major turning point in the cycle. In 1952 and 1973 cattle prices peaked and began an extensive decline. Cattle prices also rose to a peak in 1963, but the price decline which followed was not of the magnitude of the ones beginning in 1952 and 1973.

In Figure 3 a large positive difference (Available-Actual) is indicative of a large surplus of animals available for slaughter and obviously carries some important implications with regard to future price. Cattle producers should be aware that large surpluses of cattle in years exemplified by 1951-52 and 1972-73 must in some future period be marketed for slaughter. Thus, when significant surpluses occur, future slaughter numbers and their depressing effect on cattle prices should be expected.

Conclusions

The general purpose of this study was to predict per capita beef production and cattle price levels by quarters for 1975-76. Effort was also directed toward isolation of the behavioral influences inherent in the cattle cycle. Both of these objectives were satisfied, but with regard to cow-calf men's behavior in the cycle, one major item was left unresolved. This research failed to identify the exact set of circumstances necessary to precipitate a general liquidation of cow numbers. Research on this topic was first limited by the few available observations on the cattle cycle. Study in this area of behavior was also impeded by a lack of slaughter data from packing plants not under federal inspection. Commercial slaughter which is not federally inspected is currently not broken into classes. This condition forces any type of analysis which attempts to trace inventories to their eventual destinations to be assumption-filled, subjective, and prone to error.

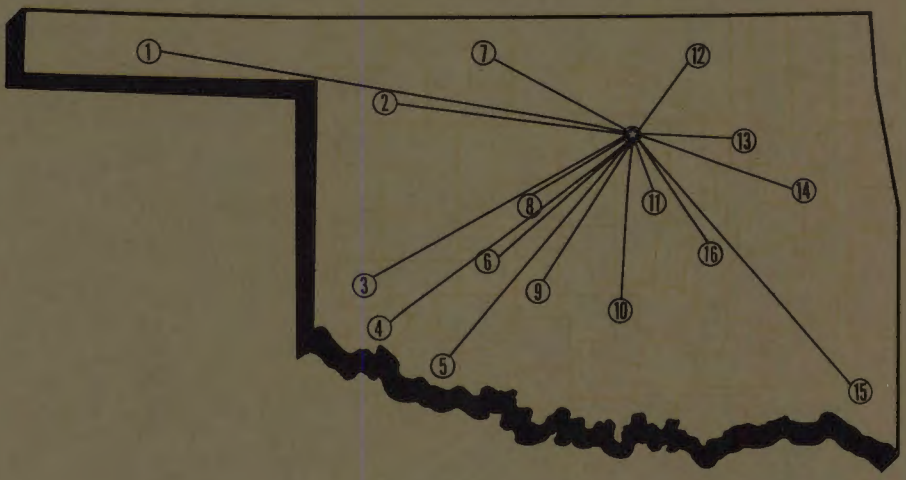
One area on which this project afforded little time was average slaughter weight projections. Little past research has dealt with this topic, which may be the single—most important determinant of price levels in the low-price phase of cattle cycles. Average weights, although admittedly difficult to project, are worthy of future research effort.

Another interesting area uncovered by this research is the role the cycle plays in changing the seasonal slaughter pattern. Seasonality of all classes of slaughter are generally uptrending during a given year, but the cycle seems to amplify the seasonal pattern during price bottoms, forcing an even larger proportion of slaughter into the last half of the year. This relationship, the causes of which are yet to be explained, is most characteristic of cow slaughter.

OKLAHOMA

Agricultural Experiment Station

System Covers the State



Main Station — *Stillwater, Perkins and Lake Carl Blackwell*

1. Panhandle Research Station — *Goodwell*
2. Southern Great Plains Field Station — *Woodward*
3. Sandyland Research Station — *Mangum*
4. Irrigation Research Station — *Altus*
5. Southwest Agronomy Research Station — *Tipton*
6. Caddo Research Station — *Ft. Cobb*
7. North Central Research Station — *Lahoma*
8. Southwestern Livestock and Forage Research Station — *El Reno*
9. South Central Research Station — *Chickasha*
10. Agronomy Research Station — *Stratford*
11. Pecan Research Station — *Sparks*
12. Veterinary Research Station — *Pawhuska*
13. Vegetable Research Station — *Bixby*
14. Eastern Pasture Research Station — *Muskogee*
15. Kiamichi Field Station — *Idabel*
16. Sarkeys Research and Demonstration Project—*Lamar*

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