ECONOMICS OF ALTERNATIVE BEEF CATTLE GENOTYPE AND MANAGEMENT/MARKETING SYSTEMS

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Two questions commonly raised by cow-calf producers are, "What type of beef animal is most profitable?" and "Can profits be increased by maintaining ownership of calves through the stocker and feeding stages?"

These two questions are highly interrelated as performance in cow-calf stage carries over into the postweaning stages. Specific answers to these questions depend upon an individual resource situation and the livestock/feed price relationships during the production period and at the time of marketing. This paper compares, in a long-run setting, costs and returns associated with nine beef herds differing in mature size and milking potential. In addition, the cow-calf operator has the option of retaining ownership of all or part of the weaner calves into the postweaning production phases, either through use of rented small-grain pastures or custom feedlots.

To address these issues, an economic model of a representative Central Texas cow-calf producer was developed to utilize the purely technical relations provided by an existing biological model. In the economic model, it was considered important (due to changing price differentials between sex, weight, and condition) that the details provided by the biological model not be lost through aggregation of the various animal classes. Non-aggregation allowed the profitability of each class to be analyzed individually. The economic model was designed to capture the dynamic nature of livestock production. Partial budgets were used to evaluate the profitability of each animal class. Input and product prices were updated at each decision point to represent changing economic conditions. Production/marketing decisions were simulated, based on the expected net returns of each system considered. The simulated decision maker was assumed not to know the actual price to be received at the time the decision was made. Optimal decisions could be obtained only by chance. Production/marketing decisions could be altered as time passed and new price information became available. If at weaning a decision was made to graze calves before feedlot finishing, this decision could be changed to sell the calves as stockers rather than feed them. To evaluate each production/marketing system over time, a comparison was made against decisions based on actual prices (hindsight).

PROCEDURES

To account for basic production relationships, a comprehensive biological model was used (Sanders; Sanders and Cartwright, 1979a, b). This biological model was developed with the philosophy that each equation should be biologically interpretable and not merely an equation that gave the "best fit" to some particular data set (Joandet and Cartwright; Sanders and Cartwright, 1979a). For a given set of input parameters, herd composition and performance can be simulated for a wide range of management schemes, nutritional environments, and cattle genotypes for size, growth, maturing rates, and milk production. The model simulates dry matter intake as a function of size, condition (fatness), and physiological status (stage of maturity, pregnancy, lactation, etc.) of animals, and the availability, digestibility, and crude protein content of the feeds consumed. Performance is calculated from nutrient intake and the animals' weight, condition (fatness), stage of maturity, and genetic potential for maturing rate and mature size. The herd dynamics portion of the model places almost no limits on herd size, proportion of animals in various classes, or management options. Production systems may vary with regard to breeding season, weaning policy, culling and selling policy, and feeding programs for individual classes.

To better simulate animal performance, the model reported by Sanders and Cartwright was revised (Stokes). The changes covered feed consumption and growth during stress periods, the propensity for fattening, feed intake of fat animals, and nutrient utilization efficiency. The original version has been used to simulate forage-based beef and dairy beef production systems in the United States, South America, and Africa (Sanders and Cartwright, 1979a). In each

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application, the results of the simulation of existing conditions have closely coincided with actual production levels. For this study, the validation phase relied on data from a Coastal bermudagrass grazing trial in central Texas utilizing cow-calf pairs (Stuth et al.) and industry-wide data on feedlot performance (Schake, Ljungdahl, and Egenolf).

The biological model was used to simulate preweaning and postweaning performance of nine different beef cattle genotypes. The genotypes were represented by various combinations of potential mature cow size and milk production. Mature cow sizes of 550, 500 and 450 kg were considered. Within each size classification, daily maximum potential milk production levels of 14, 11 and 8 kg were simulated. These nine combinations are similar to combinations available in existing genotypes. The cow-calf herds were assumed to graze Coastal bermudagrass pastures located in central Texas during the grazing season and during the winter were fed hay produced from the pastures. Pasture quality and availability were assumed to represent a "typical" year. Cows were mated to calve from February to May. All calves were weaned November 1. Replacement heifers (minimum breeding age 15 months) received the same grazing and winter hay as the cows. To compare the different genotypes, it was assumed that land use would be held constant across the herds and that the cows would be managed so that all herds would start the grazing season carrying the same condition (fatness).

To achieve uniform use of grazed forage among the nine herds, forage availability during the grazing season (March–November) was varied across mature sizes so that all herds consumed approximately the same percentage of the total dry matter production during each month (March, 6 percent; April, 7 percent; May, 15 percent, etc.) Stocking rates were calculated using average monthly cow numbers, total herd dry matter consumption, and pasture dry matter production (8599 kg/ha with a 70-percent utilization rate). These changes in grazing season availability reflect a manager's ability to observe grazing pressure and to correct stocking rates to achieve uniform land use. The effect was to hold the quality and quantity of forage approximately constant across all herds. Animal performance (growth rate, milk production, fertility, and death rates) due to genetic differences could then be calculated on the assumptions of the biological model (Sanders and Cartwright, 1979b). The requirements for maintenance, pregnancy, lactation, growth and gain in condition were calculated for each animal class based on potential mature size, potential milking ability, current size, sex, condition, and the pregnancy and lactation status. In lactating animals, the model was designed to allow milk production and growth to compete for consumed nutrients and nutrients stored in the form of fat.

During the grazing season, the larger cows had greater simulated gains in condition than the smaller cows (Table 1). Increased mature size, holding milk potential constant, allowed higher proportions of nutrient intake to be utilized to meet the requirements for pregnancy growth and gain in condition. The cows producing more milk lost in condition relative to the lower milking cows (Table 1). Increased milk production increased the nutrients required for lactation at the expense of growth and gain in condition. The heavier milking cows used stored body fat to produce milk for their calves. Higher birth rates also were associated with the higher condition levels of the larger, lighter milking cows during the mating season (May to August).

Winter hay feeding levels were varied by milk production potentials in order to achieve uniform body condition at the beginning of the grazing season. Varying the availability of winter hay represents the manager's observing condition and changing hay feeding levels to achieve similar body condition in all herds. With similar amounts of hay being fed across milking potentials, the changes in condition varied by genotype (Table 1). Within the light milking levels, which received the least hay, the cows responded by losing condition, with the larger cows having the greatest condition losses. The heavier milking cows, which received the most hay, gained in condition, with the larger cows having the least gain.

By varying winter feeding levels across milking potentials, cow condition, which varied considerably in November, become approximately equal in March (Table 1). Achieving more uniform condition among the herds would have required extremely fine and trivial adjustments in feed availability. To have achieved exactly the same condition level as the MEDMID cows, the eight-year-old LGEHEV cows would have had to be 3.23 kg lighter and the SMALIT cows 3.73 kg heavier. Other herds fell within these extremes. The larger, heavier milking cows were slightly overfed during the winter, and the smaller, lighter milking cows were slightly underfed.

Death rates were simulated as a function of month of year, age, sex, weight, condition, frame size, and stage of pregnancy and lactation. Simulated deaths within each class were computed monthly as whole numbers, using a random number generator to round the computed value. The reported small differences in calf death rates were due more to the rounding method than to the death rate adjustment factors, which were the same for all herds. The random number rounding method carried over into the number of replacement heifers required each year to produce a stable herd composition. The apparent inconsistences in Table 1 result largely from this feature

TABLE 1. Selected Performance Measures for Cow-Calf Herds with Cows of Different Sizes and Milking Abilities, Central Texas Conditions

PERFORMANCE MEASURE	Unit	Genotype[a]								
		LGEHEV	LGEMID	LGELIT	MEDHEV	MEDMID	MEDLIT	SMAHEV	SMAMID	SMALIT
Average Cow/Grazing Area	(no/ha)	2.13	2.11	2.08	2.31	2.28	2.26	2.54	2.51	2.48
Hay Consumption/Average Cow[b]	(kg)	658.00	565.00	458.00	655.00	565.00	460.00	647.00	559.00	458.00
Births/Average Cow[b]	(%)	73.00	74.40	76.10	72.60	73.40	74.10	70.20	71.60	72.30
Still Births, Calf and Young Stock Deaths/Births	(%)	8.40	8.70	8.80	8.70	7.80	9.60	9.00	9.00	9.00
Surplus Heifer and Steer Sales/Average Cow[b]	(%)	56.80	56.90	58.90	55.30	57.00	56.00	52.80	54.50	55.00
Progeny Liveweight Sold/Average Cow[b]	(kg)	135.00	127.00	122.00	126.00	122.00	111.00	115.00	111.00	104.00
Progeny Liveweight Sold/Hectare	(kg)	286.00	268.00	255.00	290.00	278.00	252.00	292.00	279.00	258.00
Cow Condition March 1[c]		.95	.95	.95	.94	.94	.94	.94	.94	.93
Cow Condition December 1[c]		.96	.97	.99	.94	.96	.98	.94	.95	.96

[a] Large size, heavy milking cows are referred to as LGEHEV; large size, light milking cows are LGELIT; and etc.
[b] Average cow represents a simple average of monthly cow numbers.
[c] A ratio of simulated actual weight and simulated frame size. A ratio of less than one indicated thinness. Eight-year cows on March 1 were selected as the focal point for the comparison.

of the model, rather than genetic differences between the herds and the feed impacts. The simulated calves differed in weight and frame size because of sex, milk production of dam, and month of birth.

Five postweaning production/marketing systems were compared to the standard practice of selling calves at weaning (Figure 1). The two grazing options were designed to represent the typical pattern of either grazing small-grain pasture until the grain begins jointing and then removing the calves, or grazing the pastures and not harvesting any grain. At weaning, the calves were either sold (System 11), place on winter small-grain pasture, or placed in a custom feedlot (System 1). Calves that were placed on pasture at weaning were either sold on March 1 (System 21), placed in a feedlot for finishing (System 2), or allowed to remain on pasture until June 1. Calves that remained on pasture until June 1 were either sold (System 31) or placed in a feedlot (System 3). All animals that entered the feedlot were fed until they achieved a "mostly Choice" slaughter grade, which was defined as 60 to 70 percent of the finished animals grading Choice. This grade was defined in the model in terms of the degree of fatness for a particular stage of maturity.

Postweaning weight gains, feed conversion

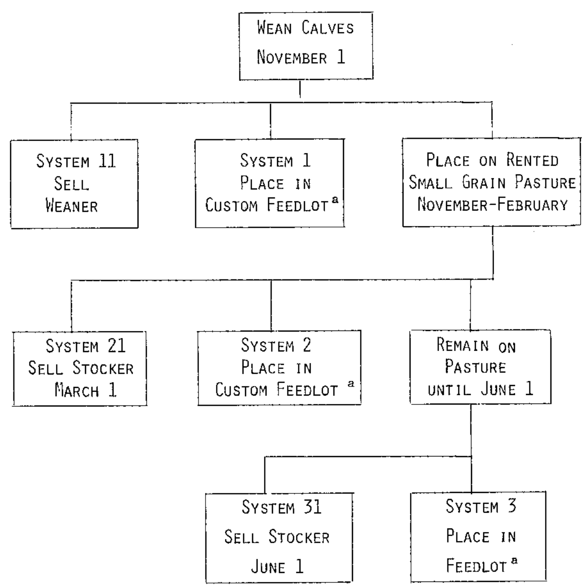

FIGURE 1. Postweaning Production options

[a] Finish to "mostly choice grade" and then sell.

rates, days on feed, weight upon achieving grade, and feed requirements varied according to the animals' genotype, sex, age, condition, and production/marketing system followed.

Economic Analysis

Prices. The analysis covered seven calf crops that were assumed to be weaned between 1972 and 1978. Each calf crop included the same number of calves of the same composition and weight. The model simulated a large number of calf classes that differ in weight and condition due to sex and age of dam. The number of classes was reduced to 24 by placing calves of similar sex and age in 3 condition groups, based on their average weight. Calf classes (4 ages, 2 sexes, and 3 condition groups) from each of the 9 herds were priced separately at all decision points for each of the 7 years. Prices received for the classes were tied directly to sale month, sex, weight, condition (fatness), and year. Data were limited (both on the side of price reports and the simulation model), thus, it was assumed that all feeder calves were of Choice grade.

Pricing equations were developed to translate reported price data into a usable form. The reported prices of Choice feeder calves from the Fort Worth and Amarillo markets were analyzed with ordinary least squares regression. For each of the seven years that feeder calves were marketed, three separate pricing equations were developed: one for the October–December period (Fort Worth); one for the March–May period (Amarillo); and one for June–August (Amarillo). Each month's prices were represented by the two market days that occurred nearest the first of the month. Each equation was of the form

$$P_{st} = \beta_{ost} + \sum_{i=1}^{4} \beta_{ist} X_{ist}$$

where

s = 1,2,3 (period of year)
t = 1972/73, . . . , 1978/79

where P is the price of Choice feeder cattle per cwt; X_1 = 1 if a steer, 0 otherwise; X_2 = 1 if second month of the period, 0 otherwise; X_3 = 1 if third month of the period, 0 otherwise; and X_4 is market weight in cwt. All 21 equations and all β_0 (intercept) and B_1 (sex) coefficients were significant and positive at the 1-percent level. The weight coefficient (B_4) was significant at the 1-percent level, except in the October–December 1974/75 equation, and was negative except in 1974/75. The month coefficients (B_2 and B_3) varied in sign and significance level. The distribution of R^2s was as follows: 80s - 4; 70s - 14; 60s - 2; and 30s - 1.

Price differences owing to condition were estimated with the standard deviation of regression equation and the condition index (ratio of weight to frame size). The pattern has been for thin calves to receive a premium over calves in normal or fleshy condition. The premiums and discounts were estimated by assuming that when the calf's condition index equaled 1.3 (extremely fleshy), the price received would be one standard deviation of the regression below the mean price for that particular weight, sex group, and sale month. If the condition index was .7 (extremely thin), the price received would be one standard deviation above mean price. No price corrections were made when the condition index equaled 1.0 (normal condition). Linear corrections were made for other condition levels. This procedure allowed the calves to be priced over the reported price range for each weight. This was not tested against actual market prices paid for animals of different condition levels. The results must be interpreted in light of this untested assumption.

A set of pricing equations based on the Amarillo market was estimated for slaughter cattle over the seven-year period. Within each year, three separate equations were estimated for spring, summer, and fall months. Again, each month's prices were represented by the two market days that occurred nearest the first of the month. Each equation was of the form

$$P_{st} = \beta_{ost} + \sum_{i=1}^{7} \beta_{ist} X_{ist}$$

where

s = 1,2,3 (period of year)
t = 1973, . . . , 1979

where P is the price of slaughter cattle per cwt; X_1 = 1 if a steer, 0 otherwise; X_2 = 1 if second month of the period, 0 otherwise; X_3 = 1 if third month of the period, 0 otherwise; X_4 = 1 if mostly Choice grade, 0 otherwise; X_5 = 1 if few Choice grade, 0 otherwise; X_6 = 1 if mostly Good grade, 0 otherwise; and X_7 is market weight in cwt. Ordinary least squares results of the equations indicated that all 21 equations and all β_0 and β_1 coefficients were significant at the 1-percent level. The month coefficients (β_2 and β_3) varied in sign and significance level. β_4 was negative in the 12 equations when β_4 was significant at the 1-percent level. When β_4 was not significant at 1-percent, but was significant at the 10-percent level, the sign was positive in one equation and negative in two. When β_4 was not significant, the sign was positive in three equations and negative in three. Negative signs were associated with β_5 and β_6 in all equations with all of the β_5, and eighteen of the β_6 coefficients significant at the 10-percent level. The weight variable was significant at the 1-percent level in three equations, at the 5-percent level in two equations, and at the 10-percent level in three. β_7 was negative in 16 of 21 equations. The distribution of R^2s was as follows: 90s - 3; 80s - 8; 70s - 5; 60s - 4; and 20s - 1. The feeder and slaughter cattle pricing equations were reported elsewhere (Stokes).

Costs. Budgets for the cow-calf and stocker operation were derived largely from Texas Agricultural Extension Service budgets. The USDA costs series "Great Plains Custom Cattle Feeding" served as the basic source for the budget of the feedlot operation.

The cost estimates for the cow-calf and postweaning operations were calculated to reflect the fixed land and management inputs of a representative central Texas beef cattle producer who could rent small-grain pastures in the Texas Panhandle and use custom feedlots in his postweaning operations. Individual input prices were adjusted each year with an available price series or by using the appropriate cost index when a complete price series was not available (Texas Dept. of Agriculture; USDA, *Agricultural Prices;* and USDA, *Livestock and Meat Situation*). For the cow-calf operation, Coastal bermudagrass pasture maintenance costs and livestock facility costs (operating, interest, and depreciation) were charged on a per unit of land area basis. Total labor (except hay feeding labor) for the cow-calf operation and the costs of pickup trucks and trailers were held constant across all nine herds. Hay and feeding labor costs varied across herds according to winter hay feeding levels. Salt, minerals, and veterinary expenses were charged on a per head basis in the cow-calf operation.

In the stocker and feedlot stages, pasture rental and transportation costs were charged on a weight basis, with labor, veterinary, and equipment (pasture) costs being charged on a per head basis. Supplemental hay costs on pasture and feed costs in the feedlot were based on simulated consumption levels. It was assumed that pasture rental rates and feed handling charges (a fixed markup on feed purchased) covered all of the fixed costs associated with land and feedlot ownership and management. If the animals were sold as stockers, a fixed rate of 3 percent of market value was charged to cover marketing costs (livestock auction) except transportation and shrinkage. No marketing charge was levied against feedlot sales (F.O.B. feedlot). Interest costs were calculated on the assumption that all costs were incurred at the beginning of each production stage except for feed purchases and feedlot veterinary costs, which were based on one-half of the incurred cost. Interest charges were based on the interest rate charged to farmers for livestock loans of all sizes (Board of Governors of Federal Reserve System). Interest costs were carried forward when the animals entered a new production stage.

Decision Procedures

The representative cow-calf operator was provided with four procedures for evaluating vertical integration opportunities. The first procedure involved a fixed decision to retain ownership through a given production system every year, irrespective of expected profitability. Each of the 24 calf classes followed the same production/marketing system, differing only in the length of the feeding period required to reach the "mostly Choice" grade. Feed costs were determined from the feed prices prevailing in the month that the cattle entered the feedlot. All net returns were converted to a per hectare basis using the stocking rate of the cow-calf operation.

The second procedure involved using the current price of finished slaughter cattle as a naive price forecast. At weaning, the representative operator estimated the net returns of Systems 1, 2, and 3 using current feed prices, current slaughter cattle prices, and the opportunity cost of selling that weaner calf class. Net returns were estimated independently from the 24 calf classes produced by each of the nine herds. If positive net returns were not forecast for a particular class, all calves in that class were sold at weaning. If the highest positive net returns were associated with System 1, calves of that particular class were placed directly into the feedlot, fed until they attained the "mostly Choice" grade and then sold. If the highest net returns were associated with either System 2 or System 3, the calves were placed on pasture for four months. At the end of the four months (March 1), the net returns from finishing cattle under Systems 2 and 3 were reevaluated using March 1 feed, slaughter cattle and stocker prices. If positive net returns were not forecast, the calf class was sold as stockers at the March 1 price. If System 2 had the highest positive net returns, the calves were placed in the feedlot on March 1. The calves were grazed for another three months if the highest positive net returns were associated with System 3. At the end of the seven-month grazing period, the decision to sell the class as stockers or to feed them was based on June 1 prices of feed, slaughter cattle, and stocker cattle. All cattle sold received the prevailing price computed from the estimated pricing equation, irrespective of the naive forecast. Interest charges were reestimated at each decision point.

The third decision procedure followed the same decision pattern as when current cattle prices were used as the expected prices, except that USDA's outlook estimates were used to forecast prices (USDA, 1972–79). As with the current price procedure, the expected net returns of producing finished slaughter cattle were always evaluated. To match the producers' decision points of November 1, March 1, and June 1, the price forecasts reported in the October, February, and April/May issues of the *Livestock and Meat Situation* were used to estimate expected net returns from each of the finishing systems. A discount for finished heifers was based on estimated price differences between finished steers and heifers during the preceding fall.

The fourth decision procedure required that a positive hedging margin be locked in with either a feeder or slaughter cattle hedge in order to retain ownership beyond weaning. Expected net returns were computed based on the total value of the futures contract less the heifer discount, interest on margin deposit (10 percent of contract value), brokerage fees, current feeder calf value and a $2 per hundredweight discount, which included the combined basis estimate and minimum net return requirement.

On November 1, the expected net returns of Systems 1 and 21 were computed for each calf class, using the November price of a March feeder cattle contract and the November price of the appropriate slaughter cattle contract. If neither of these two options indicated a positive net return for the particular calf class, the calf class was sold as weaners. If System 1 provided the highest positive net return, the calf group was placed in the feedlot on November 1 and fed until the "mostly Choice" grade was achieved. Actual net return levels for this option were then computed using the actual market price at the time of sale, the operating and feed costs of System 1, and the net return (loss) of the slaughter cattle hedge. If System 21 had the highest positive expected net return, the calves were placed on pasture until March 1, when the March feeder calf hedge was closed out, and the net return (loss) of the hedge was computed. The options of (1) selling the stocker calves on March 1, (2) placing the calves in the feedlot, and (3) retaining the calves on pasture until June 1 were evaluated in terms of expected profitability of hedges based on the March price of June feeder calf contracts or the appropriate slaughter cattle contracts. If the option of retaining the calves on pasture until June 1 was selected, the June feeder cattle hedge was closed and the net return of the hedge was determined. The June 1 option of selling or feeding the calves was evaluated with a hedge on the live slaughter cattle. Following System 3 required that two feeder cattle hedges, one for March delivery and one for June delivery, and one slaughter cattle hedge be placed. The net return (loss) from these three hedges was added to the net return (loss) from the cash market transactions.

RESULTS

Per hectare revenue for the cow-calf operation was estimated for each calf crop for the period 1972–78. In spite of the price discounts assumed for improved calf condition, herds with the heavier milking cows generated the highest total revenue. Across sizes, increased cow size lowered the revenue estimates per hectare. Revenue was the highest in 1978 followed by 1973, 1972, 1977, 1976, 1975, and 1974. Two-thirds of the costs of the cow-calf operation were accounted for by pasture, interest on livestock investment, hay cost, and interest and depreciation on livestock facilities. The increased total production cost per hectare was associated with increased stocking rates and winter hay feeding levels. Over the 1972–78 period, costs increased about 90 percent due to rising input prices. Negative net returns were estimated for all herds except in 1972 and 1973. Average net returns (losses) per hectare increased (decreased) as mature cow size increased and decreased (increased) as potential milk production increased (Table 2). Winter hay supplementation represented the major cost differences between the herds. When hay was charged at 40 percent of the prices paid by Texas farmers, there were only minor differences in the net returns per hectare. However, the net returns (losses) still were highest (lowest) for the large, light milking cows.

The results of retained ownership after weaning varied by year and option followed (Table 3). In 1972–73, the highest postweaning net returns were achieved when the LGEHEV, LGEMID, LGELIT, and MEDLIT herds followed System 2. System 21 yielded the highest net returns for the other herds. None of the "choice" systems indicated that calves should be retained after weaning. If "hindsight" had been available, a manager would have selected the production system that allowed each calf class to be marketed during the high-price months of August and September.

In 1973–74, a manager using "hindsight" would have sold all calves as weaners, as all classes for all herds incurred net losses in every postweaning option. The lowest postweaning losses were achieved by the heavy milking herds following System 1, with the balance of the herds following System 21. Neither the current price nor the USDA forecast indicated positive net returns for postweaning operations, hence, cattle were sold as weaners (System 11). Seven of the nine hedges triggered for System 2 had positive returns after the hedges were closed.

In 1974–75, Systems 1, 2, and 3 had positive net returns for all herds, with System 2 having the highest returns. The current price, the USDA forecast, and the hedge with futures option indicated positive net returns for some classes, but ranked behind the returns for Systems 1, 2 and 3. The two grazing options had negative returns. With "hindsight," net returns could have been increased by selecting a production system that would have allowed sales in June, July, or August, the highest price months of 1975.

In 1975–76, System 1, the current price, and the USDA forecast, yielded about the same positive net returns. With the exception of System 31, all of the other systems generally showed net

TABLE 2. Average Net Return and Standard Deviation of Net Returns to Land and Management per Hectare for the Various Genotypes under Alternative Production/Marketing Systems, 1972–79

Type Name[a]	System 11	System 1	System 21	System 2	System 31	System 3	Hind-sight[c]	Current Price	USDA Forecast	Hedge/w Futures
	Fixed Systems[b]							Choice Systems		
	($/ha/calf crop)									
LGEHEV										
Average	-79.18	-27.18	-83.74	-47.28	-105.15	-88.38	7.77	-69.55	-39.15	-76.69
Stan Dev	126.64	133.15	151.74	123.99	112.99	137.25	137.62	117.62	111.72	124.84
LGEMID										
Average	-71.93	-14.69	-71.98	-48.71	-88.67	-88.96	15.47	-62.34	-24.33	-69.49
Stan Dev	124.85	130.11	149.88	124.26	114.47	127.65	135.74	115.96	109.03	123.37
LGELIT										
Average	-57.95	-2.11	-52.86	-41.25	-64.60	-82.07	26.06	-51.76	-7.50	-56.74
Stan Dev	124.63	130.39	150.81	128.70	118.72	119.84	137.03	118.70	112.63	123.60
MEDHEV										
Average	-88.99	-46.24	-92.82	-58.24	-113.00	-102.76	-7.87	-83.48	-55.68	-85.27
Stan Dev	131.70	136.75	157.64	125.32	121.07	141.55	141.01	126.68	120.90	131.04
MEDMID										
Average	-77.83	-24.80	-76.92	-56.63	-92.47	-98.51	8.27	-70.84	-33.96	-75.28
Stan Dev	131.29	135.01	158.14	128.04	124.60	133.79	141.00	124.72	115.00	129.31
MEDLIT										
Average	-75.77	-22.18	-69.94	-62.17	-80.16	-101.05	6.54	-70.67	-32.88	-75.14
Stan Dev	127.67	129.28	153.63	128.50	124.37	124.07	137.25	122.71	108.34	127.22
SMAHEV										
Average	-103.02	-68.78	-106.36	-75.89	-125.31	-122.87	-27.52	-99.25	-78.09	-102.31
Stan Dev	137.19	137.53	163.47	126.66	129.49	145.70	142.26	133.76	124.60	137.61
SMAMID										
Average	-90.38	-45.33	-88.89	-73.81	-103.09	-114.90	-10.47	-86.31	-57.88	-89.32
Stan Dev	136.82	137.54	164.13	129.59	133.21	139.86	144.44	132.95	118.84	136.01
SMALIT										
Average	-80.38	-30.01	-73.77	-71.28	-82.76	-110.64	0.64	-75.43	-43.63	-80.43
Stan Dev	134.40	133.96	161.95	131.52	134.84	130.37	142.79	129.57	112.38	134.67

[a] Large size, heavy milking cows are referred to as LGEHEV; large size, light milking cows are LGELIT; and etc.
[b] System 11 is sell calves at weaning, System 1 is direct to the feedlot, System 21 is graze November 1 to February 28, System 2 is System 21 plus feedlot, System 31 is graze November 1 to May 31, and System 3 is System 31 plus feedlot.
[c] Hindsight represents selecting the most profitable system with full knowledge of actual prices.

TABLE 3. Postweaning Net Returns per Hectare for the LGELIT (large size, light milking potential) Herd Under Selected Simulated Cattle Production/Marketing Systems, by Years, 1972–1979

Year	System 1	System 21	System 2	System 31	System 3	Hind-sight[b]	Current Price	USDA Forecast	Hedge/w Futures
	Fixed Systems[a]						Choice Systems[c]		
	($/ha/calf crop)								
1972-73	50.57	53.85	71.63	36.48	22.77	78.50	0	0	0
1973-74	-115.52	-74.69	-103.13	-169.75	-145.05	0	0	0	0
1974-75	84.71	-53.30	115.75	-0.36	90.84	123.17	0	80.13	5.23
1975-76	24.58	.72	-35.12	17.67	-96.17	36.66	27.31	23.41	-1.90
1976-77	17.02	-20.75	-30.35	-44.52	-49.32	26.92	11.25	17.02	5.19
1977-78	153.99	15.71	67.70	84.13	44.16	153.99	4.77	153.77	0
1978-79	175.57	114.09	30.34	36.79	9.46	178.84	0	172.46	0

[a] System 1 is direct to the feedlot, System 21 is graze November 1 to February 28, System 2 is System 21 plus feedlot, System 31 is graze November 1 to May 31, and System 3 is System 31 plus feedlot.
[b] Hindsight represents selecting the most profitable system with full knowledge of actual prices.
[c] Zeros indicate the choice appeared to be unprofitable at the time decisions had to be made.

losses. Prices were highest in May, June, and July, with a peak in May. The price pattern in 1976–77 yielded positive returns only for System 1. The choice systems yielded positive returns, except that the hedge with futures option resulted in losses for three of the nine herds.

In 1977–78, all options except hedging yielded positive net returns for all herds, with System 1 being the highest, followed by the USDA forecast and either System 2 or System 31, depending on the herd. In 1978–79, System 1 yielded the highest returns, followed by System 21, and either System 2, the USDA forecast, or System 31, depending upon the herd. System 3 yielded losses for six of the nine herds. The current price option did not indicate any postweaning retained ownership. Net losses were incurred by the only herd that was hedged.

Table 3 provides some insight into the magnitude of the postweaning net returns (losses) for one of the nine herds. "Hindsight" allowed each calf class to follow the system that yielded the highest net returns. The differences between "hindsight" and the other options strongly indicate that managers can increase their net returns by altering their production systems (both preweaning and postweaning) to achieve proper market timing. However, the problem is that price patterns change from year to year, and no one production system will be consistently most profitable every year.

Over the seven-year period, the highest average postweaning net returns (across all herds) were associated with the fixed system of moving all calves directly to the feedlot (System 1), regardless of the market signals at fall weaning time (Table 4). Under System 1, the postweaning net returns were positive for every year analyzed except 1973–74. System 1 had the highest average net returns for all herds due to spring and early summer sales in which the highest prices generally occurred, and the lowest production cost per hundredweight of slaughter animal. When the preweaning and postweaning results were added for System 1, increasing mature size and decreasing milking potential increased the average net returns over the seven-year period (Table 2).

Using the USDA forecasts for system selection was the second best system on the average. The USDA price forecast method did not warrant retaining ownership of calves during the high profit year, 1972–1973, and warranted retaining only a few of the calves during 1978–1979. Highest postweaning net returns were associated with large size and light milking potential. The third best system was System 2, which involved grazing the animals for four months on small-grain winter pasture before entering the feedlot. Within this system, increased postweaning net returns resulted from large size and heavy milking potential. Higher milk production resulted in low System 2 postweaning net returns in 1972–

TABLE 4. Average Postweaning Net Returns per Hectare for the Various Genotypes Under Selected Simulated Cattle Production/Marketing Systems, 1972–79

	Fixed Systems[b]						Choice Systems		
Genotype[a]	System 1	System 21	System 2	System 31	System 3	Hind-sight[c]	Current Price	USDA Forecast	Hedge/w Futures
	($/ha/calf crop)								
LGEHEV	52.00	-4.56	31.90	-25.97	-9.20	86.95	9.63	40.02	2.49
LGEMID	57.24	- .05	23.22	-16.74	-17.03	87.40	9.59	47.60	2.44
LGELIT	55.84	5.09	16.70	-6.65	-24.12	84.01	6.19	50.45	1.22
MEDHEV	42.75	-3.83	30.74	-24.01	-13.78	81.11	5.51	33.30	3.72
MEDMID	53.04	0.91	21.20	21.20	-20.68	86.10	7.00	43.87	2.55
MEDLIT	53.58	5.82	13.60	- 4.39	-25.28	82.31	5.10	42.89	0.62
SMAHEV	34.24	-3.34	27.13	-22.29	-19.85	75.50	3.77	24.93	0.71
SMAMID	45.06	1.49	16.57	-12.70	-24.52	79.91	4.08	32.51	1.07
SMALIT	50.37	6.61	9.10	- 2.38	-30.26	81.01	4.95	36.75	-.05

[a] Large size, heavy milking cows are referred to as LGEHEV; large size, light milking cows are LGELIT; and etc.
[b] System 1 is direct to the feedlot, System 21 is graze November 1 to February 28, System 2 is System 21 plus feedlot, System 31 is graze November 1 to May 31, and System 3 is System 31 plus feedlot.
[c] Hindsight represents selecting the most profitable system with full knowledge of actual prices.

1973 and 1973–1974 when prices peaked during late summer. In other years, higher milk production resulted in better condition, shorter feeding periods, and allowed sales nearer the peak price period. System 2 produced profits in four of the seven years. Ranking fourth was the method based on using the current slaughter price as the expected price. Increased size resulted in higher postweaning net returns, but there was no consistent pattern to determine which potential milk production level was most profitable.

The practice of using the futures market to select a production/marketing system ranked fifth overall, with a slight positive margin. The procedure required selecting only those systems that would "assure" a positive net return from a hedge. In several of the years, a profitable hedge was not available at weaning time, therefore, the calves were sold at weaning. At other times, a profit was expected, and a shift in the basis or a change in costs eliminated the expected profits.

System 21 ranked sixth in average postweaning net returns. Only the lighter milking herds had positive average net returns over the seven-year period because of lower costs of grain. The smaller-frame calves were slightly favored as a result of a change in price relationships between November, 1978, and March, 1979, when the discount for heavier weights changed sharply. Both System 31 and System 3 resulted in negative average postweaning returns. The highest losses occurred under System 3 and were associated with those calves that took longest to reach grade and were sold well after the annual price peaks occurred.

Use of the computer simulation model made it feasible to develop estimates of the average cost of production for nine herds and six marketing alternatives (Table 5). At weaning, the average production cost ($67.79 per cwt) was lowest for the large-frame herd with cows that had a heavy milking capacity. The highest cost ($73.31 per cwt) was for the small-frame herd with a light milking capacity. For each of the three frame sizes, the heavy milking cow herds produced weaned calves at lowest cost per pound. When performance of these calves was evaluated through stocker and/or feeding stages, however, costs were lower for lower milking capacity herds. For the large- and small-frame herds, the light milking capacity produced the lowest costs for alternatives considered beyond weaning. The MEDMID herd had slightly lower costs except for System 3, in which the difference between medium and light milking capacity was trivial.

This evaluation of genotype through all stages indicates that production cost differences for steers and heifers from herds with different milking capacities were small, but favor cows with the lighter milking capacity under central Texas conditions. The lowest cost estimate for each of the alternatives beyond weaning was for the large-frame cow herd with light milking capacity. When evaluated on a constant land unit basis, the conclusions were the same.

SUMMARY

A complex beef production/growth simulation model was used to estimate the production response associated with alternative genotypes and postweaning production/marketing options for cow-calf operators in central Texas. Guides were developed for the long-run decision of selecting beef genotype, and short-run decisions relating to selling weaner calves or retaining ownership

TABLE 5. Seven-Year Average Liveweight Production Costs Under Alternative Feeding System for the Various Genotypes, 1972–1979

Feeding System	Genotype[a]								
	LGEHEV	LGEMID	LGELIT	MEDHEV	MEDMID	MEDLIT	SMAHEV	SMAMID	SMALIT
	($/cwt)								
Weaner Calf	67.79	69.91	68.91	69.43	69.70	73.02	72.13	72.80	73.71
Direct to Feedlot	58.41	57.81	56.36	59.75	58.32	58.58	61.85	60.35	59.20
Graze Nov-Feb	64.51	64.79	63.56	66.03	65.35	66.84	68.46	68.02	67.66
Graze Nov-Feb then Feedlot	59.78	59.15	57.59	61.12	59.76	59.83	63.83	61.84	60.60
Graze Nov-May	62.90	62.71	61.22	64.39	63.37	64.16	66.73	65.89	65.08
Graze Nov-May then Feedlot	60.83	60.19	58.63	62.22	60.90	60.86	64.33	63.02	61.78

[a] Large size, heavy milking cows are referred to as LGEHEV; large size, light milking cows are LGELIT; and etc.

through a stocker stage and/or a feeding stage. Average net returns favored larger cows with lower milking potential during the period 1972–79. Production costs for weaner calves favored the heavier milking types, but these calves had higher costs when carried through stocker or feeding stages. Moving weaner calves directly to the feedlot for finishing to "mostly Choice" had the lowest average costs and highest average net returns (lowest loss) during 1972–79 compared to selling weaner calves, owning them through a stocker stage on wheat, or owning them through a wheat stocker-feeding stage. Using USDA price forecasts to estimate net return for each calf class yielded the second highest average returns. Decisions based on locking in a positive net return by hedging with futures contracts did not yield higher average returns than always selling weaners.

The above results apply to central Texas herds and to stocker and feedlot systems in the Texas-Oklahoma Panhandle, where winter grazing on wheat is available for fall-weaned calves. Moreover, these results apply to the specific procedures and the specific years and price relationships used in the analysis. For example, other hedging strategies might have shown more favorable returns. Likewise, within genotype, variability could mask between genotype differences in experimental trials. However, this research indicates that large-frame cattle were more profitable, and that using a recognized forecast to evaluate each stage of production and marketing should be considered.

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