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THE ON-RANCH RETAINED OWNERSHIP DECISION -- IN PERIODS OF RELATIVELY LOW PRICES VERSUS RELATIVELY HIGH PRICES

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INTRODUCTION

The cattle ranching industry is a very dynamic industry. The size of the U.S. cow herd and the composition of the herd, ie. ratio of replacement heifers to older cows and the ratio of heifers to steers slaughtered, is continually changing over time. The price of cattle and calves also fluxuates over time and there appears to be a cyclical component to these price movements. The historical pattern has been to have two or three years of relatively high prices, followed by four to six years of relatively low prices.

A 1985 survey of mountain valley cattle ranches in Wyoming revealed that 36% were basically cow-calf operations, 22% were cow-short yearling operations and 38% were cow-yearling operations. Some of the differences in type of organization can be explained by the resources available to the ranch, or by managerial preferences. The cyclical nature of prices and a rancher's expectations about future prices may also determine the type of organization.

Because of changing technology and market conditions, ranch managers must continually examine their production practices to find ways of improving their profit margins. "Retained ownership" is frequently mentioned as an approach by which a ranch operator might improve profits. The recent popularity of the phrase, primarily referring to retained ownership in a custom feedlot, seems to overlook the fact that on-ranch retained ownership has been a long standing practice on many ranches.

The objectives of this paper are: 1) to examine the profitability of on-ranch retained ownership; and, 2) determine what effect the stage of the cattle price cycle has on the retained ownership decision.

Production Stages

A range cattle operation can be viewed as a series of production stages. In much of the northern and central plains and intermountain regions, three primary stages are cow-calf, calf wintering, and yearling summering. The cow-calf stage involves carrying the cow for one year and the calf from birth to weaning at about 6-8 months of age. The calf wintering stage of production, whether for steers or heifers, involves carrying calves through the winter to a "short-yearling" age in the spring. The short yearling may be sold, placed in feedlots for fattening, or may enter into the third stage of production, the yearling summering activity, which results in production of "long-yearlings" ready for entry to feedlots for fattening.

Review of Literature

Gee and Skold (1970) used linear programming to find the optimal enterprise combination on mountain cattle ranches in Colorado with a resource base typical of a cow-calf ranch with 130 cows. The enterprises available to this typical ranch were cow-calf, cow-yearling and yearling stocker with three different levels of meadow improvement practices. The cow-yearling enterprise had the highest profit under two of the meadow management alternatives. If the ranch was allowed to use the most intensive meadow improvement and to sell

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surplus hay, the cow-calf enterprise was the most profitable. Under this alternative the cow herd was decreased somewhat to allow for substantial amount of hay sales, in effect converting to a partial cash crop system.

Pfeiffer (1986) used budgeting to compare real returns and variability from 1975-1984 for cow-calf, cow-yearling and yearling stocker operations for the Nebraska Sandhills area. The basic cow-calf ranch consisted of 100 cows to calve, had a 90% calf crop weaned, and sold steer and heifer calves that weighed 450 and 425 pounds respectively. The cow-yearling and yearling stocker ranches were constrained by the forage resources available to the cow-calf ranch. Returns for the cow-yearling ranch were slightly higher and less variable than the cow-calf ranch. The yearling stocker organization had the highest average net returns over the time period, and also the highest degree of income variability.

Neither of these two studies considered the effect of the cattle price cycle on the optimal enterprise selection. A number of other studies could be referenced, but are not because of space constraints.

Scope and Methodology

Feuz and Kearl (1987) constructed a ranch model to analyze the on-ranch retained ownership decision for western Wyoming mountain valley cattle ranches. This paper is based upon that model. The model was constructed from data gathered in a 1985 survey of mountain valley ranches in Wyoming (Kearl, et al., 1986). The costs are at 1984 levels, which in aggregate have remained fairly constant through 1988, as some costs have increased and others decreased. The levels of production are thought to represent performance of better-than-average producers. The data may also be fairly representative of other higher elevation ranching areas in the Rocky Mountain and Intermountain regions over 5,500 ft. mean sea level.

Ranch enterprise budgets were constructed to identify production relationships, resource availability, costs, sales, and relevant production practices. Given a certain resource base and average production factors, linear programming was then used to determine the optimum resource allocation and appropriate ranch activities to maximize net ranch income. The linear programming model was initially run using 1981-1986 cattle prices and then subsequently run using 1987-1989 prices to coincide with the low and high time periods of the last cattle cycle. The prices for 1989 were assumed to be equal to 1988 levels.

THE MODEL: RESOURCES AND ENTERPRISE BUDGETS

Land Base and Production

Production varies considerably over the mountain valley area due to differences in soil, climate, and management practices. The model ranch production is above average for the area because data were obtained from better than average producers. Two cuttings of alfalfa hay are harvested and produce 3.0 tons per acre without fertilization, or 4.0 tons per acre with fertilization and 1.0 animal-unit-month (AUM) of aftermath grazing. The 1980-1984 average production for alfalfa for the study area generally was 2.25 tons per acre (USDA-SRS, 1985). Typically there is little fertilizer use and only one cutting is harvested per year over some of the area.

One ton of hay per acre is produced on native hay meadows. The improved meadow produces 1.5 tons per acre unfertilized or 2.5 tons per acre with fertilizer. These levels of production are fairly consistent with area average production of "other" hay, 1.32 tons per acre, including fertilized and unfertilized native and improved meadow hay for 1980-84 (USDA-SRS, 1985).

All meadows produce 1.5 AUMs per acre of aftermath grazing, including crop residues, regrowth and unharvested forage on "waste" acres such as canal and ditch banks, fence rows and wet or willow and river bottom areas.

Barley yields of 60 bushels per acre were typical for the area and 0.4 AUMs per acre for fall aftermath was assumed.

One acre of irrigated pasture land can produce four AUMs for the summer grazing period and 1.5 AUMs for the fall period. Both the deeded and leased range land is rated at 4 acres per AUM, or .25 of an AUM per acre for the summer season (Ross, 1986).

Livestock Enterprise Budgets

The cow-calf stage of production is composed of several activities. The main activity is the cow-unit, which also requires .05 bull and .17 calf-to-yearling replacement heifer. The output from this stage of production is .13 of a cull cow to a selling activity, .45 of a steer calf and .45 of a heifer calf that move into calf wintering or feeding activities. The steer and heifer calf activities from birth to weaning are separated from the cow-unit to facilitate parameterizing percent calf crop, weights, and summer and fall grazing requirements. Separating the cow-unit and calf activities in this way also allows the model more flexibility in choosing the optimal enterprise combination for the model ranch. Details on the model are reported in Feuz and Kearl (1987).

The calf-wintering and yearling summering activities were specified as separate stages of production. Each of these activities requires one animal as an input and the output is .98 and .99 of an animal respectively.

THE CATTLE PRICE CYCLE

As previously mentioned the cattle industry has had a history of repeating price cycles. There has been three cycles over the last 20 years. The late 1960's and early 1970's were low price years and 1972 and 1973 were high price years. The cycle repeated in seven years with 1974 - 1977 being low years and 1978 - 1980 being high price years. The last cycle has been a longer one of about 10 years with low prices from 1981 - 1986 and high prices from 1987 - present. Figure 1 displays the price for 450 pound steers from 1969 to 1988. The price for other classes and weights of cattle follow a similar pattern to that portrayed in figure 1.

Price Differentials

The price of cattle is negatively correlated to the weight of the animal. However, this relations is not stable over the stages of the cattle price cycle. By analyzing the price of calves in November, the price of short yearlings in April, and the price of long yearling in October a percentage

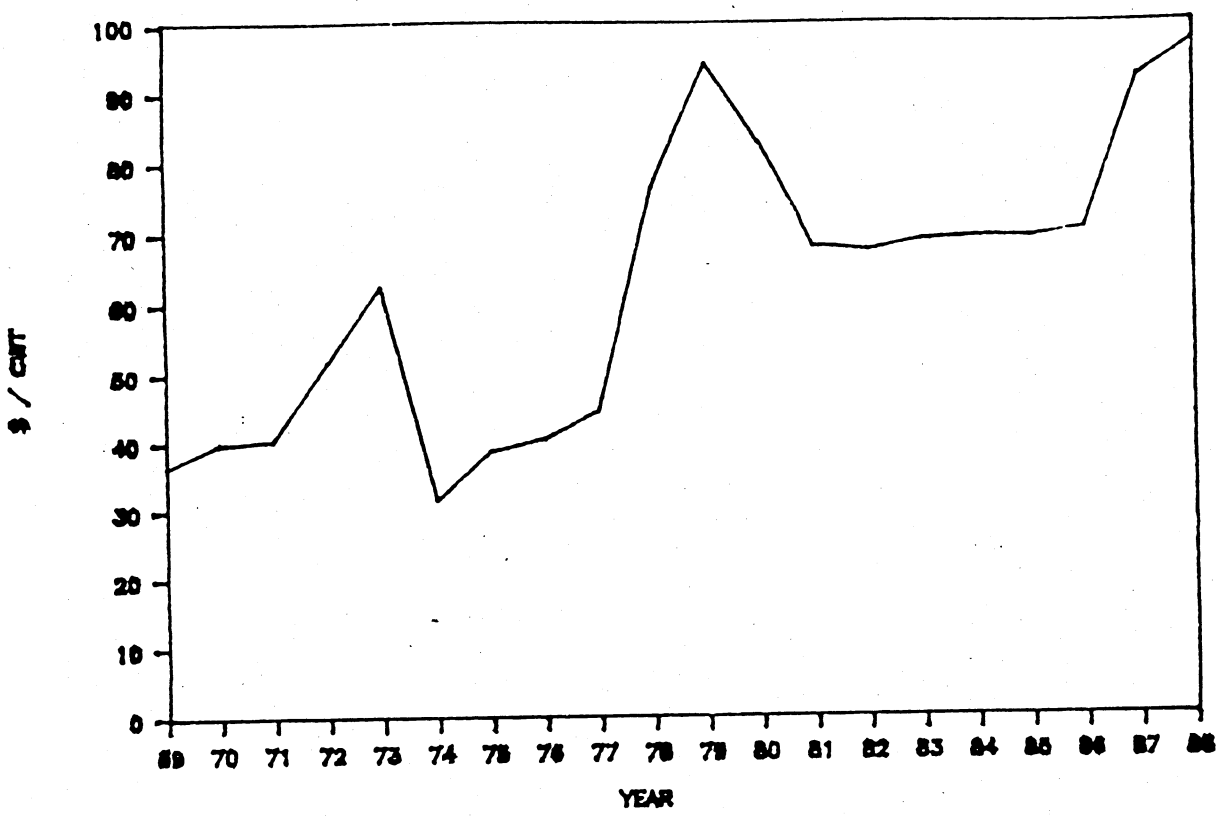

FIGURE 1. HISTORICAL PRICES OF 450 POUND, MEDIUM FRAME, YIELD GRADE 2 AND 3 STEER CALVES AS REPORTED AT TORRINGTON, WYOMING FROM 1969 - 1988.

price differential was calculated. Significant differences were found to exist between these differentials in low price years as compared to high price years. Table 1. is a summary of these price differentials.

TABLE 1. SHORT YEARLING AND LONG YEARLING PRICES AS A PERCENT OF CALF PRICE FOR STEERS AND HEIFERS FROM 1969 - 1988.

Class	Weight	Percent of Calf Price	
		High Price	Low Price
Steer Calf	425	100.0%	100.0%
Heifer Calf	400	100.0%	100.0%
Short Yearling Steer	620	88.6%	103.8%
Short Yearling Heifer	570	91.6%	110.2%
Long Yearling Steer	820	79.7%	89.2%
Long Yearling Heifer	750	82.5%	98.4%

From the information in Table 1, it would appear that retained ownership would be more profitable when cattle prices are generally lower. The price differentials may be sufficiently different to make it most profitable to sell calves in high price years but to sell yearlings when prices are down.

The actual prices used in the model are presented in Table 2.

RESULTS

Low Price Years --- 1981-1986

The initial LP solution indicated the cow-long yearling organization, which is the combination of the three stages, was optimal for the model ranch. It seems that studies often report only the optimal solutions, which leaves the reader wondering whether there are "significant" differences between the optimal and any sub-optimal solutions. For comparison purposes, coefficients were changed to force the model to complete calculations and give results for the cow-calf and cow-short yearling organizations (Table 3).

The model maximized net cash income to the ranch. For this analysis the ranch was considered to be debt free, so no interest was charged to land. Interest on cash operating expenses was calculated as a cash expense. A credit for interest income was allowed from the time of livestock and crop sales to the end of the accounting period to allow for advantages that could accrue from sale at different points in the year.

Net cash income ranged from a low of $52,172 for the cow-calf to $66,492 for the cow-long yearling model, a difference of about $14,000 or 21.5%. Income in the cow-short yearling operation is only about $2,000 less than the cow-long yearling model. After the net cash income was obtained from the LP model, other measures of income were also calculated (Table 3).

TABLE 2. WEIGHTS, PRICES, AND VALUE PER HEAD FOR THE MODEL RANCH.

CLASS	Weight	Price Per Cwt. 1981-1986	Price Per Cwt. 1987-1989	Value Per Head [a] 1981-1986	Value Per Head [a] 1987-1989
Steer Calf	425	$69.50	$97.50	$295.00	$414.00
Heifer Calf	400	60.55	88.70	242.00	355.00
Short Yearlings [b]					
Steer	620	68.40	85.00	424.00	527.00
Heifer	570	61.70	81.50	352.00	465.00
Long Yearlings [b]					
Steer	810	60.60	79.10	491.00	641.00
Heifer	750	56.60	74.50	425.00	559.00
Cull Cow	1050	34.35	45.50	361.00	478.00
Rep. Heifer Cull	725	56.60	74.60	410.00	541.00

[a] All value per head are rounded to the nearest whole dollar.
[b] Additional weights and prices exist in the model to allow more flexibility.

TABLE 3. COMPARISONS OF RETURNS FOR THE OPTIMAL COW-LONG YEARLING, THE COW-SHORT YEARLING AND COW-CALF RANCHES FOR 1981-1986. (Dollars)

Item	Forced Cow-Calf	Forced Cow-Short Yearling	Optimal Cow-Long Yearling
Number of Animal-Units	628	720	856
Number of Cows to Calve	460	460	472
Livestock Sales			
Cull Cows	21,660	21,660	22,021
Rep. Heifers	3,280	3,280	3,280
Young Cattle			
Steers	61,065	85,869	99,184
Heifers	30,492	46,748	53,550
Total Livestock	116,497	157,557	178,035
Crop Sales and Range Rent			
Hay	39,675	19,619	19,988
Barley	5,592	3,607	5,592
Range rent	11,574	11,574	
Total Crop Sales	56,841	34,800	25,580
Interest Income	2,435	8,679	3,409
Total Income	175,773	201,036	207,024
Total Cash Costs	123,601	136,562	140,532
Net Cash Income	52,172	64,474	66,492
Cash Income, as a percent of Optimal	78.5%	97.0%	100.0%
Depreciation	24,600	24,600	24,600
Net Ranch Income	27,572	39,874	41,892
Operator labor and management	20,000	20,000	20,000
Return to Capital	7,572	19,874	21,892
Return to Capital, as a percent of Optimal	34.6%	90.8%	100.0%
Interest on:			
Livestock	24,925	29,521	31,518
Mach. & Equip.	24,000	24,000	24,000
Return to Land	(41,353)	(33,647)	(33,626)

The crop producing activities remained the same for all three ranch organizations. Fertilizer was applied to the alfalfa and improved meadow ground to get the maximum level of production. In all of the models the public grazing resources were fully utilized.

In the low price years of the cylce no additional range land was leased by any of the three organization. Two of the organizational types, the cow-calf and the cow-short yearling, were understocked and rented out all of the deeded range land and had significant crop sales. The total number of animal-units were 628 and 720 for the cow-calf and cow-short yearling ranches as compared to 856 for the cow-long yearling ranch. Crop sales and land rent accounted for nearly 33% of the total income for the cow-calf operation and just over 17% for the cow-short yearling ranch.

Peak Years -- 1987-1989

The model was run a second time and prices for 1987-1989 were used for livestock. The optimal solution remained the cow-long yearling ranch organization. The model was again constrained to depict the cow-short yearling and cow-calf organizations for comparison purposes (Table 4).

Net cash income ranged from $113,965 for the cow-calf operation to $122,851 for the cow-long yearling model, a difference of only 7.2%. The cow-short yearling operation had a net cash income of $117,700.

During the high price years all of the deeded range land is used by all three ranch organizations. In addition to this, additional range land is leased up to the maximum allowed by the LP model. The number of animal-units (AU) increased on the cow-calf ranch from 628 in trough years to 895 in peak years. The AUs also increased from 720 to 873 for the cow-short yearling ranch and the cow-long yearling ranch had a modest increase from 856 to 885 AUs. During peak years, crop sales and land rent, as a percent of total income, ranged from a high of just over 10% for the cow-calf ranch to less than 2% for the cow-short yearling ranch.

IMPLICATIONS

There are a number of interesting implications implied by these results:

1. during the 1981-1986 period two organizations out of three would maximize income by leasing out as much land as possible and selling crops, except for the feed necessary to balance the operation and allow for the use of public range lands;

2. in the low price years the livestock activities are functioning to market the ranch produced feed and forage not marketable by other means;

3. the optimal ranch organization is the cow-long yearling ranch for both time periods of the analysis, however, the differences between the ranch organizations are much less in the high price years;

4. during high price years, maximum returns can be obtained by fully stocking the ranch and using all available grazing resources; and,

5. on-ranch retained ownership is a viable means of increasing ranch profitability, particularly in years of low cattle prices.

TABLE 4. COMPARISONS OF RETURNS FOR THE OPTIMAL COW-LONG YEARLING, THE COW-SHORT YEARLING AND COW-CALF RANCHES FOR 1987-1989. (Dollars)

Item	Forced Cow-Calf	Forced Cow-Short Yearling	Optimal Cow-Long Yearling
Number of Animal-Units	895	873	885
Number of Cows to Calve	655	556	486
Livestock Sales			
Cull Cows	40,630	34,416	30,114
Rep. Heifers	5,951	4,869	4,328
Young Cattle			
Steers	122,130	135,730	135,892
Heifers	63,900	75,000	69,940
Total Livestock	232,611	250,015	240,274
Crop Sales and Rent			
Hay	22,344		16,851
Barley	5,592		5,592
Range rent		4,668	
Total Crop Sales	27,936	4,668	22,443
Interest Income	2,272	9,956	3,306
Total Income	262,819	264,639	266,023
Total Cash Costs	148,854	146,939	143,172
Net Cash Income	113,965	117,700	122,851
Cash Income, as a percent of Optimal	92.8%	95.8%	100.0%
Depreciation	24,600	24,600	24,600
Net Ranch Income	89,365	93,100	98,251
Operator labor and management	20,000	20,000	20,000
Return to Capital	69,365	73,100	78,251
Return to Capital, as a percent of Optimal	88.6%	93.4%	100.0%
Interest on:			
Livestock	45,375	46,339	42,057
Mach. & Equip.	24,000	24,000	24,000
Return to Land	(10)	2,761	12,194

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SELECTION AND DEVELOPMENT OF THE REPLACEMENT ASSET: THE CASE OF THE REPLACEMENT BEEF HEIFER

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Beef Cattle Management is a series of decisions designed to accomplish clearly defined goals. Several major management decisions are made annually that impact the biological and economic efficiency of commercial cow-calf operations. The selection and development of replacement heifers is one of these major management decisions which significantly affects the productivity and profitability of the cattle operation. When replacement heifers are selected, producers are anticipating and predicting the future biological and economic performance of their herd. One of the questions most commonly asked by cow-calf producers is "How do I go about selecting and developing my replacement heifers?" And like most other commonly asked questions, this question has no particularly satisfying answer. The most truthful answer would probably be "it depends". "It depends" on the individual producer's management philosophy, the level of performance of the producer's herd for a number of traits (genotypic), the environment (phenotypic), availability of individual cost and performance data, breeding system, current and future market prices and financial position--to name a few. It is postulated that the theory of replacement in the biological process has not been adequately developed to answer some of these questions.

The limiting assumption of replacement theory research efforts, from the individual producer's perspective, is inadequate qualification and quantification of the selection and development process of the replacement animal. The research reported in this paper will indicate a procedure to be used to determine replacement heifer selection and development values for use in asset replacement theory. Sensitivity analysis will be presented to quantify the economic importance of accurately assessing the selection and development cost of the replacement female.

Previous Research

The problem of determining optimal policies for the replacement of assets has been addressed extensively in the agricultural economics literature. Replacement optimization is particularly important in agriculture because of change over time in pregnancy rates, weaning rates, growth rates, feed consumption and conversion rates, annual yields, etc., that are often associated with biological production processes.

Chisholm's and Perrin's work set the precedence for most present day work in this area. The result of Chisholm's effort was the establishment of a correctly specific theory of asset replacement based upon the principal of maximizing net present value (NPV). Perrin expanded upon Chisholm's work in 1972. He developed an alternative and equivalent replacement criterion based upon equating marginal revenue and marginal opportunity cost.

Numerous articles have appeared in the literature since Chisholm's and Perrin's work (Kay and Rister; Boehlje and White; Gunter and Bender; Bradford and Reid). Asset replacement research specific to the area of livestock breeding animal replacement decisions has also progressed. In 1976, Bentley et al. combined Perrin's marginal criteria for replacement with Burt's methodology for considering stochastic conditions. Through this effort they determined the optimal replacement age for beef cows in the presence of stochastic calving

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