A STOCHASTIC DOMINANCE ANALYSIS OF CONTRACT GRAZING FEEDER CATTLE

Frank Johnson, Thomas H. Spreen, and Timothy Hewitt

Abstract

Contract grazing feeder cattle is an arrangement where cattle owned by one party graze forage produced on land owned by another party. The forage producer is paid a fixed price per pound gained. Stochastic dominance analysis is used to compare contract grazing and the more traditional system in which the same individual owns both the cattle and land.

Key words: feeder cattle, stochastic dominance, risk, farm management.

The beef cattle production system in the United States can be divided into three stages: cow-calf production, an intermediate forage-based growing phase, and confined feedlot finishing. The first stage entails production of a weaned calf, conducted by cow-calf operators who breed cows to produce calves. At weaning, all male calves and those heifers not required as beef cow replacements are usually sold. The next stage is a period in which calves consume a ration which is high in roughage and contains little or no concentrate feed. Calves typically graze high-quality forages for three to eight months. The third stage is feeding cattle in a confined feedlot. Animals consume a ration which contains a high proportion of concentrate feeds such as corn. Animals are fed a minimum of 100 days and/or as long as 200 days depending upon weight at time of placement. After the feedlot stage is completed, the animals are slaughtered.

This paper focuses on the second stage, known as stocker cattle production or backgrounding. A backgrounding operation can be structured in several ways. A cow-calf producer can choose not to sell calves at weaning and graze weaned animals before placing them in a feedlot. An alternative system is one in which a producer purchases newly weaned calves and places them on a high-quality forage. For the purpose of economic analysis, these two systems are identical since the opportunity cost of not selling newly weaned calves should equal the actual cost of purchasing weaned calves. A producer who owns the stocker cattle and provides all feed to the animal (either through cultivated pastures or purchased feed) will be called an integrated producer.

Another arrangement is called contract grazing. The cow-calf producer maintains ownership of the calves and places them on pastures cultivated by the pasture owner. The pasture owner is responsible for all of the tasks related to backgrounding except transport to and from the backgrounding site. The cattle owner is responsible for providing healthy cattle, paying all transport costs, and accepting a death loss of up to 2 percent. The contract usually specifies the length of the grazing period, the method of weighing cattle, and the price per pound of gain the cattle owner pays the pasture owner.[1]

In this paper the costs and returns from backgrounding feeder cattle in West Florida are estimated over the 1973 to 1983 period. These estimates are computed for an integrated operator assuming that weaned calves are purchased at prevailing market prices. Net returns are also calculated for both participants in a contract grazing arrangement. Furthermore, the critical weight gain price is determined at which point preferences change from participating in a contract grazing arrangement to integrated cattle production.

A backgrounding operation is faced with production risk and/or price risk. Production

[1]A wide array of contract grazing contracts exists but the terms described here are standard for most contracts utilized in the study area.

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risk arises from the fact that forage production tends to vary from year to year. Unlike a confined feedlot in which weight gains are fairly predictable, a backgrounding operator depends upon moisture and temperature conditions which are conducive to forage production. If forage production is inadequate, he is faced with the difficult and costly decision of purchasing feed. In the case of a forage crop failure, the integrated producer has the option of terminating the backgrounding program and selling the cattle. In a contract grazing arrangement this option may be closed to the pasture producer, and he may be forced to purchase supplemental feed.

Price risk arises from the fact that feeder cattle prices are highly volatile. Numerous studies have demonstrated the volatile and random nature of these prices (e.g., Spreen and Arnade).

An integrated cattle producer faces both production and price risk. In a contract grazing arrangement, production risk is borne solely by the pasture owner and price risk is faced solely by the cattle owner. By splitting the risk encountered in backgrounding cattle, are both parties better or worse off? Stochastic dominance is used in this study to address this question (Anderson, Anderson et al.).

METHODOLOGY

Stochastic dominance is an appropriate tool to analyze alternative risky prospects. Consider two production alternatives whose probability density functions of net returns are denoted by f(x) and g(x), defined over the interval [a,b]. The preferences of the decision maker are represented by a utility function U(x). The function U(x) is assumed to possess continuous first and second derivatives. In this analysis, since the uncertain nature of net returns is explicitly considered, maximization of utility entails maximization of expected utility.

Several ordering rules can be delineated depending upon the assumptions regarding the decision maker's preferences towards risk. The simplest decision rule is that the decision maker prefers more income to less income. In this case, the distribution f(x) is said to dominate g(x) by first-order stochastic dominance if and only if

$$F_1(R) \leq G_1(R)$$

for all R contained in [a,b] and $F_1(R) < G_1(R)$ for at least one value of R, where

$$F_1(R) = \int_a^R f(x)dx$$

and

$$G_1(R) = \int_a^R g(x)dx\ .$$

$F_1(R)$ and $G_1(R)$ are the cumulative distribution functions of the probability density functions f(x) and g(x), respectively.

Anderson shows that if f(x) dominates g(x) in the sense of first-degree stochastic dominance, then a decision maker with a utility function U(x) such that the first derivative of U(x), $U_1(x) > 0$, will prefer the alternative associated with f(x) to the alternative associated with g(x).

A second ordering rule combines the notion of more is preferred to less with the assumption that successive amounts of income have a diminishing value to the decision maker. This is the assumption of diminishing marginal utility or a concave utility function—mathematically, the first derivative of the utility $U_1(x) > 0$, and its second derivative $U_2(x) < 0$.

The distribution f(x) dominates g(x) according to second-degree stochastic dominance if and only if

$$F_2(R) \leq G_2(R)$$

for every R contained in [a,b], with strict inequality for at least one R, where

$$F_2(R) = \int_a^R F_1(x)dx$$

and

$$G_2(R) = \int_a^R G_1(x)dx\ .$$

The functions $F_2(R)$ and $G_2(R)$ are the areas under their respective cumulative distribution functions, $F_1(x)$ and $G_1(x)$.

Anderson has shown that if f(x) dominates g(x) in the sense of second-degree stochastic dominance, then the production alternative associated with f(x) is preferred to the production alternative associated with g(x) according to the second ordering rule. Decision makers using this criterion are said to be averse to risk.

Anderson notes that second-degree stochastic dominance can usually order a larger set of risky prospects than first-degree stochastic dominance. This is not unexpected since the criterion for second-degree stochastic dominance is more restrictive than first-degree stochastic dominance. Although the set of efficient production alternatives will generally be smaller than under first-degree stochastic dominance, the second-degree stochastic dominant efficient set still may be large.

There are two approaches to further limit the size of the stochastically efficient set. The first approach is to add more restrictive assumptions regarding the nature of preferences. The other approach is to explicitly define a particular preference function. This second approach is called stochastic dominance with respect to a function.

In this paper the number of alternatives considered is relatively small, and second-degree stochastic dominance is sufficent to order the risky prospects. The approach used to determine the stochastically efficient set requires generation of a time series of net returns for each risky prospect. The observations in each time series are assumed to represent a sample from the stochastic process generated by the true probability density function of net returns associated with a particular production alternative. The individual observations within each time series are ranked from smallest to largest. By placing a probability mass of 1/n on each observation, where n is the total number of observations, the cumulative distribution function can be approximated by plotting the net returns on the horizontal axis and probability on the vertical axis. First- or second-degree stochastic dominance can be determined by visual inspection of a plot of two ordered time series.

EMPIRICAL ANALYSIS

Data were collected from the forage trials conducted at Jay, Florida (near Pensacola). Dry matter yields for two winter annual forages, rye and ryegrass, and millet, a summer annual forage, were collected over the 1973 to 1983 period. Clippings were taken at approximately six-week intervals over the productive life of the forages. These values were used to estimate monthly dry-matter production (Johnson).

Information regarding forage quality was not available from the Jay, Florida, forage trials. These values were adapted from other sources (Spreen et al., Appendix A) and are assumed to be invariant from year to year.

Two winter grazing enterprises and one summer grazing enterprise were analyzed. Both winter operations were assumed to begin with pasture seeding on October 1. One winter operation involved grazing rye pasture from December 1 through March 31. The other winter operation involved grazing ryegrass pasture from December 1 through April 30.[2] Four-hundred pound Medium Frame No. 1 steers were assumed to be purchased at prevailing Florida average prices in November (Simpson and Alderman) under both operations. Cattle were sold in the month following the end of the grazing period. For simplicity, the year of the operation is labeled as the year the cattle are sold. For example, the 1972–73 season in which cattle grazed December through April is called 1973.

The summer enterprise entailed purchase of 550-pound Medium Frame No. 1 steers at Florida average prices in April (Florida Department of Agriculture). The steers grazed millet pasture from May 1 through August 31 and were sold in September.

Weight gains from the backgrounding operations were estimated via a simulation model developed by Spreen et al. The simulation model requires monthly forage quantity and quality data and initial animal weight. For those months in which available forage was inadequate to meet the maintenance requirements on pasture, hay was provided. Hay was purchased at prevailing Florida-Georgia prices as reported in *Agricultural Prices, Annual Survey* (USDA) and was fed at levels which allowed minimal weight gains. Otherwise no supplemental feeding was considered.

Costs and Returns

The cost of growing pasture was based upon budgets developed by Ross et al. Fertilization rates per acre were based upon those used in experimental trials at Jay, Florida—300 pounds of 8-24-24, .3 ton of lime, and 175 pounds of ammonium nitrate for both winter and summer forages. For more detail on the forage budgets, see Johnson.

Other costs including procurement, transportation, medication, fuel and repairs, interest on operating capital, labor, overhead (such as insurance and taxes), and marketing fees were taken from Ross et al. The analysis assumed a 1 percent death loss associated with procurement and transportation in, and a 1 percent death associated with grazing. A 3 percent purchase shrink and 1 percent sale shrink were included.

One hundred acres of pasture were assumed fixed and stocking rates of 1, 1.25, 1.5, 1.75, 2, 2.25, and 2.5 head per acre were simulated for ryegrass and stocking rates of 1, 1.25, 1.5, 1.75, and 2 head per acre were simulated for

[2]Use of mixed stands of cool season forages, for example, rye-ryegrass-clover, are more likely to be found in commercial operations. Unfortunately, forage trials were conducted on only single species pastures.

rye pastures. Stocking rates of 1.5, 2, 2.5, 3, and 3.5 head per acre were simulated for millet. These stocking rates were chosen because the most profitable operations fell within these ranges.

Simulations were performed for each pasture, year, and stocking rate. Weight gain, total cost for the integrated producer, and cost of the pasture owner were estimated. The pasture owner was assumed to incur the cost of growing the pasture, medication, implants, other operating costs, overhead, labor, and the losses associated with the purchase and sales shrink. The cattle owner's costs included the purchase price of the steer (or opportunity cost if he raised them), order buying costs, transportation in, other marketing costs, and the 2 percent death loss associated with procurement and pasturing.

EMPIRICAL RESULTS

Results from the growth simulation analysis on rye, ryegrass, and millet are shown in Tables 1, 2 and 3. Predicted weight gain (per animal), the estimated break-even selling price, and the estimated cost of gain for each year are shown at varying stocking rates. Examination of the results reveals that predicted weight gains decline as stocking rates increase. Weight gains on ryegrass are higher than gains on rye, at the same stocking rate. This occurs because the dry-matter yields of ryegrass exceeded the yields of rye by an average 1708 pounds per acre annually. Higher weight gains on ryegrass lower break-even prices and cost of gain compared to rye as the costs associated with producing rye and ryegrass are comparable.

There is no discernable relationship between stocking rate and break-even selling prices or stocking rate and cost of gain. This result stems from the fact that the optimal stocking rate depends directly on forage availability. As forage availability varies widely across production years, a preferred stocking rate one year will give disastrous results in another year. For example, stocking rye pasture at 1.5 head per acre gives the lowest break-even price and cost of gain in

TABLE 1. SIMULATED WEIGHT GAIN AND COSTS FROM BACKGROUNDING STEERS ON RYE PASTURE, JAY, FLORIDA, 1973–83

Year		Head per acre		
		1.00	1.50	2.00
1973	WG[a]	188	148	79
	BE[b]	41.24	41.69	46.32
	CG[c]	25.94	23.65	35.59
1974	WG	188	186	133
	BE	48.32	45.01	47.59
	CG	36.73	26.19	28.97
1975	WG	173	106	65
	BE	30.61	30.35	32.18
	CG	43.60	50.33	76.24
1976	WG	188	125	56
	BE	33.90	33.81	36.50
	CG	40.80	43.91	78.52
1977	WG	188	151	79
	BE	36.10	34.54	37.46
	CG	41.10	36.68	56.68
1978	WG	188	167	97
	BE	41.97	39.70	43.20
	CG	40.63	32.90	45.58
1979	WG	130	35	22
	BE	71.73	82.29	84.89
	CG	60.30	161.02	256.21
1980	WG	188	185	134
	BE	78.63	74.96	79.88
	CG	45.57	33.50	37.41
1981	WG	188	180	115
	BE	70.59	67.03	72.96
	CG	50.70	38.50	48.94
1982	WG	188	188	156
	BE	65.92	61.29	62.31
	CG	53.59	39.12	38.43
1983	WG	188	188	161
	BE	64.64	59.95	60.31
	CG	54.15	39.49	37.55

[a]WG denotes weight gain per head in pounds and is adjusted for a 3 percent purchase shrink and a 1 percent sales shrink.

[b]BE denotes break-even price per hundredweight in nominal dollars.

[c]CG denotes cost of gain per hundredweight in nominal dollars.

years of ample forage production such as 1973, 74, 77, 78, 80, and 81. In 1979, rye production was quite small, and stocking at 1.5 head per acre meant that large quantities of hay had to be purchased. Hay purchases increased production costs so that the cost of gain at 1.5 head per acre was much higher than the cost of gain when stocked at 1.0 head per acre.

Results from summer grazing on millet exhibit characteristics similar to the winter grazing results. Weight gains decline as stocking rates increase. Millet, however, produces far more dry matter per acre than winter forages and can be grazed at higher stocking rates. When stocked at three head per acre, daily average weight gain averaged approximately one pound over the 11-year period.

Net revenues were calculated assuming the cattle were sold on the first day of the month following the grazing period. Three net revenue calculations were computed: (1) profits accruing to the integrated cattle producer who owns both the cattle and the pasture, (2) profits earned by the pasture owner who grows the pasture and works the cattle during the four- to five-month period and is paid a fixed price per pound of gain, and (3) profits accruing to the cattle owner who buys and sells the cattle and pays the pasture owner a fixed price per pound of weight gained. In order to conduct the stochastic dominance analysis, all three sets of profits were indexed to 1983 dollars by using the "Prices Paid by Farmers for Commodities and Services, Interest, Taxes and Wage Rates" index (USDA). Simulations for each pasture and stocking rate showed an average positive net profit for winter operations over the 11-year period. Simulations on summer millet pasture showed an average net loss for all stocking rates.

TABLE 2. SIMULATED WEIGHT GAIN AND COSTS FROM BACKGROUNDING STEERS ON RYEGRASS PASTURE, JAY, FLORIDA, 1973–83

Year		Head per acre			
		1.00	1.50	2.00	2.50
1973	WG[a]	244	219	167	102
	BE[b]	36.28	36.05	38.43	42.77
	CG[c]	15.97	13.00	12.91	19.70
1974	WG	244	227	188	123
	BE	42.92	41.31	42.59	46.87
	CG	24.49	18.73	18.04	23.37
1975	WG	137	56	43	32
	BE	33.29	35.56	36.53	37.18
	CG	57.08	110.31	143.44	189.30
1976	WG	244	225	165	100
	BE	29.73	27.58	28.87	31.45
	CG	27.96	21.89	24.10	34.07
1977	WG	239	197	123	82
	BE	32.29	31.27	33.83	36.59
	CG	29.54	25.88	33.47	49.40
1978	WG	189	116	60	39
	BE	41.62	44.57	48.77	51.67
	CG	39.03	50.67	88.75	142.09
1979	WG	244	238	183	116
	BE	58.06	55.55	59.14	65.70
	CG	28.78	21.40	22.56	30.60
1980	WG	244	244	224	182
	BE	71.26	67.97	68.42	72.27
	CG	32.51	23.82	21.22	22.62
1981	WG	244	241	193	125
	BE	64.05	60.65	63.54	70.39
	CG	36.80	27.39	28.04	37.59
1982	WG	244	244	224	177
	BE	60.00	56.04	55.82	58.99
	CG	39.53	29.09	25.99	28.57
1983	WG	244	244	244	217
	BE	57.87	54.03	52.12	53.16
	CG	38.56	28.43	23.37	22.86

[a]WG denotes weight gain per head in pounds and is adjusted for a 3 percent purchase shrink and a 1 percent sales shrink.

[b]BE denotes break-even price per hundredweight in nominal dollars.

[c]CG denotes cost of gain per hundredweight in nominal dollars.

Stochastic Dominance Analysis

The growth simulation analysis provided 11 observations of the distribution of net returns for rye and ryegrass production systems. A lack of forage data in 1982 for millet meant that 10 observations were available from millet pasture systems. These observations were ranked from smallest to largest.

First-degree stochastic dominance was unable to discriminate and ranked all winter grazing operations as elements of the undominated efficient set. This was because less risky operations (e.g., backgrounding one head per acre) lost less money in bad years and earned smaller profits in good years. The amounts of these losses and profits tended to increase as the stocking rates went up. Therefore, when any two enterprises were compared, their cumulative distribution functions intersected. Comparisons between forages at similar stocking rates indicated relatively little difference in the cumulative distribution functions except in profits earned in the best years.

For the winter grazing programs, second-degree stochastic dominance ranked ryegrass at 1.25, 1.5, 1.75, and 2 head per acre, and rye at 1.25, 1.5, and 1.75 head per acre as the undominated or preferred set of operations. No single forage-stocking rate combination dominated all others. Focus is centered on backgrounding on ryegrass at 2 head per acre since the average net revenue from this operation is higher than for any other.

Backgrounding on millet pasture over the summer months was estimated to be unprofitable, and losses were estimated to increase as the stocking rate increased. The primary cause for this failure was the general downward trend in prices from April to September. Prices decreased an average of 6.2 cents per pound between April and September. Due to the negative returns from backgrounding on millet pasture, no analysis was conducted regarding contract grazing on this forage.

TABLE 3. SIMULATED WEIGHT GAIN AND COSTS FROM BACKGROUNDING YEARLING STEERS ON MILLET PASTURE, JAY, FLORIDA, 1973–83

Year		Head per acre				
		1.50	2.00	2.50	3.00	3.50
1973	WG[a]	122	119	116	104	79
	BE[b]	51.36	51.04	50.96	51.84	54.14
	CG[c]	28.29	25.99	24.81	27.51	37.82
1974	WG	125	119	107	89	61
	BE	44.31	43.57	43.56	44.64	46.86
	CG	40.75	36.32	35.53	41.47	62.82
1975	WG	143	128	126	118	100
	BE	31.76	30.81	30.57	30.69	31.82
	CG	38.35	33.96	32.83	33.60	41.54
1976	WG	143	143	143	135	125
	BE	42.49	41.00	40.10	39.96	40.56
	CG	36.84	29.60	25.25	23.68	25.57
1977	WG	143	143	143	140	129
	BE	41.72	40.22	39.31	38.89	39.49
	CG	37.72	29.99	25.62	23.20	25.18
1978	WG	143	142	126	116	110
	BE	54.62	53.21	53.47	53.70	54.90
	CG	38.05	30.86	29.74	28.65	34.55
1979	WG	143	143	143	131	122
	BE	88.38	86.79	85.84	86.69	87.95
	CG	39.43	31.72	27.10	26.21	28.15
1980	WG	143	143	143	141	130
	BE	66.61	64.88	63.85	63.33	64.33
	CG	43.75	35.37	30.33	27.36	29.68
1981	WG	143	142	126	116	118
	BE	70.50	68.78	69.17	69.52	70.07
	CG	48.39	39.59	38.43	37.27	41.29
1982[d]						
1983	WG	143	143	128	117	112
	BE	70.52	68.58	68.89	69.21	70.61
	CG	51.37	41.87	40.41	39.57	46.72

[a]WG denotes weight gain per head in pounds and is adjusted for a 3 percent purchase shrink and a 1 percent sales shrink.

[b]BE denotes break-even price per hundredweight in nominal dollars.

[c]CG denotes cost of gain per hundredweight in nominal dollars.

[d]No analysis conducted because of lack of forage data.

Results for Contract Grazing

Table 4 shows estimated net returns, in nominal dollars, for each type of participant when ryegrass is stocked at 2 head per acre. Nominal net revenues for those engaged in contract grazing are shown for prices per pound of gain of 35, 40, and 45 cents.[3]

Net revenues for cattle and pasture owners involved in contract grazing depend directly on the negotiated price per pound of gain the cattle owner pays the pasture owner. Once this price is determined, the pasture owner is concerned primarily with weight gain, while the cattle owner hopes for increases in cattle prices over the grazing period. The analysis indicates that for operations stocked at 2 head per acre on ryegrass, cattle owners can pay up to 46 cents per pound of gain and still realize average positive net returns, while pasture owners can earn a positive average profit receiving as little as 29 cents per pound of gain. Average profits for each participant were estimated to be approximately equal at 38 cents per pound of gain. When the size of the operation is 200 head placed on 100 acres and the contract price is 38 cents, the cattle owner earns a yearly average of $4,159 and the pasture owner earns $4,588. Standard deviations of the average net revenues for the two at 38 cents per pound of gain are $20,955 for the cattle owner and $9,818 for the pasture owner.

Contract grazing splits the risk of the integrated cattle producer between the cattle and pasture owners. The cattle owner assumes the risks of price fluctuations in the market, while the pasture owner takes on the risks of putting sufficient weight on the animals. In a contract grazing arrangement, the cattle owner passes on any losses due to poor pasture, but is exposed to the additional risk of large losses in years when weight gain is large, and the selling price in the spring is much lower than fall purchase prices. This occurs twice over the period of study, in 1974 and 1981, when losses to the cattle owner are the largest of any participant at any time. For the integrated producer, the loss due to the drop in prices is at least partially mitigated by the relatively large weight gain.

Risk for the pasture owner appears considerably less than for the cattle owner. The coefficient of variation (c.v.) resulting from the fluctuation of differences between purchase and selling prices (c.v. = 1021) is much greater than the coefficient of variation determined by changes in weight gain (c.v. = 38). Coefficient of variation values from the fluctuations in net revenues when the contract price is 38 cents per pound gain are also higher for the cattle owner (c.v. = 503) than for the pasture owner (c.v. = 214).

TABLE 4. NET REVENUES ON RYEGRASS PASTURE STOCKING AT TWO HEAD PER ACRE, 1973-1983

Year	Integrated producer	Cattle owner: Paying 35¢ per lb. of gain	Cattle owner: Paying 40¢ per lb of gain	Cattle owner: Paying 45¢ per lb. of gain	Pasture owner: Receiving 35¢ per lb. of gain	Pasture owner: Receiving 40¢ per lb. of gain	Pasture owner: Receiving 45¢ per lb. of gain
	Dollars						
1973[a]	16,524[b]	9,480	7,810	6,140	7,044	8,714	10,384
1974[a]	-8,944	-15,322	-17,202	-19,082	6,378	8,258	10,138
1975[a]	-9,298	-90	-520	-950	-9,208	-8,778	-8,348
1976[a]	10,342	6,744	5,094	3,444	3,596	5,248	6,898
1977[a]	1,230	852	-378	-1,608	378	1,608	2,838
1978[a]	13,050	19,500	18,900	18,300	-6,450	-5,850	-5,250
1979[a]	38,286	33,734	31,904	30,074	4,552	6,382	8,212
1980[a]	-8,032	-14,206	-16,446	-18,636	6,174	8,414	10,654
1981[a]	-2,996	-5,682	-7,612	-9,542	2,886	4,616	6,546
1982[a]	5,266	1,230	-1,010	-3,250	4,036	6,276	8,516
1983[a]	11,460	5,784	3,344	904	5,676	8,116	10,556
Average[c]	8,747	5,566	3,221	875	3,181	5,526	7,872
Average[c] per head	43.74	27.83	16.10	4.37	15.90	27.63	39.36

[a]Nominal dollars.

[b]These values are for 200 head on 100 acres.

[c]Adjusted to 1983 dollars.

[3]This is the range of prices per pound of gain most often observed among commercial operations in the study area.

Contract Grazing Versus Integrated Cattle Production

Second-degree stochastic dominance indicated that the integrated cattle-producing operation dominates owning the cattle in a contract grazing agreement for every cost of gain price above 37 cents per pound. At weight gain prices less than 18 cents per pound, owning the cattle in a contract grazing arrangement is preferred. Owning pasture in a contract grazing agreement is preferred to integrated cattle production for weight gain prices above 45 cents per pound. Integrated cattle production dominates pasture owning at weight gain prices of 8 cents per pound or less.

Integrated cattle production is not dominated by owning the cattle in a contract grazing operation for most reasonable weight gain prices because the profits for the integrated cattle producer are much larger while the risk, as indicated by the standard deviation of net returns, is nearly the same. When 100 acres of ryegrass are stocked at 2 head per acre, the standard deviation of net revenues for the integrated cattle producer is $21,761, while for the cattle owner, paying 38 cents per pound of gain, the standard deviation of net returns is $20,925. Average annual profits for the integrated cattle producer are $8,563, while the cattle owner earns an average annual profit of $4,298 after paying the pasture owner 37 cents per pound of gain.

Integrated cattle production fails to dominate owning pasture in a contract grazing arrangement at plausible weight gain prices because the riskiness of integrated cattle production is much greater. The integrated cattle producer has an estimated 36 percent chance of losing money in any given year, while the pasture owner has only a 18 percent chance, and the cattle owner, 36 percent. This is not unexpected since contract grazing splits the risk between cattle and pasture owners, with the cattle owner assuming the largest share.

Pasture owners have a smaller chance of losing money than integrated cattle producers because the only risk that the pasture owner faces is growing sufficient forage, while the integrated cattle producer faces this uncertainty as well as the larger risk of decreasing cattle prices. In years of poor pasture the pasture owner can cut his losses through supplemental feed; whereas, for the integrated cattle producer (and the cattle owner), nothing can help a sharp decrease in cattle prices.

Pasture owning dominates integrated cattle production at weight gain prices of about 45 cents per pound when stocking rates are 2 head per acre. The critical weight gain price at which point the preferred operation changes from integrated cattle production to pasture owning tends to vary directly with the stocking rate, with 40 cents per pound being the critical price at 1 head per acre and 47 cents per pound at 2.5 head per acre.

CONCLUDING REMARKS

Results from the simulation model indicated that backgrounding over the winter on either rye or ryegrass forage was a profitable enterprise. While net revenues were estimated to be highest for the operation on ryegrass forage stocked at 2 head per acre, second-degree stochastic dominance ranked backgrounding operations on rye and ryegrass at several stocking rates as members of the undominated set. No one operation was able to dominate the others by second-degree stochastic dominance. Summer grazing on millet was not profitable at any stocking rate. Profits for the integrated cattle producer were primarily dependent on changes in cattle prices and, to a lesser extent, on weight gain and backgrounding costs.

Since weight gain prices are agreed to before the start of backgrounding operations, risks for contract grazing participants lie in cattle prices for the cattle owner and weight gain for the pasture owner. Cattle owners are counting on the general upward trend in cattle prices over the winter, while pasture owners hope to grow enough forage to put sufficient weights on the animals.

Second-degree stochastic dominance indicated that integrated cattle production is preferred to owning pasture in a contract grazing arrangement for all weight gain prices of 8 cents per pound or less, and integrated cattle production is preferred to owning the cattle as a contract grazer for all weight gain prices exceeding 37 cents per pound.

These results would indicate that the "supply" of pasture owners should exceed the "demand" by cattle owners. That is, cattle owners with land available for integrated cattle production should take that approach for backgrounding cattle, while pasture owners should only be able to find cattle owners for contract grazing who have no such land available. Such cattle owners might be found in southern Florida, parts of Texas and New Mexico, and the upper south where it is difficult to cultivate winter forage due to weather and/or soil conditions. It is likely, however, that many pasture owners will have to purchase cattle if they wish to participate in a backgrounding enterprise.

Although specific forages and grazing periods may differ, it is likely that the results of this analysis are applicable to other southeastern states. Contract grazing offers a promising alternative to southeastern farmers with idle land during the cool season and who lack the resources to be an integrated backgrounding operator. At current prices, the required initial investment to background 200 steers on 100 acres of ryegrass pasture is nearly $60,000 for animal purchase and forage cultivation. The initial investment for a pasture owner, however, is approximately $10,000 to produce 100 acres of ryegrass. Lower initial cash outlay makes participating as a pasture owner in a contract grazing arrangement more accessible to many producers.

In this analysis, the cattle owner's profits are based on cash market prices for feeder cattle. Through the use of feeder cattle futures or forward contracting, the cattle owner may be able to reduce the high variability in his net returns. Ward and Schimkat discuss the use of feeder cattle futures to reduce the price risk faced by Florida cattle producers. They conclude that basis patterns play a major role in the potential effectiveness of feeder cattle futures in the reduction of price risk. Strategic hedging of feeder cattle by cattle owners and its effect on the profits of contract grazing participants is a possible direction for future research.

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