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Expected Utility Analysis of Stocker Cattle Ownership Versus Contract Grazing in the Southeast

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Stocker cattle ownership is compared to contract grazing using stochastic simulation. Returns are evaluated for both cattle owners and caretakers in contract grazing agreements. For caretakers, contract grazing is significantly less risky than cattle ownership. Slightly to moderately risk-averse caretakers could be expected to prefer some type of contract grazing to direct ownership of cattle. For cattle owners, contracting reduces risk only slightly while significantly reducing expected returns.

Key Words: contracts, expected utility, grazing, stocker calves

JEL Classifications: Q0, L1

With a temperate climate, abundant forage, and an extensive marketing infrastructure, the southeastern United States is well-suited to beef cattle production. Traditionally, most beef operations in the Southeast have been oriented toward cow/calf production, with calves being sold at or shortly after weaning; however, grazing stocker calves is also an important enterprise for a significant number of producers.

Statistics on the size of the southeastern stocker grazing/backgrounding industry are not readily available. In any case, the stocker industry is likely not as large as it could be. Each fall, thousands of Southeastern calves are shipped to wheat pastures and feedlots in the High Plains. Table 1 provides some evidence regarding the extent of stocker grazing/backgrounding activities in the Southeast. It appears from the information summarized in this Table that in most southern states a relatively small percentage of calves (other than replacement heifers) remain on the farm after weaning. For example, the number of stocker/feeder steers and heifers on farms in Florida on January 1, 2002, represented just over 5% of the previous year's calf crop. For Virginia, that percentage was 34%, the highest for the 11 southeastern states reported here.

Stocker grazing/backgrounding represents a relatively simple means of adding value to calves; however, it is a value-adding opportunity that many producers may not view as attractive for a number of reasons. Cash flow obligations may compel some producers to sell calves at weaning; other producers may lack access to capital required to purchase calves. Producers may also view grazing/backgrounding as too risky—particularly if money must be borrowed to purchase calves or if loan payments must be deferred to retain calves.

In view of the capital constraints facing

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Table 1. Cattle and Calf Inventory in Selected Southern States: January 1, 2002

State	Number of Operations	Beef Cows (1,000)	2001 Calf Crop (1,000)	≥500-lb Calves		≥500-lb Calves as % of Calf Crop
				Steers (1,000)	Heifers[a] (1,000)	
AL	25,000	750	680	60	41	14.9%
AR	27,000	927	820	145	65	25.6
FL	16,500	958	940	25	25	5.3
GA	21,000	594	580	40	30	12.1
KY	39,000	1,485	1,080	215	100	29.2
LA	13,200	466	405	24	17	10.1
MS	21,000	576	540	55	27	15.2
NC	22,000	434	450	43	20	14.0
SC	10,000	210	185	13	13	14.1
TN	45,000	1,060	1,050	118	75	18.4
VA	22,000	690	720	175	70	34.0
U.S. Total	814,400	33,099.7	38,280.8	16,799.8	10,057.1	
South as % of U.S.	32.1%	24.6%	19.5%	5.4%	4.8%	

Source: *Cattle*. USDA-NASS, Washington, DC, February 1, 2002.
[a] Excludes heifers retained as replacements.

many producers, contract grazing of stocker calves is a production alternative that may have much appeal in the Southeast. Under this system, a cattle owner contracts with a caretaker to graze cattle on pasture that is owned or leased by the caretaker. This paper will examine various contractual arrangements and grazing fee rates from the perspective of both the cattle owner and the pasture owner/renter. The impact of different contract terms on returns over variable costs for each of these parties will be calculated. The effect of risk on grazing decisions will be accounted for in the analysis by calculating certainty equivalents (*CE*) for both cattle and pasture owners assuming varying degrees of risk aversion. The objective of this research is to provide useful insight into the following questions (posed from the perspective of both the cattle owner and the pasture owner/renter): Is a cattle owner better off putting cattle out for grazing under contract or renting pasture and overseeing the grazing himself or herself? Is a pasture owner/renter better off grazing someone else's cattle under contract (as a caretaker) or purchasing his or her own cattle to graze?

Use of Contracts in Livestock Production

The use of contracts in livestock production has been widespread since at least the 1950s. Contracting has undoubtedly been more common in the poultry industry than in the beef or pork industries; however, contract pork production has increased dramatically in recent years (McBride and Key). Contracting in the beef industry has been less prevalent than in either the pork or poultry industries, though the practice in the fed cattle sector has fostered a great deal of debate (e.g., see Ward et al.).

Contracts can be classified as one of two general types: marketing contracts or production contracts. A marketing contract represents an agreement between a contractor (buyer) and a producer (seller) that establishes a price (or method for determining price) and other terms and conditions under which a product will be exchanged. Production contracts establish which inputs into the production process will be provided by the contractor and which will be provided by the producer. The contractor also specifies how the producer will be compensated for his contribution to the production process.

Johnson et al. examine the use of contracts by farmers using data from United States Department of Agriculture's farm costs and returns survey. They found that in 1993, only 2% of cattle farms used either marketing or production contracts. The value of production under both

types of contract represented 23% of the value of production on these farms. By contrast, nearly 89% of poultry farms used contracts, and some type of contractual arrangement covered 86% of the total value of production on poultry farms. Perry and Banker report that in 1998, 25.3% of the total value of cattle production was produced or sold (or both) under some type of contract. This compares with 42.9% of the value of hog production and 94.9% of the value of poultry production.

Several authors have noted the advantages of contracting for farmers producing a crop under contract (e.g., see Johnson et al. and Sporleder). In general, contracts allow producers and contractors to share risks, either production risks or marketing risks or both. To the extent that contracts reduce risks, they contribute stability to a producer's income. Contracts may also give producers access to technology and technical expertise that they would not have access to on their own. Such technological advantages improve the efficiency of production. McBride and Key note that in hog production, adoption of production contracts raised productivity by an average of over 20%. Finally, contracting often benefits producers whose access to capital is limited. In some cases, contracts may improve the producer's creditworthiness by reducing risks. More importantly, production contracts generally specify that a significant portion of inputs will be provided by the contractor, thus significantly reducing the producer's need for capital and relieving some cash flow burdens.[1]

Of course, contracts are not without their disadvantages. Clearly, the reduction in risk accompanying the use of contracts will most generally be expected to come at the expense of lower average returns. In addition, the use of contracts—particularly production contracts—will require the producer to give up some degree of autonomy. Finally, producers who depend on contract production to ensure sufficient income to pay for investments in facilities or equipment (or both) may find it difficult to ever terminate the contractual arrangement. Even worse, if the contractor decides to terminate the contract, producers may find themselves with no way to service debt on highly fixed assets.

Contract Grazing

Contract grazing arrangements would generally fall under the category of production contracts. In a typical contract grazing arrangement, a cattle owner contracts with a caretaker to turn calves out on pasture owned or leased by the caretaker. The caretaker is paid a yardage fee (a flat charge per day that the animal is on pasture under the caretaker's management), a set amount per pound of gain, or some combination of both. Any number of arrangements are possible regarding which inputs will be provided by the owner, which by the caretaker, and who will bear the cost of death loss. These and any other negotiated items should be clearly spelled out in a written contract (Doye, Kletke, and Coe).

Relatively little academic work has been done on the issue of contract grazing. In a related vein, May et al. look at pasture rental agreements from a resource management perspective, investigating how different pasture rental arrangements affect stocking rate decisions. They find that per acre agreements result in 2% higher stocking rates than per head lease rates.

[1] All of the contracting advantages and disadvantages mentioned here are present to some degree for one or both parties (i.e., cattle owners and caretakers—who may both be considered producers) to a grazing contract. Most grazing contracts result in both parties bearing some production risk, whereas marketing risk generally remains with the cattle owner. Contract grazing may also result in more stable income, especially for caretakers since they receive an income that is independent of relatively variable cattle prices. As for technology and technical assistance, caretakers benefit if they graze cattle with superior genetics or cattle that have had superior preweaning management to what they could have provided on their own. Cattle owners, likewise, may benefit from better forage and grazing management provided by a caretaker. Finally, contract grazing likely helps both parties reduce the impact of capital constraints. Caretakers do not require the capital necessary to purchase calves for grazing, and cattle owners do not require direct control of the land, facilities, and equipment necessary to support all of the cattle they own.

Johnson, Spreen, and Hewitt compare contract grazing to integrated production. Using stochastic dominance techniques, they find that from a pasture owner's perspective, contract grazing dominates cattle ownership at any per pound of gain payment rate greater than \$0.45. At a payment rate of less than \$0.08/lb. of gain, owning cattle dominated contract production from the pasture owner's perspective. This results in a wide range of payment rates over which the preferred alternative is indeterminate.

In a similar study, Harrison et al. find that contract grazing significantly reduces risks for pasture owners but not for cattle owners. This finding is broadly consistent with Johnson, Spreen, and Hewitt. Both of these studies are limited to considering contracts for which payment is made on a per pound of gain basis. Moreover, although different payment rates are considered, contracts do not differ in terms of who is providing various inputs (cattle owner or pasture owner).

Teegerstrom et al. investigate several different ownership options for cattle producers. Using decision theory analysis to compare cow/calf production, ownership of summer stocker calves, and contract grazing, they find that the optimal alternative could be cow/calf production or contract grazing, depending on the criteria used to evaluate the decision. They also use portfolio analysis to define the optimal combination of pasture rental (i.e., renting owned pasture to somebody else), contract grazing, summer stocker ownership, and cow/calf production. With this approach, they find that for slightly to moderately risk-averse producers, the optimal portfolio consists of renting pasture to somebody else and contract grazing. As risk aversion increases beyond that level, renting out pasture becomes the only activity in the optimal portfolio.

This study will compare various contract grazing arrangements with stocker ownership and extend the existing literature on the subject by considering the issue from the perspective of both the caretaker (i.e., pasture owner) and the cattle owner. Moreover, several different contract arrangements will be evaluated to determine how the level and variability of returns are affected by different payment rates as well as contract terms and conditions (i.e., method of payment and division of input costs between cattle owner and caretaker).

Data and Methods

Stochastic simulation using winter grazing enterprise budgets is used to generate 500 observations on returns over variable costs (*RVC*) for stocker ownership and four different contracting options for both cattle owners and caretakers.[2] Grazing returns are primarily influenced by cattle prices (in the case of stocker ownership) and by cattle performance (reflected in average daily gain and death loss). These parameters are varied within a winter grazing budget from the University of Georgia Agricultural Economics Department to simulate the 500 *RVC* observations. Table 2 summarizes the grazing budget used in this study. Contracting options differ in the rate and method of payment as well as in which costs are paid by the cattle owner and which by the caretaker. In all simulations, budgets assume that 150 head of 400-pound steers are placed on winter annual pasture. Also, for each contracting option, the same set of simulated prices, average daily gain (*ADG*), and death loss (*DL*) values are used. Table 3 summarizes the four contracting options compared in this study.

An empirical distribution of *ADG* was used in simulating *RVC* values. *ADG* values were derived from 13 gain/acre figures recorded in stocker grazing trials in central Mississippi from 1975 through 1988. To convert gain/acre values into *ADG* values, a stocking rate of 1.5 head per acre and a grazing period of 170 days were assumed. These stocking rate and grazing period values are consistent with the pro-

[2] Contract terms and conditions used in this study were developed by the authors, in consultation with industry professionals, to be consistent with the payment methods and rates observed within the stocker grazing industry in the Southeast. These specific contracts were chosen to allow investigation of the effects on outcomes not only of different payment rates but also of different contract terms (i.e., who pays for various production inputs).

Table 2. Enterprise Budget for Temporary Winter Grazing in Southeastern United States

Number of Acres	100.00	Paywgt. to Paywgt. ADG (lbs/day)	2.25
Stocking Rate (Head/Acre)	1.50	Gain per Head	3.83
Number of Calves Sold	147	Grazing Fee Rate ($/cwt Gain)	35.00
Death Loss (%)	2.00	Grazing Fee Rate ($/Head/Month)	2.00
Number of Calves Placed	150	Exp. Feeder Cattle Price ($/cwt)	$68.43
Feeding Period (Days)	170		
In Weight (cwt)	4.00		

Item			Total	Unit	Total	Contract 1	
Variable Costs:	Unit	Units per hd	Quantity (units)	Price ($/unit)	Amount Ownership	Caretaker	Cattle Owner
Calf	Cwt	4.00	600	$84.61	$50,766	$0	$50,766
Procurement Costs	Head	1.00	150	$3.76	$564	$0	$564
Winter Forage	Acre	0.67	100	$73.88	$7,388	$7,388	$0
Hay	Ton	0.25	37	$55.00	$2,021	$2,021	$0
Receiving Ration	Cwt	1.40	206	$10.00	$2,058	$2,058	$0
Minerals	Lbs	25.00	3,675	$0.15	$551	$0	$551
Medication	Head	1.00	150	$10.00	$1,500	$0	$1,500
Growth Stimulant	Implant	1.00	150	$1.00	$150	$0	$150
Repairs	Head	1.00	147	$0.80	$118	$118	$0
Land Rental/Grazing Fees	Acre	0.67	100	$20.00	$2,000	$2,000	$21,346
Labor	Hrs	1.00	147	$6.00	$882	$882	$0
Caretaker's Death Loss	$		383	$0.00	$0	$803	−$803
Interest on Operating Capital	$		67,999	$0.06	$1,900	$404	$1,496
Total Variable Cost					$69,899	$15,675	$75,570
Expected Returns		147 head sold					

Exp. Total Gain (cwt/hd)	Total Weight Sold (cwt)		Total Returns	Returns over Variable Costs: Caretaker	Owner
3.83	562.28	Ownership	$80,324	$10,425	
		Contract 1	$21,346	$5,671	$4,754

Note: ADG is average daily gain.

Table 3. Four Alternative Contract Grazing Agreements

Payment Provisions	Contract 1	Contract 2	Contract 3	Contract 4
$/Head/Month	$2.00	N/A	N/A	$14.00
$/cwt of Gain	$35.00	$40.00	$42.50	N/A
Death Loss Covered by Cattle Owner	0%	2%	0%	0%
Supplemental Feed Paid by	Caretaker	Caretaker	Caretaker	Owner
Minerals Paid by	Owner	Caretaker	Caretaker	Owner
Medication & Implants Paid by	Owner	Owner	Caretaker	Owner

duction practices used in the Mississippi grazing trials. In the simulation, *ADG* values were randomly drawn from this empirical distribution.

Prices used in the simulation consist of monthly average Georgia auction market prices from 1991 through 2003—a period of time roughly corresponding to the last cattle cycle. These prices were obtained from the Livestock Marketing Information Center. To calculate *RVC* from winter grazing, two prices are required: a fall stocker calf price and a spring feeder calf price. In this simulation, an October–November average price for 400–500-lb. steers was used along with a May average price for 700–800-lb. steers.[3,4] These prices were used to define the parameters of two log-normal price distributions. Five hundred stocker and feeder prices were simulated from these distributions. The two price series were correlated using a procedure adapted from Naylor et al., which uses information in the covariance matrix to correlate random variables from a multivariate normal distribution. (For a detailed explanation and justification of this procedure, see Krzanowski, pp. 204–205. For additional applications of the procedure see Anderson, Coble, and Miller; Clements, Mapp, and Eidman; and Trapp.)

A death loss series for a winter grazing program was not available for use in this study. To generate a stochastic series for death loss, a gamma distribution with a mean of 2% and a standard deviation of 0.75 was used [$\Gamma(\alpha = 5.33, \beta = 0.375)$]. For the 500 simulated observations, this distribution resulted in death loss values ranging from 0.30% to 5.37% with a mean of 2.00%. Table 4 provides descriptive statistics on the price and *ADG* data used in developing the simulation model for this study.

The grazing enterprise budgets used in this study assume that some supplemental feeding is required, including a starter ration and some hay. Although starter ration expense may be fairly consistent from year to year, supplemental hay expense likely varies from year to year

[3] An October-to-November average stocker calf price is used to reflect the fact that a set of stocker calves for grazing is often put together from purchases made over several weeks. Conversely, at the end of the grazing period, calves are generally sold at one time.

[4] In the budget used to calculate returns for this study, a stocking rate of 1.5 head per acre and a grazing period of 170 days were assumed. Since average daily gain is varied in the simulation of returns, steer ending weights are not constant. A price slide of $5/cwt is used to adjust the sales price on calves weighing more or less than 750 lbs. The average difference between the May price of 600–700-lb. calves and 700–800-lb. calves in the price data used for this study was $5.04/cwt.

Table 4. Description of Price and Production Data Used in Comparing Stocker Ownership and Contracting Options

Data Series	Average	SD	Minimum	Maximum
Stocker Price	$84.61	13.83	$58.58	105.02
Feeder Price	$68.43	9.76	$44.26	$81.20
Average Daily Gain	2.26	0.39	1.54	2.83

depending on pasture conditions (influenced primarily, of course, by weather). In the simulation, these expenses are not varied. Likewise, there may be some correlation between *ADG* and hay expense. Data were not available for incorporating this hypothesized correlation into the simulation. For that reason, feed expense is not stochastic in this simulation.[5]

To rank alternative grazing arrangements for cattle owners and caretakers of varying risk aversion levels, a constant absolute risk aversion (*CARA*) utility function is used to convert *RVC* values to utility estimates. The *CARA* utility function is represented mathematically as

$$(1) \qquad E(U)_r = \frac{1}{n}\sum_{i=1}^{n}(1 - e)^{-rW_i},$$

where $W_i = W_0 + RVC_i$, r is a coefficient of absolute risk aversion, and n is the total number of observations (500). Simulated ending wealth is represented by W_i, and initial wealth is represented by W_0.[6] Utility values are calculated for absolute risk-aversion coefficients ranging from zero (risk neutral) to 7.7×10^{-5}.[7]

For a given level of utility and a given risk-aversion coefficient, it is possible to calculate a *CE* by solving Equation (1) for *RVC*. The *CE* represents the lowest sure price for which a decision maker would be willing to sell a risky prospect (Hardaker, Huirne, and Anderson). For any two alternatives i and j, if $CE_i > CE_j$, then alternative i is preferred to j. The equations for determining the *CE* for a given risk-aversion coefficient (CE_r) is given below:

$$(2) \qquad CE_r = \frac{\ln(1 - \bar{U})}{-r} - W_0,$$

where $\bar{U}$ is a value for utility calculated from Equation (1) above, and all other variables are as previously defined.

Results

A summary of the simulated *RVC* values is presented in Table 5. Note that, not surprisingly, direct ownership (i.e., owning stockers that are grazed on owned or rented pasture) results in higher returns than any of the contracting options for cattle owners. It also results in the most variable returns. It is worth noting, however, that (still from the cattle owner's perspective) the downside risk is greater under contracting. The minimum return is higher with direct ownership than for any contracting option. From the caretaker's perspective, contract 2 results in the highest average returns. From the cattle owner's perspective, of the four contracting options, contract 4 results in the highest average returns.

From the cattle owner's perspective, none of the contracting options examined here compare very favorably with grazing owned cattle on owned (or rented) pasture, even for a very risk-averse individual. Owning stocker calves yields an average return over variable costs for the cattle owner of $6,206, whereas the most favorable contract yields a return of $5,261 with essentially the same level of variability. All of the contract terms considered result in a fairly small reduction in the variability of returns but fairly large reductions in mean returns.[8] For example, for the cattle owner, contract 1 reduces average returns by over $5,500 (compared to grazing owned cattle on owned/

[5] In this analysis, it may be assumed that the "cost" of adverse weather or poor pasture conditions (or both) is reduced average daily gain. If supplemental feed is used in bad years to maintain average daily gain, then the cost of adverse weather is higher feed expense. Because of this trade-off, including feed expense as a stochastic variable would be unlikely to significantly affect results.

[6] Reported results are for an initial wealth of zero. Results do not significantly change over a range of initial wealth from zero to $200,000.

[7] Babcock, Choi, and Feinerman present a method for relating the coefficient of absolute risk aversion to the size of a given risky outcome (or gamble). They use the standard deviation of net returns as an approximation of gamble size. Following their approach, the risk-aversion coefficients of 7.7×10^{-5} corresponds to a risk premium of 25% of the gamble size. (The standard deviation of returns over variable costs for grazing owned cattle on owned/leased pasture is $6,678.)

[8] This is not a surprising result. Returns to key factors of production (land, labor, and management) are now going to somebody else (i.e., the caretaker), but the cattle owner is still subject to all risks associated with cattle prices.

Table 5. Simulated Return Over Variable Cost Estimates for Stocker Ownership and Contracting Options

	Own Stockers	Contract 1		Contract 2		Contract 3		Contract 4	
		Caretaker	Owner	Caretaker	Owner	Caretaker	Owner	Caretaker	Owner
Mean	$6,206	$5,757	$449	$6,349	−$143	$5,324	$881	$945	$5,261
SD	6,678	3,082	6,289	3,499	6,349	3,702	6,464	97	6,663
Minimum	−13,581	−1,564	−16,815	−1,818	−17,466	−3,375	−16,621	550	−14,492
Maximum	27,371	11,574	19,172	12866	18,505	12,690	19,661	1,128	26,314

Note: $N = 500$.

rented pasture); however, the standard deviation of returns declines by only about $400. For caretakers, contract 2 appears to dominate all other alternatives, having a considerably higher mean *RVC* than either cattle ownership or any other contracting option. The standard deviation of returns is lower for contract 2 than for cattle ownership or for contract 3.[9]

A clearer comparison of all of the grazing alternatives is possible with the calculation of certainty equivalents. Figure 1 presents *CE* values [calculated using Equation (2)] for the caretaker. From the caretaker's perspective, direct ownership is preferred to contract 1 for risk-aversion coefficient below 2.6×10^{-5} (risk premium about 9% of gamble size). Direct ownership is preferred to contract 3 for absolute risk-aversion coefficients out to 6.1×10^{-5} (risk premium about 20% of gamble size). Contract 4 is never preferred to any of the other alternatives for any level of risk aversion considered here. From the cattle owner's perspective, the ranking of alternatives does not change over the range of absolute risk-aversion coefficients considered here. From the cattle owner's perspective, the order of preference among the alternatives considered here is direct ownership, contract 4, contract 3, contract 1, and contract 2.

[9] The wide discrepancy in returns to the caretaker and cattle owner reported in Table 5 may seem unreasonable in an efficient market. However, a couple of other factors must be considered. First, since costs are charged for land and capital in these budgets, the bulk of net returns should be viewed as a return to operator labor and management, most of which is provided by the caretaker. Second, caretakers and cattle owners may often have different objective functions. A cattle owner most likely maintains ownership of the cattle beyond the end of the grazing enterprise (i.e., through finishing). The objective of the cattle owner is not necessarily to maximize profits from the grazing enterprise but to maximize profits over the entire period of ownership. Utilizing contract grazing may provide benefits (e.g., greater flexibility in the timing of calf purchases and fed cattle sales) that are realized as higher profits from the finishing enterprise. On the other hand, a caretaker is most likely only involved in the grazing enterprise. This difference in objectives could help to explain how large discrepancies in returns could persist over time in the contract grazing enterprise.

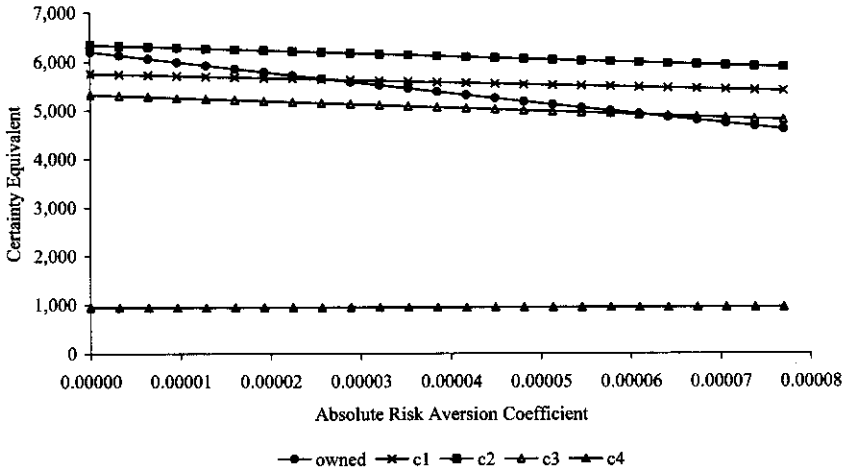

Figure 1. Simulated Certainty Equivalents of Return over Variable Costs to the Cattle Caretaker from Stocker Ownership and Contracting Options

Table 6. Impact of Grazing Fee on Caretaker and Cattle Owner Certainty Equivalents

Grazing Fee ($/cwt of gain)	Caretaker	Cattle Owner
$18.00	−587	5,873
18.50	−309	5,593
19.00	−30	**5,312**
19.50	248	**5,031**
20.00	527	4,751
20.50	805	4,470
21.00	1,083	4,189
21.50	1,362	3,908
22.00	1,640	3,627
22.50	1,918	3,346
23.00	2,196	3,065
23.50	2,473	2,784
24.00	2,751	2,502
24.50	3,029	2,221
25.00	3,306	1,939
25.50	3,584	1,658
26.00	3,861	1,376
26.50	4,139	1,094
27.00	4,416	812
27.50	4,693	530
28.00	**4,970**	248
28.50	**5,247**	−34
29.00	5,524	−316
29.50	5,801	−598

Note: Coefficient of absolute risk aversion is $r = 4.52 \times 10^{-5}$. Certainty equivalent for ownership of calves and ownership/rental of pasture is $5,239.

Analysis of Alternative Contract Rates and Terms

Sensitivity analysis was conducted to determine a grazing fee that would leave the decision maker (cattle owner or caretaker) indifferent between ownership and contracting. In the contractual arrangement used for this portion of the analysis, all medical and supplemental feed expenses are paid by the cattle owner. To conduct this sensitivity analysis, *CE*s were calculated, again from 500 simulated observations on *RVC*, at a series of different grazing fee rates. Table 6 presents calculated *CE* values from the caretaker's and the cattle owner's perspective. Results are presented for the *CARA* coefficient $r = 4.52 \times 10^{-5}$ (corresponding to a risk premium of 15% of the gamble size). Note that the *CE* for grazing owned cattle on owned/rented pasture is $5,239. Bold numbers in the Table highlight the rental rates that result in approximately that same *CE* for the caretaker and for the cattle owner operating under contract.

These results illustrate a potential difficulty in establishing contract grazing arrangements. From the caretaker's perspective, a risk-averse caretaker would prefer to own cattle rather than graze somebody else's cattle under contract at any grazing fee of less than approximately $28.00 per hundredweight of gain. On

Table 7. Break-Even Grazing Fees for Cattle Owners and Caretakers Under Terms of Contract 1

	Owner's Break-Even Grazing Fee	Caretaker's Break-Even Grazing Fee	Equal Return Grazing Fee
Average	$39.02	$28.42	$30.80
SD	11.31	4.78	4.89
Minimum	4.87	21.04	20.93
Maximum	74.81	43.27	47.47

Note: All grazing fees given in $/cwt of gain.

the other hand, a similarly risk-averse cattle owner would prefer turning cattle out onto owned (or leased) pasture to grazing under contract at any grazing fee of greater than about $19.50 per hundredweight of gain. In short, it seems that, in general, there is quite a large discrepancy between the level of grazing fee that makes contract grazing attractive to a potential caretaker and that that makes contract grazing attractive to a cattle owner.

Clearly, it is important not to apply this principle too rigidly. Otherwise, one would assume that contract grazing should never occur. A number of factors other than the grazing fee also affect contract grazing decisions. Cattle owners may face land and management (i.e., time) constraints that make it impossible for them to graze all of their cattle on owned or leased land. Likewise, pasture owners may face capital constraints that make it impossible for them to own cattle (or as many cattle as they need to fully utilize their land resource). In each of these cases, contracting could be an attractive option.

A final simulation was conducted to determine the impact of market price and animal performance on grazing fees. In this analysis, a break-even grazing fee was calculated for both the cattle owner and the caretaker for contract 1 (from Table 2) using the 500 simulated cattle prices, *ADG*, and death loss values. The difference between the cattle owner's break-even grazing fee and the caretaker's break-even grazing fee represents profits to the entire system. These profits (or losses) were allocated between the cattle owner and the caretaker according to the share of total variable costs paid by each. In this manner an "equal-return" grazing fee was estimated for each of the 500 simulated observations. The results of this simulation are summarized in Table 7. The most notable feature of these results is that, on average, the cattle owner's break-even grazing fee rate is higher than the caretaker's break-even grazing fee rate. This indicates that, on average, grazing is profitable, and the potential does exist for both parties to profit from contract arrangements. This result emphasizes the point made earlier that even though contract grazing may not yield a level of returns (or utility) equal to grazing owned cattle on owned/rented pasture, it may still be advantageous for cattle owners or caretakers dealing with binding capital or management constraints (or both).

Linear regression was performed to estimate the effect of market and animal performance variables on the "equal-return" grazing fee. Using ordinary least-squares estimation, the following equation was estimated (with standard errors in parentheses below the estimated coefficients):

$$(3)\quad GF = \underset{(0.874)}{54.831} + \underset{(0.013)}{0.022}MARGIN - \underset{(0.348)}{11.510}ADG + \underset{(0.137)}{1.196}DL,$$

where *GF* is the equal-return grazing fee (in $/cwt of gain); *MARGIN* is the spring feeder calf price minus the associated fall stocker calf price (in $/cwt); *ADG* is the average daily gain achieved by grazing steers; and *DL* is the percentage death loss on grazing steers. Using this equation, a "fair" grazing fee can be calculated for any assumed buy/sell margin, average daily gain, and death loss percentage.

Table 8. Equal-Return Grazing Fees ($/cwt Gain) Under Different Buy/Sell Margin and ADG Assumptions

Buy/Sell Margin	ADG										
	1.50	1.60	1.70	1.80	1.90	2.0	2.10	2.20	2.30	2.40	2.50
0.00	39.96	38.81	37.66	36.50	35.35	34.20	33.05	31.90	30.75	29.60	28.45
−5.00	39.85	38.70	37.55	36.40	35.24	34.09	32.94	31.79	30.64	29.49	28.34
−10.00	39.74	38.59	37.44	36.29	35.14	33.99	32.83	31.68	30.53	29.38	28.23
−15.00	39.63	38.48	37.33	36.18	35.03	33.88	32.73	31.57	30.42	29.27	28.12
−20.00	39.52	38.37	37.22	36.07	34.92	33.77	32.62	31.47	30.31	29.16	28.01
−25.00	39.41	38.26	37.11	35.96	34.81	33.66	32.51	31.36	30.21	29.05	27.90

Note: Death loss is assumed to be 2%; ADG is average daily gain.

Table 8 summarizes a number of such calculations. Figures in Table 8 provide a benchmark for evaluating grazing fees; however, they should be interpreted with caution. These figures are based on returns calculated from a hypothetical budget. This budget is representative of cattle owner and caretaker costs, but individual operators could have operating costs that differ significantly from those used in the budget. Also, the buy/sell margin, average daily gain, and death loss are all unknown at the time grazing decisions must be made. Uncertainty regarding these factors will obviously affect grazing fee decisions by both cattle owners and caretakers.

Summary and Conclusions

Contract grazing of stocker calves may represent an important opportunity for many southeastern cattle producers. Contract grazing could allow pasture owners to receive regular income from their land and labor resources while limiting the amount of capital that they have at risk. This could be a particularly attractive option for producers with limited access to capital, those facing cash flow problems, or those whose financial position leaves them vulnerable to the level of financial risk associated with purchasing stocker calves. From the cattle owner's perspective, contracting could allow them to increase their investment in cattle in spite of land or management constraints.

One difficulty of evaluating contract grazing options is that there is very little standardization of grazing contract terms and conditions. A virtually unlimited number of arrangements is possible, each differing to some degree in who pays for inputs, who bears death loss, and how compensation is provided. This fact highlights the importance of having a written contract specifying all the details of the contract grazing arrangement.

In this study, four hypothetical contract grazing arrangements were compared to stocker ownership. From the cattle owner's perspective, stocker ownership offered a higher level of returns than any of the contracts. Moreover, reductions in risk to the cattle owner were minimal so that even extremely risk-averse cattle owners would not prefer any of the contracting options considered here to grazing cattle on owned (or leased) pasture. These results are broadly consistent with previous research (Harrison et al.). For caretakers, contracting offered a significant reduction in the variability of returns. One of the contracts considered here was preferable to cattle ownership from the caretaker's perspective for any level of risk aversion.

Using sensitivity analysis, this research illustrates one of the obstacles to the adoption of contract grazing arrangements. In general, from a cattle owner's perspective, contract grazing is not a preferred option except at a grazing fee rate that is too low to be attractive to pasture owners. Obviously, other factors can, and often do, override this concern (e.g., capital constraints that make it impossible for a pasture owner to obtain cattle directly or time constraints that make it difficult for a cattle owner to directly oversee the grazing op-

eration). For decision makers in these circumstances, results of this research indicate that it should generally be possible to develop a contract grazing arrangement that results in positive profits for both caretaker and cattle owner. Although this level of profitability may not approach what is possible with direct control of both cattle and land, the possibility of earning some level of profits from grazing may be very attractive to cattle owners or caretakers facing binding management or capital constraints in their operations.

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