Stochastic Dominance Analysis of Futures and Option Strategies for Hedging Feeder Cattle

R. Wes Harrison

Stochastic simulation and generalized stochastic dominance are used to compare the risk-return properties of the Chicago Mercantile Exchange feeder cattle futures contract with those of the feeder cattle put option contract. Cash marketing, futures, and option strategies are analyzed for four backgrounding systems common to the mid-south region of the United States. The results show that at-the-money put option strategies dominate corresponding futures contract strategies according to generalized stochastic dominance. This implies that at-the-money put option contracts are superior to feeder cattle futures contracts for risk-averse backgrounders in the mid-south region of the United States.

Backgrounding involves assembling and growing calves from weaning weights to feedlot-ready weights between seven and eight hundred pounds. Most feeder calves go through some type of backgrounding process prior to being placed in feedlots for finishing. This is true particularly for calves produced in the southern region of the United States, where weaning weights tend to be lighter. Backgrounding is an intermediate stage of production that bears much of the adjustment between the supply of calves and a sometimes volatile demand for feeder cattle. Consequently, feeder cattle prices are among the most volatile of all classes of cattle (Spreen and Arnade 1984; Bobst, Grunewald, and Davis 1982; Russell and Franzmann 1979). Feeder cattle prices are also among the most difficult to predict because several factors affect the demand for cattle by feedlots. For example, the price of feeds influences the demand for feeder cattle because it affects the margins feedlots receive for feeding cattle to slaughter weights. In addition, both domestic and international markets influence the demand for slaughter cattle, which in turn affects the demand for feeder cattle. Hence, the price risk associated with producing feeder cattle can be significant in some years.

In principle, price risk can be managed by hedging with futures and option contracts. However, most studies on hedging feeder cattle in the mid-south region were conducted prior to the adoption of option contracts in 1987. O'Bryan, Bobst, and Davis (1977) investigated the effectiveness of the Chicago Mercantile Exchange (CME) futures contract for reducing revenue variability as compared with the cash market. They found that revenue variances were smaller for hedging compared with cash marketing, but the reduction in variance also resulted in a significant reduction in mean revenue. In a similar study, Ward and Schimkat (1979) examined the effectiveness of futures contracts for reducing price risks. Their study focused on analyzing alternate hedging ratios for the Florida feeder cattle industry. They found futures contracts to be a useful marketing tool for reducing price risks. However, they did not address the risk-return tradeoffs between cash marketing and hedging. Grunewald (1980) constructed E-V efficient portfolios for hedging and cash marketing strategies for various Kentucky backgrounding operations. His study indicated that portfolios on the E-V frontier comprised 50% to 80% futures hedging strategies. Hence, he concluded that hedging with futures could be an important marketing tool for reducing the price risks for some backgrounding operators. In a related study, Bobst, Grunewald, and Davis (1982) found that the CME futures contract could be an effective tool for reducing risks given different price expectations for backgrounders. These studies have shown that hedging with futures contracts reduces the risk of backgrounding in the mid-south region, but only at the expense of a significant reduction in average returns.

Option contracts, however, may be a more effective risk management tool for backgrounders.

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The essence of hedging with futures contracts involves offsetting losses (gains) in the cash market with gains (losses) in the futures market. However, a put option contract allows backgrounders to protect their cash market positions against declining prices, while retaining the possibility of greater profits in the event that prices increase. This is because hedgers are not obligated to buy or sell futures contracts under the option strategy, whereas under the futures contract strategy they must offset their original futures position. In principle, options are a superior hedging instrument in this regard, but they do require the payment of a premium that partially offsets, or may completely nullify, this advantage. Moreover, even though options provide downside price protection, they result in lower returns relative to a futures strategy when prices decline. Thus, whether or not an option strategy is superior to a particular futures-based strategy is an empirical question that cannot be answered a priori. The answer depends on the likelihood that prices will increase (or decrease) over the hedging period, and on the level of the option premium.

Harrison et al. (1996) examined the use of both futures and option hedging strategies for backgrounders in the mid-south region of the United States. The study focused on comparing futures and option strategies with contract grazing. The authors analyzed the net return distributions for integrated and contract production for a backgrounding system common to the study area. Using stochastic dominance analysis, they showed that owning pasture in a grazing contract dominates integrated production when coupled with a futures strategy for generally risk-averse backgrounders. Grazing contracts were also found to dominate option strategies for the strongly risk-averse backgrounder.

The purpose of this study is to examine the risk-return properties of hedging strategies that use the CME feeder cattle option contract and compare them with strategies that use the CME feeder cattle futures contract. This study differs from previous literature in that it directly compared futures and option strategies to cash marketing strategies for several backgrounding systems common to the mid-south region of the United States.

The paper is divided into three sections. The first section discusses the empirical methods used in the study. The selected backgrounding systems are described, and cash marketing and hedging models are presented. The methods and data used to stochastically simulate cash marketing and hedging models are also discussed. The second section presents and discusses the results of the study. The final section of the paper discusses the conclusions.

Methods

Expected utility theory shows that risk-averse individuals are willing to trade off expected return for a reduction in risk. Both futures and option contracts can potentially reduce the risks of backgrounding. Yet the optimal selection of a hedging strategy depends on its relative risk-return tradeoff and the risk preferences of the decision maker.

Mean-variance (E-V) and stochastic dominance (SD) analysis are the predominant tools used for evaluating risky alternatives in the agricultural economics literature. Stochastic dominance and E-V analysis are closely related since both provide a mechanism for constructing efficient sets, which exclude alternatives that would lower expected utility. In fact, E-V and second degree stochastic dominance yield equivalent results when the outcome distributions of the risky alternatives are normal. However, SD is a more robust test when outcomes are not normally distributed since it imposes no restrictions on the probability distributions of the risky alternatives. Consequently, SD is applicable to a broader set of empirical problems.

The three commonly used forms of stochastic dominance are first degree stochastic dominance (FSD), second degree stochastic dominance (SSD), and stochastic dominance with respect to a function (SDRF) or generalized stochastic dominance (GSD). Of the three, FSD is the least discriminatory test since it makes only the weak assumption that more income is preferred to less. Second degree stochastic dominance provides more discriminatory power because it imposes the additional assumption of risk aversion, but in many cases both FSD and SSD yield efficient sets that are too large to aid in decision making. For this reason GSD is often more useful because it provides a means to construct efficient sets for various levels of risk aversion.

Meyer's generalized stochastic dominance (1977) is grounded in expected utility theory. Assume a decision maker whose utility as defined over income is given by $U(y)$. Moreover, assume the decision maker faces two risky alternatives, A_1 and A_2, with cumulative probability distributions given by $F(y)$ and $H(y)$ respectively. GSD defines both necessary and sufficient conditions under which $F(y)$ is preferred to $H(y)$ by decision makers whose Arrow-Pratt coefficient of absolute risk aversion lies within a specific interval. More specifically, GSD solves for a utility function $U(y)^*$ which minimizes

$$\int_0^y [H(y) - F(y)]U'(y)dy \tag{1}$$

subject to

$$R_L(y) \leq \frac{-U''(y)}{U'(y)} \leq R_U(y), \tag{2}$$

where $-U''(y)/U'(y)$ is the Arrow-Pratt measure of absolute risk aversion. Meyer has shown that if the minimum of expression (1) is nonnegative, then $F(y)$ is preferred or indifferent to $H(y)$ for the class or decision makers with risk preferences that fall within the interval $R_L(y),R_U(y)$. GSD provides a partial ordering of uncertain alternatives by dividing them into two mutually exclusive sets: an efficient set and an inefficient set. The inefficient set contains alternatives that, if chosen, would unambiguously lower expected utility. GSD is used to evaluate selected cash marketing and futures and option hedging strategies for selected backgrounding systems in this study. GSD was chosen as the analytical framework because the outcome distributions for option strategies are not normally distributed, and because it allows for the construction of efficient sets for various levels of risk aversion.

Stochastic dominance analysis requires that probability distributions for the cash marketing and hedging strategies be available for evaluation. The probability distributions for these strategies are estimated by stochastically simulating cash and futures prices for the selected backgrounding systems. Once simulated, cash and futures prices are combined with cash marketing and hedging models to construct probability distributions for local selling prices and unit hedging revenues for the selected backgrounding systems. These distributions are then analyzed using GSD.

Simulation of the Marketing Strategies

Cash marketing, futures hedging, and option hedging strategies are simulated for four backgrounding systems. These systems were selected after reviewing literature related to backgrounding operations in Kentucky and the mid-south (Bradford et al. 1978; Johnson, Ferguson, and Rawls 1989). While the literature notes many possible systems, four were identified by extension specialists as the most common in the study area. General characteristics for the selected systems are summarized in table 1. Each backgrounding system (BS) is designed to grow a calf from a weaned weight in the 450–500 pound range to a market weight between 700 and 800 pounds. Marketing dates for the four systems are determined by their respective ending dates. Of the four systems selected, three are winter systems that begin in October and end with sale dates the first week of April, August, and September of the following year. The fourth system is a summer grazing system that begins in April and ends in October of the same year.

The marketing strategies assume that price risk is defined as the variability in the seasonal pattern of cash and futures prices over the selected backgrounding periods. Returns for the marketing strategies are simulated for the 1992 production period, which is the reference year for the study.

Cash Market Strategies. Unit returns for the cash marketing strategies are simulated stochastically by modeling the stochastic nature of local selling prices for each of the four backgrounding systems. The following formula is used:

$$SP_i = CP_i + CCP_i, \tag{3}$$

where

SP_i = the simulated local selling price for a Medium No. 1 steer with a sale date determined by the ith backgrounding system,

CP_i = the observed 1992 week's average local cash price for a Medium No. 1 steer at the time the ith backgrounding system is initiated,

Table 1. General Characteristics of the Selected Backgrounding Systems

	Winter			Summer
Characteristic	BS_1	BS_2	BS_3	BS_4
Animal type & weight	Steer 450 lbs	Steer 450 lbs	Steer 450 lbs	Steer 500 lbs
Typical feeds & forage	Grass hay, corn grain, & soy. meal	Fescue pasture, corn silage, & soy. meal	Fescue pasture, corn silage, & soy. meal	Fescue pasture
Period (days)	182	304	335	183
Beginning date	October	October	October	April
Marketing date	April	August	September	October

CCP_i = the stochastically simulated change in local cash prices over the backgrounding period for the ith backgrounding system, and

i = 1, 2, or 3, for backgrounding systems that begin the first week in October and end with sales the first week of April, August, and September, respectively; and where $i = 4$ for the system that begins the first week in April and ends with sales the first week of October.

Futures Contract Strategies. A short hedging strategy is also modeled for each backgrounding system. The hedging strategy assumes that futures contracts are sold at the beginning of the backgrounding period, then repurchased later when cattle are sold on the local cash market. The feeder cattle contracts selected for hedging are the CME contracts that mature closest to, but after, the sale dates of each backgrounding system. For example, the CME April contract is used as the hedging instrument for the first backgrounding system, which begins the first week in October and ends with cash sales the first week in April. Other hedging strategies are open to backgrounders, of course, but the complexities they add to the analysis are beyond the scope of this study.

Unit hedging revenues are simulated in a fashion similar to that described for cash marketing. However, the stochastic nature of hedging revenues is described by relative changes in the futures price and local cash price at the time the hedge is lifted. Hence, the ending period basis is the random event that determines the variation in hedging revenues. Unit hedging revenues for the futures strategies are simulated using the following formula:

$$HR_i = F_i + Basis_i - HC_i, \tag{4}$$

HR_i = the simulated unit hedging revenue for Medium No. 1 steers with a sale date determined by the ith backgrounding system,

F_i = the observed 1992 week's average closing futures price for the selected CME feeder cattle futures contract at the time the ith backgrounding system is initiated,

$Basis_i$ = the stochastically simulated local ending period basis for the ith backgrounding system (the basis is defined as cash price minus futures price), and

HC_i = unit costs that include a \$50 commission and brokerage fee for one round turn trade, and a 10% interest charge on \$1,000 for margin calls.

Option Contract Strategies. The use of a put option to protect against declining prices over the backgrounding period is next modeled for each backgrounding system. The backgrounder is assumed to select at-the-money strike prices, that is, a strike prices equal to the current futures price at the beginning of the respective backgrounding period. In addition, strategies assume that put options are purchased at the beginning of the backgrounding period and expire/sell decisions are made when feeder cattle are sold on the cash market. The options used as the hedging instrument correspond to the futures contracts of the previously described short hedge. For example, the April put option is used as the hedging instrument for the first backgrounding system. Other option strategies and strike prices are available to backgrounders, but the complexity they add to the analysis is beyond the scope of this study.

Simulating the stochastic properties of options is more complex than the previous two cases. If at the end of the backgrounding period prices have not changed or have increased such that they are equal to or greater than the strike price, then the option will have no intrinsic value. Moreover, the option will have very little time value since it will be close to expiration. In this case, the option has no value and the backgrounder's unit revenues would equal the local cash prices less premium and brokerage fees. However, if prices have decreased to levels below the strike price, then the option's value would equal the difference between the strike price and the futures price (assuming zero time value). If the backgrounder sells cattle on the local cash market and the option on the option market, then unit revenues would equal the strike price plus the ending period basis less premium and brokerage fees. Following this logic, unit revenues for the option strategies are simulated as follows:

$$OPR_i = SP_i - PREM(S_i) - OPC_i, \quad \text{if: } F_i + CFP_i \geq S_i \tag{5a}$$

or

$$OPR_i = S_i + Basis_i - PREM(S_i) - OPC_i, \quad \text{if: } F_i + CFP_i < S_i \tag{5b}$$

where

OPR_i = the simulated unit option revenue for Medium No. 1 steers with a sale date determined by the ith backgrounding system,
CFP_i = the stochastically simulated change in futures prices for the selected CME feeder cattle contract over the ith backgrounding period,
S_i = the at-the-money strike price associated with the CME put option contract, which is equal to the futures price used in the traditional hedging strategy (F_i),
$PREM(S_i)$ = the premium charged for the CME feeder cattle put option contract given S_i, and
OPC_i = unit option costs that equal a \$50 brokerage fee, and all other variables are as previously defined.

Estimating Option Premiums

Options are traded for numerous strike prices at specified intervals above and below the current futures price for any given futures contract. In general, strike prices close to the current futures price for nearby futures contracts are the most actively traded. However, strike prices on options with expiration dates in the more distant future may not be actively traded. This is a problem for the option contracts used for the longer backgrounding periods in this study. Consequently, observed premiums for strike prices (S_i) on these contracts were not available.

To circumvent this problem Black's model is used to estimate the option premiums ($PREM(S_i)$) in this study. Black's formula is a derivative of the Black-Scholes model for European stock options (Black 1976). It relates the current option premium to the current futures price, the time remaining to option expiration, the interest rate, and the futures price volatility. Use of Black's model requires that an estimate of futures price volatility be obtained. Two methods are typically used.

The first method involves using current premiums for several options with different strike prices and then solving Black's formula for the so called implied volatility (Kenyon 1984). This method cannot be used for the contracts associated with the longer backgrounding periods because no strike prices were traded in October 1992, the reference month and year of the model. The other method involves measuring the variance of futures prices over a historical period that includes variation similar to that expected in the future. This is the method adopted by this study. Closing prices for the twenty trading days prior to the maturity dates of the 1992 CME April, August, September, and October feeder cattle futures contracts were collected. These data were used to estimate the volatility of futures prices according to the method prescribed by Kenyon (1984, p. 103). The interest rate used in the calculation of premiums was 3.8%, which was the average annual rate for a 1992 one year United States Treasury bill.

Stochastic Simulation of Cash and Futures Prices

The stochastic nature of the cash marketing, futures hedging, and option hedging models is described by the means and variances of CCP_i, $Basis_i$, and CFP_i, which in turn are defined by the means, variances, and covariance of cash and futures prices. Stochastic simulation of the models requires that a series of random draws be generated from the underlying stochastic process that generated cash and futures prices over each backgrounding period. This is accomplished by using a multivariate normal distribution to approximate the stochastic nature of historical cash and futures prices over each backgrounding period. The multivariate distribution ensures that covariances among cash and futures prices are maintained.

Naylor et al. (1966) describes a method for sampling variates from the multivariate normal distribution. This procedures utilizes a theorem that states that given an m-dimensional vector, $\mathbf{z}$, which contains independent standard normal variates, then there exists a unique lower triangular matrix $\mathbf{C}$ such that

$$\mathbf{x} = \mathbf{C}\mathbf{z} + \boldsymbol{\mu}, \tag{6}$$

where $\mathbf{x}$ is an m-dimensional vector of random variables and $\boldsymbol{\mu}$ is an m-dimensional vector of expected values for each element in $\mathbf{x}$. Moreover, if the variance-covariance matrix of $\mathbf{x}$ is defined as $\mathbf{V} = E[\mathbf{x} - \boldsymbol{\mu}) \cdot (\mathbf{x} - \boldsymbol{\mu})']$, then it can be shown that $\mathbf{V} = \mathbf{C}\mathbf{C}'$ (King 1979). Therefore, the elements of $\mathbf{C}$ can be calculated from $\mathbf{V}$, and each variate in $\mathbf{x}$ can be generated as follows:

$$x_i = \mu_i + \Sigma c_{ij} z_i, \; i = 1, \ldots, m, \tag{7}$$

where c_{ij} are the elements of $\mathbf{C}$ and z_i are elements of $\mathbf{z}$.

This procedure is used to randomly select 200 samples of cash and futures prices ($\mathbf{x}$) for each marketing strategy analyzed in this study. These stochastically generated samples are used to calculate CCP_i, $Basis_i$, and CFP_i, which are used in the previously described models to construct probability distributions for selling prices and hedging revenues. The multivariate normal distribution used to generate cash and futures prices is defined by the means (**μ**), variances, and covariances (**V**) estimated from weekly averages of Kentucky cash and CME closing futures prices for Medium No. 1 steers. These data were collected over the period 1978 to 1992 for the first weeks of beginning and ending months of each backgrounding system. All prices were deflated using the consumer price index (1992 = 100).

Results

Summary statistics for the stochastic simulations of CCP_i, $Basis_i$, and CFP_i are presented in table 2. The results show that the average CCP_i is positive for each backgrounding system (BS), which indicates that prices tended to increase over the sample period. The most significant increases in prices are associated with the winter backgrounding systems, which led to higher unit returns for the cash marketing alternatives of BS_1, BS_2, and BS_3 relative to the summer system BS_4. Of the winter systems, BS_3 yielded the highest average return because of higher probabilities that prices increase over this backgrounding period.

Summer backgrounding (BS_4) yields lower average returns because of relatively low probabilities that cash prices increase over the summer months. This is shown by a relatively low average change in cash prices over the backgrounding period, i.e., CCP_4 = .41 (table 2). However, even though it yields the lowest average return, the summer backgrounding system (BS_4) is associated with the least amount of variability in returns. This is shown by a lower standard deviations for CCP_4 and SP_4 relative to the cash marketing alternatives for the other three backgrounding systems.

These results imply that producers adopting backgrounding systems that begin in the fall and end with marketing in the spring and midsummer months have a higher probability of experiencing a price increase relative to summer backgrounding. However, the higher returns associated with winter backgrounding are accompanied by greater variability. Hence, although winter backgrounding yields higher returns on average, it has a higher probability of unfavorable returns in some years.

Summary statistics for the stochastic simulations for SP_i, HR_i, and OPR_i are also presented in table 2. Figures 1–4 illustrate the cumulative density functions for each marketing strategy. All futures contract strategies yield average unit revenues below the cash marketing alternatives. This is expected since hedging with futures contracts offsets the gains (losses) of increasing (decreasing) cash prices with losses (gains) in the futures market. Moreover, futures are associated with transaction costs that lower their average returns relative to

Table 2. Summary Statistics for Simulated Distributions and Marketing Strategies for Selected Backgrounding Systems

Backgrounding System	Change in Cash Price (CCP_i)	Ending Period Basis ($Basis_i$)	Change in Futures Price (CFP_i)	Selling Price (SP_i)	Futures Revenue (HR_i)	Option Revenue (OPR_i)
			($/cwt)			
Oct–April (BS_1)						
Mean	4.62 (4.59)[1]	−8.52 (−8.51)	2.55 (2.52)	81.34	70.46	81.00
Standard Dev.	12.95 (13.10)	4.79 (5.04)	15.29 (15.51)	12.98	4.80	11.59
Skewness				.03	−.22	.57
Oct–Aug (BS_2)						
Mean	4.28 (4.29)	−7.84 (−7.84)	2.38 (2.36)	81.00	69.77	79.63
Standard Dev.	16.57 (16.06)	4.33 (4.25)	14.94 (15.08)	16.61	4.34	15.52
Skewness				.22	.10	.68
Oct–Sept (BS_3)						
Mean	5.41 (5.37)	−7.74 (−7.73)	3.37 (3.34)	82.13	69.81	80.80
Standard Dev.	15.64 (15.80)	3.41 (3.61)	17.15 (16.73)	15.68	3.42	14.45
Skewness				.10	−.22	.67
April–Oct (BS_4)						
Mean	.41 (.38)	−7.48 (−7.49)	7.13 (7.09)	77.51	67.03	73.91
Standard Dev.	7.95 (8.37)	2.99 (2.96)	20.29 (20.76)	7.97	3.01	8.78
Skewness				−.05	−.13	.44

1. Summary statistics for the historical distributions are reported in parentheses. The means and variances for simulated CCP_i, $Basis_i$, and CFP_i were found not to be significantly different from the means and variances of the historical price data according to t and F tests.

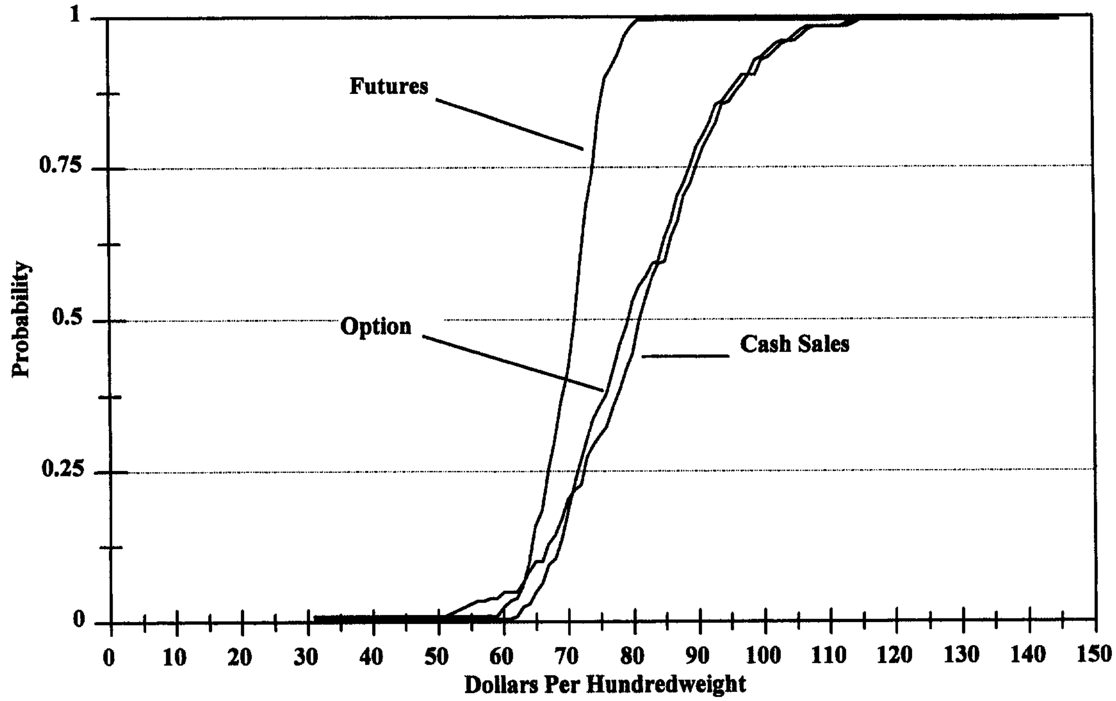

Figure 1. Cumulative Density Functions of the Marketing Strategies for Backgrounding System 1.

cash sales. However, hedging with futures contracts is associated with less risk relative to cash marketing because the ending period basis (*$Basis_i$*) is significantly less variable relative to the variability in cash prices (*CCP_i*). This is also shown by standard deviations that are lower for the futures strategies as compared with their cash marketing counterparts (table 2). This supports the results of

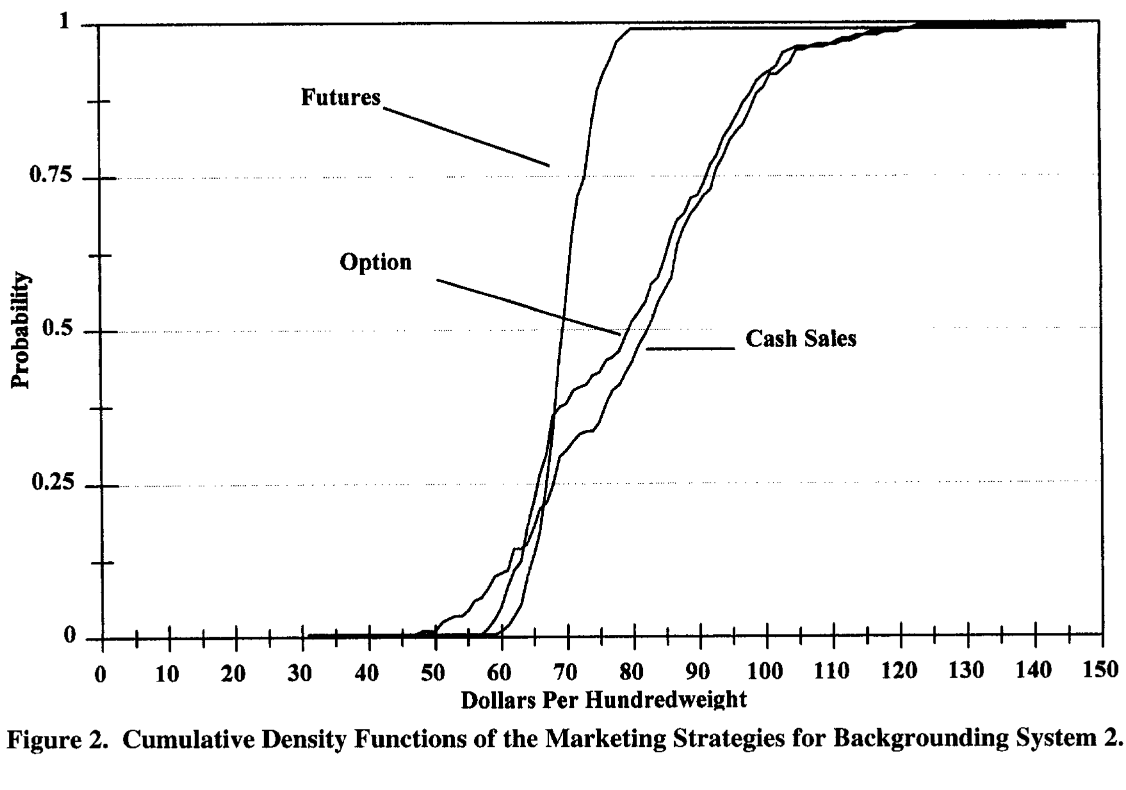

Figure 2. Cumulative Density Functions of the Marketing Strategies for Backgrounding System 2.

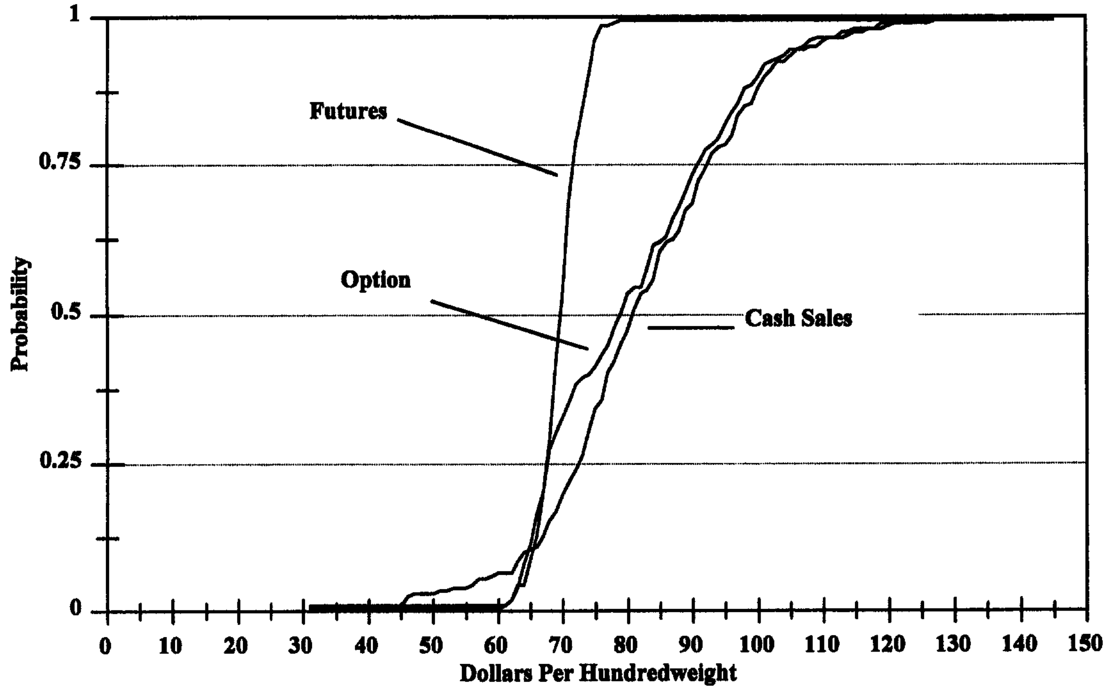

Figure 3. Cumulative Density Functions of the Marketing Strategies for Backgrounding System 3.

previous studies that found that traditional hedging with futures contracts is less risky relative to cash marketing, but only at the cost of lower mean returns (O'Bryan, Bobst, and Davis 1977; Ward and Schimkat, 1979; Bobst, Grunewald, and Davis 1982).

Average unit revenues for the option strategies are greater than those for the futures strategies for

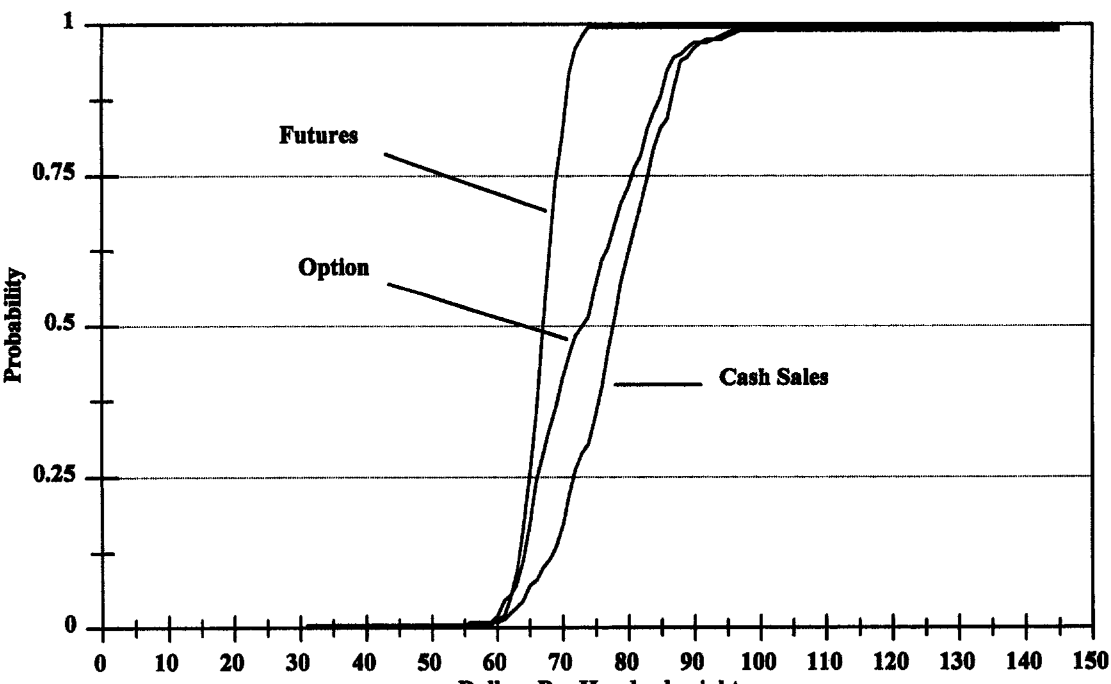

Figure 4. Cumulative Density Functions of the Marketing Strategies for Backgrounding System 4.

all four backgrounding systems (table 2). This occurs because the option strategies yield higher returns relative to the futures strategies if prices increase and lower revenues relative to futures if prices decline. Thus, since the backgrounding systems considered in this study have higher probabilities of increasing prices (as shown by positive average price changes, table 2), the option strategies have higher revenues relative to the futures strategies at the upper tails of the CDFs (figures 1–4).

However, even though the option strategies yield higher returns, their returns are more variable relative to the futures hedging strategies (table 2). Hence, they may be attractive to some decision makers because they dominate the option strategies at the lower tails of the CDFs (figure 1). Other results show that the option strategies compare favorably with cash marketing because they are skewed toward the upper tails of their CDFs (figures 1–4). As before, this occurs because prices tend to increase on average for each backgrounding system.

Stochastic Dominance Analysis

An analysis of the summary statistics for the revenue distributions is incomplete without the aid of an efficiency criterion to determine the preferred strategies. This is because the preference of any particular alternative depends on relative risk-return tradeoffs and the risk attitudes of the backgrounder. Generalized stochastic dominance (GSD) is used to construct efficient sets for the selected backgrounding systems (tables 3 and 4). Elicited risk preferences are not available for backgrounders in the study area. The risk categories used in this study were taken from a study by Williams et al. (1993). The GSD analysis was conducted using a computer program developed by Goh et al. (1989).

Table 3 presents GSD pairwise comparisons of the marketing strategies for each backgrounding system. This allows for direct comparisons of each marketing strategy for a particular backgrounding system. The futures strategies for BS_1, BS_2, and BS_3 are dominated by both the cash marketing and option strategies for the generally risk averse efficient set. This result is also shown for moderately and strongly risk averse categories (table 3). The cash marketing strategies dominate the futures hedging strategies because the basis yields average hedging revenues that are significantly lower than cash revenues (table 2). This occurs even though the basis is significantly less risky relative to cash prices. The option strategies also dominate the futures strategies, but for different reasons. The dominance of the option strategies is associated with the fact that prices increase significantly on average for the winter backgrounding systems (table 2). This results in the option strategies being skewed significantly toward the cash marketing distributions (figures 1–4).

However, the cash marketing strategies were

Table 3. Stochastic Dominance Pairwise Comparisons of Marketing Strategies for Selected Backgrounding Systems

Backgrounding System	Generally Risk Averse[a]			Moderately Risk Averse			Strongly Risk Averse		
Oct–April (BS_1)	Cash	Futures	Option	Cash	Futures	Option	Cash	Futures	Option
Cash	———	1[b]	?	———	1	?	———	1	0
Futures	0	———	0	0	———	0	0	———	0
Option	?	1	———	?	1	———	1	1	———
Oct–Aug (BS_2)	Cash	Futures	Option	Cash	Futures	Option	Cash	Futures	Option
Cash	———	1	?	———	1	?	———	?	0
Futures	?	———	0	0	———	0	?	———	0
Option	?	1	———	?	1	———	1	1	———
Oct–Sept (BS_3)	Cash	Futures	Option	Cash	Futures	Option	Cash	Futures	Option
Cash	———	1	?	———	1	?	———	1	0
Futures	0	———	0	0	———	0	0	———	0
Option	?	1	———	?	1	———	1	1	———
April–Oct (BS_4)	Cash	Futures	Option	Cash	Futures	Option	Cash	Futures	Option
Cash	———	1	1	———	1	1	———	1	1
Futures	0	———	0	0	———	0	0	———	0
Option	0	1	———	0	1	———	0	1	———

[a]Generally risk averse, moderately risk averse, and strongly risk averse categories are defined by Arrow-Pratt coefficient intervals of 0.0–0.105, 0.0105–0.052, and 0.052–0.105, respectively (Williams et al. 1993).

[b]Reading across, a one indicates that the row strategy dominates the column strategy, a zero indicates that the row strategy is dominated by the column strategy, and a question mark indicates no domination.

found to dominate both futures and option strategies for the summer backgrounding system regardless of the backgrounder's level of risk aversion. This means that the reduction in risk associated with the futures and option strategies is not large enough to offset the corresponding reduction in average revenues when compared with cash marketing. This occurs because summer backgrounding is associated with relatively little price risk.

Table 4 presents GSD efficient sets when marketing strategies are compared across all backgrounding systems. A check (√) indicates that a strategy is a member of the efficient set. All strategies not included in the efficient set are dominated by at least one strategy in the set. The generally risk-averse efficient sets exclude the marketing strategies associated with backgrounding system BS_2. The cash marketing strategies for BS_3 have a higher mean and a lower standard deviation (or variance) relative to their BS_2 counterparts (table 2). Hence, BS_3 dominates BS_2 for all marketing strategies considered. This implies that risk-averse decision makers would prefer backgrounding system BS_3 to BS_2. Summer backgrounding (BS_4) is also excluded from all the efficient sets. This is an interesting result since BS_4 is the least risky of all strategies considered, and it is generally known that producers in the study area background

Table 4. Generalized Stochastic Dominance Efficient Sets of Marketing Strategies for Selected Backgrounding Systems

Backgrounding System	Generally Risk Averse[a]	Moderately Risk Averse	Strongly Risk Averse
Oct–April (BS_1)			
Cash	✓[b]	✓	
Futures			
Option	✓	✓	✓
Oct–Aug (BS_2)			
Cash			
Futures			
Option			
Oct–Sept (BS_3)			
Cash	✓	✓	
Futures			
Option			
April–Oct (BS_4)			
Cash			
Futures			
Option			

[a]Generally risk averse, moderately risk averse, and strongly risk averse categories are defined by Arrow-Pratt coefficient intervals of 0.0–0.105, 0.0105–0.052, and 0.052–0.105, respectively (Williams et al. 1993).
[b](✓) indicates that a strategy is a member of the efficient set. All strategies not included in the efficient set are dominated by at least one strategy in the efficient set.

during the summer. The occurrence of summer backgrounding may be explained by cost advantages of summer grazing relative to winter feeding. Nevertheless, pairwise comparisons of all the marketing strategies reveal that BS_4 is dominated by the option strategy associated with BS_3. Hence, risk-averse producers may want to consider this winter backgrounding system coupled with an option strategy over summer backgrounding.

Summary and Conclusions

This study compares the risk management properties of the CME feeder cattle futures contract with those of the CME feeder cattle put option contract. Stochastic simulation was used to estimate the unit return distributions for cash marketing and hedging strategies of four backgrounding systems common to Kentucky and the mid-south region of the United States. Local cash and futures prices were the stochastic inputs into the model. The return distributions were analyzed using generalized stochastic dominance.

A significant finding of this study is that at-the-money feeder cattle put option strategies are superior to routine hedging with feeder cattle futures contracts. Option strategies dominate their corresponding futures contract strategy for each of the winter production systems according to generalized stochastic dominance. This occurs because of higher probabilities that prices will increase over the winter backgrounding periods, and because option premiums did not significantly offset the upside revenues associated with the option-based strategies. Moreover, the cash marketing strategies also dominated the futures strategies for the winter backgrounding systems. These results held true regardless of the producer's level of risk aversion.

Nonetheless, the cash marketing strategies were found to dominate the futures- and option-based strategies for the summer backgrounding system regardless of the backgrounder's level for risk aversion. Therefore, backgrounders interested in summer backgrounding may not want to use either the futures- or the option-based strategies considered in this study. Nevertheless, when winter backgrounding is compared with summer backgrounding, generalize stochastic dominance shows that winter backgrounding coupled with a put option hedge dominates the summer backgrounding system.

The principal advantage of options is that they allow hedgers flexibility in setting lower bounds on revenues while allowing for upside return potential. The results of this study showed that option strategies with at-the-money strike prices are preferred to routine hedging for several backgrounding systems in the mid-south region of the United States. However, further research is needed to conclude that options are superior to futures contracts as a risk management tool. For example, selective hedging strategies, where the backgrounder lifts and replaces a short hedge a discrete number of times during the production period, may result in higher mean returns and less risk relative to options. Evaluating whether or not options outperform these types of futures strategies is a possible direction for future research.

References

Black, F. 1976. "The Pricing of Commodity Contracts." *Journal of Financial Economics* 3:167–79.

Bobst, W.B., O.C. Grunewald, and J.T. Davis. 1982. "Efficient Cash and Hedged Enterprise Combinations in Feeder Calf Backgrounding Operations." *Southern Journal of Agricultural Economics* 14:105–10.

Bradford, G.A., J.A. Boling, S.R. Rutledge, and T.W. Moss. 1978. "Comparing Management Systems for Beef Cattle Backgrounding: A Multidisciplinary Approach." *Southern Journal of Agricultural Economics* 10:57–62.

Goh, S., C. Shih, M.J. Cochran, and R. Raskin. 1989. "A Generalized Stochastic Dominance Program for the IBM PC." *Southern Journal of Agricultural Economics* 21:175–82.

Grunewald, O.C. 1980. "A Risk Programming Analysis of the Role of Hedging in the Kentucky Feeder Cattle Industry." Ph.D. diss., University of Kentucky, Lexington.

Harrison, R.W., B.W. Bobst, F.J. Benson, and L. Meyer. 1996. "Analysis of the Risk Management Properties of Grazing Contracts Versus Futures and Option Contracts." *Journal of Agricultural and Applied Economics* 28:247–62.

Johnson, L.A., K.W. Ferguson, and E.L. Rawls. 1989. "Risk-Return Comparisons of Tennessee Feeder Cattle Backgrounding Systems." *Journal of American Society of Farm Managers and Rural Appraisers* 53:41–46.

Kenyon, D. 1984. *Agricultural Commodity Options: A Teacher's Guide.* Athens: University of Georgia.

King, R.P. 1979. "Operational Techniques for Applied Decision Analysis under Uncertainty." Ph.D. diss., Michigan State University, East Lansing.

Meyer, J. 1977. "Choice among Distributions." *Journal of Economic Theory* 14:326–36.

Naylor, T.H., J.L. Balintty, D.S. Burdick, and K. Chu. 1966. *Computer Simulation Techniques.* New York: John Wiley and Sons, Inc.

O'Bryan, S.L., B.W. Bobst, and J.T. Davis. 1977. "Factors Affecting Efficiency of Feeder Cattle Hedging in Kentucky." *Southern Journal of Agricultural Economics* 9: 185–89.

Russell, J.R., and J.R. Franzmann. 1979. "Oscillators as Decision Guides in Hedging Feeder Cattle: An Economic Evaluation." *Southern Journal of Agricultural Economics* 11:83–88.

Spreen, T.H., and C.A. Arnade. 1984. "Use of Forecasts in Decision Making: The Case of Stocker Cattle in Florida." *Southern Journal of Agricultural Economics* 16:145–50.

Ward, R.W., and G.E. Schimkat. 1979. "Risk Ratios and Hedging: Florida Feeder Cattle." *Southern Journal of Agricultural Economics* 1:71–77.

Williams, J.R., G.L. Carriker, G.A. Barnaby, and J.K. Harper. 1993. "Crop Insurance and Disaster Assistance Designs for Wheat and Grain Sorghum." *American Journal of Agricultural Economics* 2:435–47.