PUT OPTIONS ON LIVE CATTLE FUTURES CONTRACTS AND ALTERNATIVE MARKETING STRATEGIES

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Put options on live cattle futures contracts and alternative marketing strategies

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PUT OPTIONS ON LIVE CATTLE FUTURES CONTRACTS AND ALTERNATIVE MARKETING STRATEGIES

Abdulaziz Mohamed Al-Shuaibi

A Thesis Submitted to the Faculty of the

DEPARTMENT OF AGRICULTURAL ECONOMICS

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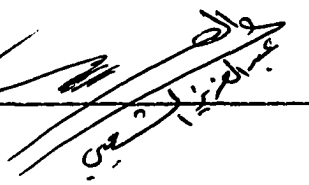
SIGNED 

APPROVAL BY THESIS DIRECTOR

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Professor of Agricultural Economics

7/7/87
Date

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ABSTRACT

The main objective of this study was to evaluate alternative marketing strategies involving options on live cattle futures contracts during the period of 1966-85. To predict the option premiums that wuold have occurred at various points in this period of time, the study did research on market premiums of options on live cattle futures contracts from October 30, 1984, to November 22, 1985. The research showed that actual premiums conform closely to the premiums estimated by the Black model of option pricing. The generalized stochastic dominance with absolute risk aversion function intervals is demonstrated in the study in order to make the evaluation. The results showed that under different risk preferences, the commodity options provide the dominant alternative for cattle producers. Options provided protection from losses resulting from falling cash price and in some cases raised average income of hedgers.

CHAPTER I

INTRODUCTION

The agricultural industry is characterized by the term of uncertainty. It is largely agreed that agricultural producers usually face three major types of risks which cannot be completely eliminated. They are production process risks, such as weather disasters, marketing risks, such as price fluctuations resulting from unexpected shifts in supply and demand of the product, and financial risk such as unexpect rises in interest rates.

Because of the dominance of perfectly competitive markets on most agricultural products, these products rank in different degrees of marketing risk, depending on the degree of storability of such products. For example, a commodity that has a storable inventory, such as wheat, produces less risk than live cattle which by definition has no inventory at all in an ordinary sense.

Historically, in the United States and world wide, the cattle feeding industry, which constitutes an important part of the agricultural industry, has expanded dramatically since the 1950's because of rising personal incomes and a high demand for red meat due to population growth. Before

1973, price relationships for feedlots and fed cattle tended to insure a margin of profits on most cattle placed for feed. AFter 1973 the cattle feeding industry underwent changes in economic conditions which forced the net returns of cattle feeders to be more volatile. This led to often substantial losses in their businesses. In general, these economic changes were caused by several factors, such as rapid growth in inflation and its influence on the consumer purchasing power, fluctuation in the prices of feed grains which was relatively high after 1973, and changes in energy and labor costs. These factors and many others have caused a wide variability in fed cattle prices and contributed to growth of marketing risk for this agricultural product. Consequently, after 1973, most feeders of cattle incurred financial losses which can be attributed to errors in marketing and/or production strategies under the prevailing economic conditions. From 1974 up to the present, the cattle feeding industry has remained a high risk capital-intensive industry.

To eliminate or reduce marketing risk, producers of live cattle may use a variety of alternative strategies for marketing their products. These strategies may have potential for reducing the adverse effects of price variability. Beside selling the commodity at prevailing cash prices, live cattle producers have used traditional futures

hedging for their product which has been available to them since 1966. Rather than having full risk, cattle feeders have used futures trade in varying degrees and for certain proportions of their product to guarantee margins for their products. Using futures contracts provided producers with relatively certain gross income, but it does not insure the highest price for producers throughout the season. That means it may reduce the losses, but it does not eliminate the losses and the risk. Sometimes, the use of futures contracts may increase the losses because the farmer who sells futures contracts at planting time and then experiences a crop failure may lose from buying back futures contracts at a higher price as well as from not having a product to sell.

Organized futures markets for agricultural commodities, especially for commodities that have storable inventories such as corn and wheat, have been extensively used for more than 130 years. Approximately 60% of agricultural commodities have been traded using futures contracts since 1968.[1] Futures trading for live cattle was initiated on the floor of the Chicago Mercantile Exchange in 1966. This commodity, however, does not satisfy many characteristics which the writers on futures markets

[1]Menzie and Archer, 1973.

believed were required for successful futures contracts trading such as storability of the product and a seasonal pattern of production and storage. Nevertheless, live cattle futures contracts have traded in significant volume since its early introduction to the market.

Based on the futures trading of live cattle, cattle feeders hedge their commodity by selling futures contracts so as to approximately fix the effective selling price of the cattle, although cash and futures price movements may cause the hedge to be less than perfect in insulating the hedger from the vagaries of market price variability.

Using futures trading over time has provided producers with a reduction in income at some times and an addition to income at others. Therefore, changing the techniques of trading the product may result in different gross returns to producers, and these techniques have a potential effect on the income of producers. As the uncertainty expanded in live cattle markets due to changes in economic conditions, the need for alternative marketing strategies increased.

In evaluating four trading techniques, Pluhar and Shafer (1984) cited only one hedging strategy which was superior to a simple cash sale. Therefore, using futures hedging is not always superior with respect to simple cash trade.

Shafer, et al. (1981) studied alternative marketing strategies for different feeding periods for live cattle in Texas. The main purpose of this study was to investigate whether or not using alternative marketing strategies for live cattle has an effect on gross returns per head. The strategies used in this study are Cash Market Strategy (CM), Lock-in or Do Not Feed Strategy (LIDF), Lock-in or Cash Market Strategy (LICM), Extended Lock-in Strategy (ELI), and Technical Trading Strategy (TT). The Lock-in Strategies represent the hedge using futures contracts with different combinations. This allows to lock the price to the futures price if futures trade is preferable. They used the cash market as a basis for evaluating the other hedging strategies. The results show that using cash price (selling fed cattle at prevailing cash price) produced a loss of $2.29 per head over the 47 hedging periods. Whereas each of the other hedging strategies provided a positive average return per head for the same feeding period. This study may not only present the superiority of hedging with respect to the cash market, but it also shows the probability of changing gross returns if cattle feeders use different marketing strategies for marketing their product.

Firch and Al-Sakkaf (1986) predicted premiums on options on cotton futures contracts for a period the options were not traded (1973-1984) using a Black model. They used

these premiums for evaluation of alternative cotton pricing strategies of simple cash price on the spot market, forward contracting, hedging using futures contracts, and hedging by buying put options on cotton futures contracts. Their study shows that over a 12 year period forward contracting and hedging with using futures contracts would have lowered the average income of growers with respect to cash sales, but using options as a marketing strategy throughout the same period, 1973-1984, would have raised the average income of the growers by 4%-9% relative to simple cash markets. Their conclusion was that using different marketing strategies affects the average income of cotton producers. Moreover, using put options may not only insure the commodity from price falling but under certain conditions it may raise the average income of cotton producers.

Menzie and Archer (1973) drew the relationship between the theoretical issues of futures price, fluctuations and gross returns to live cattle producers. They used two periods for their study. Time period I started from December 4, 1964, through August 3, 1968 and time period II, which started from August 10, 1968 through November 27, 1971. In time period I, they found that futures prices had larger fluctuations than cash prices, but the futures price was slightly above cash prices, thereby assuring hedgers with higher gross returns than the gross returns received by

using prevailing cash prices at delivery time. In time period II, however, futures price had underestimated the fat cattle and captured lower prices for the hedge position. They concluded that futures trade may reduce the risk of loss but has essentially lost a chance of obtaining maximum profits. However, futures trade is not always profitable for hedgers. In addition, futures prices are as variable as cash prices, leading to different distributions of income over time.

Catlett and Boehlje (1982) examined the issue of whether using commodity options on live cattle futures contracts is a good substitute for traditional futures hedges for live cattle. They used selected strategies for futures and options while introducing a mathematical model for computing average gross returns for both futures hedge and options hedge. The strategies they used were a full futures hedge, beginning basis of $1.50 per hundred weight or more, beginning basis of $1.00 per hundred weight or more, delivery month hedge, and nondelivery month hedge. For each of these five strategies, two options strategies were introduced. One of them allows an option to expire and never to be exercised and the other allows an option to expire if there is any loss identified, but if there is not any loss, the option will be exercised. The period of study was 1965-1977. The results show that 95% of the option

hedges produce lower mean returns than futures hedges. Using a full futures hedge as a comparison point, the results show that a 5% option strategy of delivery month with $1.00 basis, and $1.50 basis are all preferred to a full futures hedge. But 20% and 30% option strategies are inferior to a full futures hedge because through these strategies, the options had a high premium payment. They concluded that a producer who hedges using 5% and 10% options could raise his gross mean return and lower the variance.

Using different marketing techniques for live cattle trade is a very new concept. This happened because the market managers doubt the value of traditional futures trade and other techniques. This doubt has come from the nature of the commodity as mentioned above. The need for futures trade has increased since the 1970's because of many factors mentioned in the beginning of this chapter. The producers of live cattle in Arizona as well as in the United States have used futures hedge as a price risk management technique in order to fix the effective selling price of the cattle.

New strategies are needed in order to provide feeders with more viable hedging choices. Using commodity options on live cattle futures contracts is another strategy which became available in October 1984 after the Commodity Exchange Act of 1982 removed the 1936 prohibition on trading options on futures contracts. There was a lack of

experience in using this technique by live cattle producers and also by marketing firms which made it difficult for the commodity options strategies to be implemented.

In order to reduce the risk, maximize gross returns and improve net profits, feeders of cattle may use the new marketing tool, options, which provide them with alternatives not available in traditional futures contracts. This flexibility has come from the nature of commodity options which can be exercised if the strike price is preferable to feeders and let expire if the market price is preferable to feeders. In the perfectly competitive market and with one-output-one-input profit model, feeders of cattle can make judgments about specific trading techniques. If the price is certain and assuming all other economic conditions constant, the profit model is as follows:

$$\pi = P(Q)-r(x) \qquad (1)$$

where P is the Price of commodity

Q is the amount that producers can supply in the market

r is the price of input

x is the amount of input used in the production and Q is the amount that can be produced from using x input, so

$$\pi = P \cdot f(x) - r(x)$$

where $f(x) = Q$ (2)

For the profit maximizing firm the first order condition is:

$$\frac{\partial \pi}{\partial x} = Pf'(x) - r = 0 \qquad (3)$$

$$P(MPP) = r$$

$$VMP = r \qquad (4)$$

where VMP is value of marginal product Equation (4) means that the price of input must equal to the value of marginal product of that input in order to maximize profit of that firm. This model, however, assumes that the price of the commodity is constant. In the real world, as has been mentioned above, the price of a commodity is changeable every day and feeders of live cattle are dealing with expected prices rather than a certain (constant) amount.

In 1971, Sandmo developed a "simple" risk model. This model is the same as the model discussed above except for the application of price uncertainty assuming producers are risk averse. In his model, Sandmo assumed that a firm is maximizing some utility of profit that is:

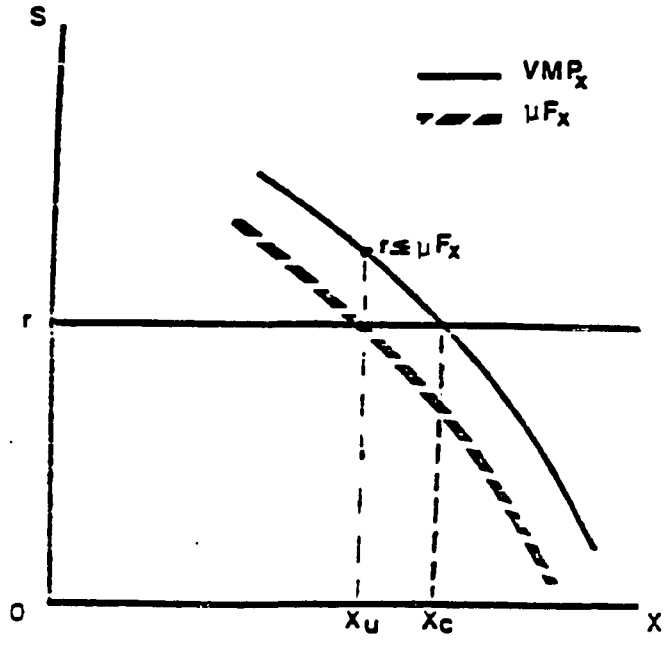

Figure 1. The optinal quantity demanded of input (X) under certainty and uncertainty equilibrium

$$E[U(P \cdot f(x) - rx)] \tag{5}$$

Where E means expectations operator.

and $$U = U(\pi) \tag{6}$$

Where U = utility

π = profit

By taking the first order condition for this model we get,

$$\mu F'(x) \geq r \tag{7}$$

Where μ = expected output price

Equation (7) shows that producers are dealing with expected value of marginal product and this expected value of certain input exceeds its price assuming its price is constant. So, the uncertainty in commodity price will cause the value of marginal produce curve to shift the left. This will lead to lower quantity demanded for input leading to lower production. This comparison between the two profit models, with certain and uncertain price, can be seen in graph 1.

As producers produce less, a consequently lower profit will be obtained. Therefore, they will try other marketing techniques that may stabilize the price and the value of marginal products.

Until recently, research on evaluation of alternative marketing strategies, including commodity options have not been done because of the lack of market premiums of options. But the provision of the mathematical model in 1976 by Black allows us to predict the options premiums for years that options were not traded. So, the evaluation may provide a good comparison for cattle feeders in order to make the choice clearer to them.

Chapter two will explain the mechanism and characteristics of commodity options on futures contracts and define the terminology used in options markets. Chapter three will provide an intensive research on options on live

cattle futures contracts during the first 14 months of trading and will present the economic model used for this research. Chapter four will explain in detail the 24 strategies that will be used to evaluate the effectiveness of options if they had existed during the 1966-1985 period, while the options premiums will be predicted mathematically. Chapter five will discuss the results of the strategies after computation of gross mean returns for each strategy. In this chapter mean-variance analysis and the stochastic dominance approach will be used in ranking the results of the alternative marketing strategies. Chapter six will evaluate the potential future role that options on live cattle futures contracts may play in the marketing of live cattle in Arizona.

CHAPTER 2

CHARACTERISTICS OF FUTURES CONTRACTS AND COMMODITY OPTIONS

Because commodity options are based upon futures contracts, a brief explanation of the characteristics of futures contracts is needed and will be presented in this chapter.

A futures contract is an agreement between the seller, who may be the producer of commodity, and the buyer for the seller to deliver the commodity at specified time in the future and at specified price. The futures price is variable and changes as people's expectations of future prices change. There is a general tendency for futures prices to move in the same direction of cash prices.

Futures contracts have traded on several commodities for more than 100 years. Live cattle futures trading was initiated on the floor of Chicago Mercantile Exchange in 1966.

Futures contract terms vary depending on the nature of commodity and exchange organization. Several delivery months are specified for each futures contract. For most agricultural commodities, including live cattle, the delivery must take place before five business days of

delivery month end. This enables the transaction and the delivery process to finish before the end of the specified month. For live cattle the Chicago Mercantile Exchange specifies six contract months as follow: February, April, June, August, october, and December.

These futures contracts are traded in organized markets and they are standardized to be identical in quantity, quality, and location of delivery. So, most trading focuses on the number of contracts and current futures price. The contract of live cattle contains 40,000 pounds of beef while the contract of corn contains 5,000 bushels of corn. Futures contracts will be settled by either delivering the commodity, or by offsetting the transaction in futures by taking opposite positions.

Hedging in futures contracts involves opposite transactions in cash and futures markets. Someone who buys the cash commodity would sell futures contracts to begin a hedge and buy futures contracts at the time the cash commodity is sold to end the hedge.

Before investigating commodity options and the resultant pricing process, it is pertinent here to review some general identifying characteristics of options. These characteristics have important effects on how the option strategies are applied and the potential affects that these strategies will have on gross income.

An option is a contract that conveys the right-but not the obligation-to buy or sell a futures contract at a fixed price during a specified time period. The right to sell futures contracts at a fixed price during a specified period of time is called a put option. the right to buy futures contracts at a fixed price during a specified period of time is called a call option. The seller of a put option has the obligation to buy a futures contract at the strike price if the buyer of the option exercises the option to sell before the expiration date of the option. The buyer of the option will usually close the position by selling the same option and telling the broker that it is a closing transaction without making or receiving delivery of the futures contract. The price at which an option can be exercised in the market is called the strike price. New strike prices will be opened for trading as futures prices rise or fall and a strike price is always available for trading several cents above or below the current futures price.

Option premium is the price that option buyers pay and option sellers receive in option transactions. But option premiums are not the only money that the option buyer has to pay. Option buyer and seller also pay a fee to their brokers. The broker's charges on the purchase or sale of options might be a separate commission for each sale and

each purchase. There might be an additional fee charged if the option is exercised. Buyers and sellers of futures contracts must deposit margin money with the broker. Only sellers of options must maintain a margin account with the broker.

Option premium is divided into two components, intrinsic value and time value.

Intrinsic value equals the strike price minus the price of underlying futures contract in the case of put options and is equal to the price of underlying futures contract minus strike price in the case of call options. A buyer of a put option would not exercise the option if the strike price is below the underlying futures price and buyer of call option would not exercise his option if the strike price is above the futures price. So, the intrinsic value is what the option is worth if exercised at current futures and strike prices and will be either positive or zero.

Option expiration: The option, like any other contract, has a validity period at which it can be used (exercised) and it expires several weeks before the last day of trading of the underlying futures contract. So exercising the option by the buyer must be done before expiration date of the option.

Someone who owns the commodity or is in the process of producing the commodity and wants to hedge would buy put options. An options buyer may also be someone who has definite intentions to buy a commodity sometime in the future and wants to avoid paying prices substantially above those currently available in the cash market. This hedger would activate the hedge by buying call options. Buying put options limits the loss which results from declining price of the commodity because the buyer will realize the difference between the strike price and futures price when the futures price is below the strike price at the time the buyer sells the put option to close the position.

An option seller (writer) is someone who expects to earn the premium paid by the option hedger for risking relatively unlimited losses if the futures price rises substantially after selling a call option or the futures price falls substantially after selling a put option. Professional options sellers commonly "hedge" their exposed positions in options by taking appropriate positions in futures contracts, and in this way they realize good gains with limited risk. Other option sellers operate in what is called covered options by selling call options representing quantities actually owned or purchased in futures contracts.

Gains or losses by hedgers in futures contracts are offset by similar cash market losses or gains. The option

hedger, unlike the futures hedger, has the right to sell (put option) futures contracts at the strike price which effectively sets a minimum selling price for the spot commodity that has been hedged, but the put option hedger gains all of the benefits or rises in the value of his spot commodity if the price goes up after he has paid the premium and brokerage fee. If the futures prices fall, the hedger will exercise the option and receive prices higher than market price. If the price increases, the hedger will not exercise his options and will lose the cost of the option (premium plus brokerage fee). So, using options as a hedge may provide farmers with less risk of price reduction without missing the opportunity to gain most of the benefits from higher market price if price rises.

Options are traded at several strike prices above and below the current futures contract price. When the strike price exceeds the current futures price in a put option and is below the current futures price in the case of call option, the option is said to be "in-the-money" and the difference is intrinsic value of the option. The option will be "at-the-money" if the strike price is equal to the current futures price. Finally, the option is said to be "out-of-money" if the strike price is less than futures price in the case of put options and above the futures price in the case of call options. "At-the-money" and

"out-of-money" options have no intrinsic value, but they do have time value.

Time value is the second source of option premium. Time value is a function of the "possibility" that an option will have increased intrinsic value some time before expiration. This is the reason that the"out-of-money" option will be traded at positive values.

The time value depends on five variables: the price of underlying futures contract, the difference between the strike price and the futures price, the time to expiration, the futures price volatility, and the interest rates. The time value of the option rises as the futures price rises. The time value of the option declines as the differential between the futures and strike price becomes larger. The time value, by definition, will decrease as the time approaches for the option expiration assuming that other factors are constant. The time value will rise with increased price volatility because the probability of option taking on intrinsic value is increased and therefore the option seller will insist upon a higher premium. The time value of option will decline as the interest rate increases becaue buying options becomes less attractive to the purchaser because he must pay the premium at the time of purchase and the benefits of the option, if any, come some time later.

General Assumptions of Options Market

1. Options are for delivery of futures contracts and for delivery of the actual commodity.
2. Options are traded on organized exchanges rather than individual dealer trading. This provides the traders and hedgers with more security about their transactions in commodity options.
3. Several strike prices above and below current futures price are traded.
4. Options can be bought or sold on any weekday except holidays. An option buyer can close the position by trading out the option any time before the expiration date. The option buyer does not need to exercise the option unless that is more beneficial to him than closing with an offsetting transaction or letting the option expire without any action.
5. The options are "American" options. This means that the option may be exercised any time before expiration. "European" options may only be exercised at expiration. The Black model represents European options, but adapting it to represent American options adds greatly to its complexity and changes the premiums only slightly.

CHAPTER 3

RESEARCH ON OPTION PREMIUMS

As mentioned in previous chapters, the lack of experience in trading commodity options made it difficult for traders to act using this type of hedging in the market. Similarly, it became difficult for researchers to carry out research on options. Until recently, the market premiums of options were not available to them for the study of the market pricing and marketing strategies. After 1976, and specifically, after the publication of the Black model which provides a mathematical model for computing market premiums of options, there was the possibility of computing premium for options for earlier years. For most researchers, the Black model is a starting point in options research and marketing behavior. Research on options premiums is needed to provide a basis for predicting values for option premiums in the past when options were not traded and to predict them in the future.

Put options on live cattle futures contracts began trading on October 30, 1984. Based on the market premiums of 1984 until the end of 1985, intensive research was done

in order to provide estimates of Black model parameters which may enable us to predict option premiums.

The Model

The value of option premiums consists of two major components: the intrinsic value and time value. The intrinsic value of put options is simply the difference between the strike price and futures price and it can be known exactly since the strike and futures prices are available. Time value (TV) needs research because of the complexity of its determinants.

This study computed daily time values of the February, April, June, August, October, and December put options using futures prices, strike prices, and premiums of options from October of 1984 until November 18, 1985. Note that the market premiums in this period are available because there was trading on options in this time period. The time value is the premium minus intrinsic value. On a put option the intrinsic value is equal to the strike price minus the futures price when the strike price is higher than the futures price. If futures price is higher than the strike price or the two prices are equal, then the intrinsic value is zero.

The analysis model was designed to fit the daily time values aggregated by month as a function of S-F. This model was a multiple regression function with two sides. One

side represents the option's time value when the option is in-the-money and the other side of function represents the option's TV when the option is out-of-money. The constant (intercept) is the time value of at-the-money options. As mentioned in Chapter 2, time value depends on five variables as follows: futures price, strike price, minus futures price, interest rate, volatility of futures price, and time to option contract maturation. Of these five variables, all but interest rate and volatility are readily observable or can be specified. Based on the fitted regression functions and the Black model, the study will summarize the relationships between TV and strike minus futures prices.

The special multiple regression equation will be as follows:

$$TV=b_0+b_1(S-F)d_1+b_2(S-F)^2d_1+b_3(S-F)d_2+b_4(S-F)^2d_2+e$$

where (S-F) is strike price minus futures price

d_1 and d_2 are dummy variables assuming

$d_1=1$ if $(S-F)<0$ $\quad$ $d_2=1$ if $(S-F)>0$

$d_1=0$ if $(S-F)>0$ $\quad$ $d_2=0$ if $(S-F)<0$

$d_1=1$ if $(S-F)=0$ $\quad$ $d_2=1$ if $(S-F)=0$

The application of dummy variables to this regression function allows the fitting of a continuous regression function to the data which provide excellent fit at the points of at-the-money and different slopes (curvatures) to the two sides of the equation. TV reaches the

maximum when S-F=0 and declines at a decreasing rate as the difference between strike price and futures price increases. The usage of dummy variables in this function provides excellent fit to the data compared with other forms of equations. For instance, using other forms of continuous regression functions fits data very poorly when S-F=0. When using dummy variables in this context, it has been found that the intercept value of the equation is a precise estimate of TV when the option is at-the-money.

The regression functions for each month of live cattle put options trading, beginning with November of 1984 and ending with November of 1985, are reported in tables 1 through 6. As mentioned in the previous chapters, live cattle industry has a continuous product in the usual sense. In this study all available futures contracts will be presented and investigated individually. Tables 1 through 6 show the estimated coefficients, standard errors, and adjusted R^2 of each month of options time values for February through December put options.

The intercept and slope coefficients in Tables 1 through 6 are used to estimate the time value of put options at-the-money and in-the-money and out-of-money options by 1, 3 and 5 cents. These are reported in Tables 8, 9, and 10. The study focuses on the most active trading contracts which are June, August and October.

Table 1. The Estimated Coefficients, Standard Errors and Adjusted R^2 of Each Month of Option Time Values for the February Put Options

Month	Constant	$(S-F)d_1$	$(S-F)^2d_1$	$(S-F)d_2$	$(S-F)^2d_2$	Adj R^2
November	1.301a	0.360	0.026	-0.325	0.020	0.948
(1984)	0.022b	0.012	0.001	0.021	0.004	
December	0.941	0.286	0.022	-0.333	0.035	0.891
	0.240	0.013	0.001	0.260	0.005	
January	0.429	0.158	0.014	-0.184	0.020	0.632
	0.027	0.016	0.002	0.028	0.005	

Source: Fitted Regression Functions.

a. The estimated coefficient of the constant.
b. The estimated standard error of the coefficient.

Table 2. The Estimated Coefficients, Standard Errors and Adjusted R^2 of Each Month of Option Time Values for the April Put Options

Month	Constant	$(S-F)d_1$	$(S-F)^2d_1$	$(S-F)d_2$	$(S-F)^2d_2$	Adj R^2
November	2.006a	0.535	0.044	-0.507	0.046	0.944
	0.033b	0.025	0.004	0.042	0.010	
December	1.689	0.431	0.033	-0.426	0.038	0.960
	0.021	0.017	0.003	0.023	0.004	
January	1.365	0.442	0.041	-0.426	0.038	0.932
	0.260	0.020	0.003	0.023	0.004	
February	0.643	0.306	0.025	-.320	0.029	0.903
	0.023	0.013	0.002	0.921	0.004	
March	0.597	0.313	0.041	-0.408	0.084	0.782
	0.045	0.047	0.010	0.037	0.006	

Source: Fitted Regression Functions.

a. The estimated coefficient of the constant
b. The estimated standard error of the coefficient.

Table 3. The Estimated Coefficients, Standard Errors and Adjusted R^2 of Each Month of Option Time Values for the June Put Options

Month	Constant	$(S-F)d_1$	$(S-F)^2d_1$	$(S-F)d_2$	$(S-F)^2d_2$	Adj R^2
November	2.316a	0.544	0.043	-	-	0.976
	0.038b	0.026	0.004	-	-	
December	2.165	0.494	0.037	-0.492	0.028	0.968
	0.036	0.028	0.004	0.061	0.014	
January	1.790	0.457	0.035	-0.447	0.031	0.967
	0.024	0.018	0.003	0.030	0.006	
February	1.521	0.410	0.030	-.302	0.008	0.990
	0.072	0.045	0.006	0.078	0.017	
March	1.487	0.437	0.034	-0.419	0.032	0.983
	0.014	0.009	0.001	0.010	0.002	
April	0.661	0.238	0.022	-0.217	0.018	0.535
	0.041	0.043	0.008	0.026	0.003	

Source: Fitted Regression Functions.

a. The estimated coefficient of the constant
b. The estimated standard error of the coefficient.

Table 4. The Estimated Coefficients, Standard Errors and Adjusted R^2 of Each Month of Option Time Values for the August Put Options

Month	Constant	$(S-F)d_1$	$(S-F)^2d_1$	$(S-F)d_2$	$(S-F)^2d_2$	Adj R^2
February	1.796	0.489	0.039	-0.344	-0.046	0.981
	0.021	0.019	0.004	0.077	0.042	
March	1.717	4.479	0.037	-0.487	0.038	0.968
	0.023	0.018	0.003	0.020	0.003	
April	1.691	0.462	0.035	-0.449	0.031	0.977
	0.018	0.017	0.003	0.013	0.002	
May	10709	0.434	0.030	-0.398	0.025	0.897
	0.037	0.026	0.004	0.020	0.002	
June	1.383	0.418	0.033	-0.407	0.032	0.951
	0.021	0.016	0.002	0.012	0.001	
July	0.743	0.232	0.020	-0.177	0.009	0.586
	0.045	0.042	0.007	0.018	0.001	

Source: Fitted Regression Functions.

a. The estimated coefficient of the constant
b. The estimated standard error of the coefficient.

Table 5. The Estimated Coefficients, Standard Errors and Adjusted R^2 of Each Month of Option Time Values for the October Put Options

Month	Constant	$(S-F)d_1$	$(S-F)^2d_1$	$(S-F)d_2$	$(S-F)^2d_2$	Adj R^2
April	1.786	0.485	0.038	-0.500	-0.044	0.980
	0.026	0.032	0.008	0.040	0.011	
May	2.069	0.488	0.033	-0.448	0.023	0.924
	0.040	0.036	0.006	0.041	0.009	
June	2.070	0.515	0.039	-0.468	0.030	0.979
	0.021	0.021	0.004	0.015	0.002	
July	1.950	0.472	0.035	-0.392	0.021	0.984
	0.037	0.026	0.004	0.020	0.002	
August	1.412	0.341	0.022	-0.321	0.020	0.786
	0.041	0.022	0.002	0.020	0.002	
September	0.725	0.267	0.025	-0.247	0.021	0.655
	0.048	0.036	0.003	0.037	0.004	

Source: Fitted Regression Functions.

a. The estimated coefficient of the constant
b. The estimated standard error of the coefficient.

Table 6. The Estimated Coefficients, Standard Errors and Adjusted R^2 of Each Month of Option Time Values for the December Put Options

Month	Constant	$(S-F)d_1$	$(S-F)^2d_1$	$(S-F)d_2$	$(S-F)^2d_2$	Adj R^2
May	2.219	0.628	0.066	-	-	0.954
	0.059	0.078	0.025	-	-	
June	2.067	0.523	0.044	-0.533	0.048	0.973
	0.025	0.030	0.007	0.048	0.014	
July	2.243	0.493	0.032	-0.461	0.027	0.959
	0.027	0.021	0.003	0.019	0.003	
August	1.989	0.437	0.026	-0.414	0.023	0.938
	0.031	0.016	0.002	0.026	0.004	
September	1.809	0.387	0.022	-0.430	0.028	0.974
	0.022	0.011	0.001	0.014	0.002	
October	1.239	0.239	0.011	-0.308	-0.171	0.887
	0.036	0.011	0.001	0.119	0.053	
November	0.344	0.071	0.004	-	-	0.444
	0.058	0.026	0.002	-	-	

Source: Fitted Regression Functions.

a. The estimated coefficient of the constant
b. The estimated standard error of the coefficient.

The calculation of these estimates is demonstrated in computing of the estimate of the time value for June put options in April 3 cents in-the-money is as follows:

$TV=1.216+(.421)3(0)+(.039)3^2(0)+(-.415)3(1)+(.037)3^2(1)$

Notice that while the option is in-the-money, d_1 will be equal to zero and d_2 will be equal to one as assumed in the dummy variable criteria.

Black and Scholes (1973) demonstrated a very interesting mathematical model for estimating option premiums on options on shares of corporate stocks. This model has been further developed by Black in order to make it consistent with options on commodities (Black 1976).

But before we adapt this model to the prediction of option premiums, this should be tested in order to provide some idea about the effectiveness of this model. In order to test this model, the premiums of February futures contract options of 1986 traded in August 1985 are used to compare with predicted premiums using Black model for the same period. This month has been selected arbitrarily for the study. The comparison of these premiums (predicted and actual) are reported in table 10. The predicted premiums in table 10 are estimated using Black model and applying the factors for this model. The test shows that predicted premiums are almost the same as the actual which gives us the idea of effectiveness application of Black model.

Table 7. The Estimated Time Values for June Put Options

Month	At-The-Money	Out-of-the Money			In-the-money		
	0	-1.00	-3.00	-5.00	1.00	3.00	5.00
		cents per pound					
November	2.35	1.85	1.10	0.70	-	-	-
December	2.17	1.71	1.02	0.63	1.71	0.92	0.36
January	1.79	1.37	0.73	0.37	1.37	0.72	0.32
February	1.52	1.14	0.56	0.22	1.23	0.71	0.27
March	1.49	1.08	0.44	0.04	1.10	0.50	0.14
April	1.22	0.84	0.32	0.12	0.84	0.32	0.12
May	0.66	0.44	0.12	-	0.46	0.18	0.06

Source: The intercept (constant) and slope coefficients.

Table 8. The Estimated Time Values for August Put Options

Month	At-The-Money	Out-of-the Money			In-the-money		
	0	-1.00	-3.00	-5.00	1.00	3.00	5.00
		cents per pound					
February	1.81	1.35	0.67	0.31	1.42	0.34	-
March	1.72	1.28	0.64	0.31	1.27	0.61	0.27
April	1.69	1.26	0.62	0.26	1.27	0.62	0.22
May	1.71	1.31	0.68	0.29	1.34	0.74	0.34
June	1.37	1.00	0.43	0.12	1.01	0.45	0.15
July	0.74	0.53	0.23	0.08	0.58	0.29	0.08

Source: The intercept (constant) and slope coefficients.

Table 9. The Estimated Time Values for October Put Options

Month	At-The-Money	Out-of-the Money			In-the-money		
	0	-1.00	-3.00	-5.00	1.00	3.00	5.00
		cents per pound					
April	1.79	1.34	0.67	0.31	1.33	0.68	0.39
May	2.07	1.61	0.90	0.45	1.64	0.93	0.41
June	2.07	1.59	0.88	0.47	1.63	0.94	0.48
July	1.95	1.51	0.85	0.47	1.58	0.96	0.52
August	1.41	1.09	0.59	0.25	1.11	0.63	0.31
September	0.73	0.48	0.15	0.02	0.50	0.17	0.02

Source: The intercept (constant) and slope coefficients.

Table 10. The Estimated and Actual Option Premiums on Options on February, 1986, Live Cattle Futures Contract Traded in August, 1985.

Date of Trading	Futures Prices	Actual Option Premiums	Predicted Option Premiums
	cents/lb	(actual) cents/lb	(Predicted)
8-1-85	59.20	3.10	3.01
8-2-85	59.28	3.05	2.98
8-5-85	60.55	2.45	2.40
8-6-85	59.88	2.75	2.38
8-7-85	59.55	2.90	2.89
8-8-85	59.75	2.85	2.37
8-9-85	60.23	2.55	2.39
8-12-85	60.15	2.60	2.39
8-13-85	58.88	2.32	2.34
8-14-85	59.13	3.17	3.45
8-15-85	59.20	3.25	3.46
8-16-85	58.83	3.40	3.44
8-19-85	58.28	3.67	3.42
8-21-85	58.23	3.60	3.42
8-22-85	57.48	4.00	4.04
8-23-85	58.40	3.45	3.43
8-26-85	58.15	3.65	3.42
8-27-85	58.50	3.40	3.43
8-28-85	57.60	3.72	4.04
8-29-85	57.20	4.17	4.03
8-30-85	57.60	3.92	4.04

10.Source: Chicago Mercantile Exchange and Black model.

The slight difference between the predicted premiums and actual premiums may be caused as a result of some errors in selection of predicted interest rate and volatility which have a large effect on option premiums.

The estimates of option premiums using this model are based on the variables as follows: price of underlying futures contract, strike price minus futures price, days to maturation, interest rate and percent of price volatility. The volatility of futures price is defined as the change in futures price as a result of change in stock price. (Appendix A provides the equation and variables that are used in the Black model). All of these five variables are readily observed in the data available or can be specified except interest rate and price volatility. In simplifying his model, Black assumed that the appropriate interest rate was riskless and constant. In this research, unlike Black's assumption of interest rate, the assumption is made that the appropriate rates of interest and volatility are those used by traders. There are infinite numbers of combinations of interest rate and volatility which cause the Black model to produce a single point on the time value function. Since the function used in this research is nonlinear, a particular combination of interest rate and volatility can be found that minimizes the sum of the absolute errors for at-the-money options and 1, 3, and 5 cents out- and in-the-money

options. It has been found that the absolute errors were very small and close to zero in most cases of computing a particular combination of interest rate and volatility. The interest rates and volatilities estimated by using Black model and regression function time values are reported in Tables 11, 12, and 13.

This study used the Black model for the estimation of interest rates and volatilities which then were used in Black model to estimate the options premiums in all the years included in the study (1966-1985) when there were no options trading at all. There are two types of interest rates and volatilities for each month's regression function, one of them based on the 1, 3 and 5 cents in-the-money and the other based on 1, 3, and 5 cents out-of-money.

It has been found that changes in interest rate has less effect on option premiums than changes in volatility. For example, a given percentage change in interest rate will result in a smaller percentage change in premiums in the opposite direction than the same percentage change in volatility.

These estimated interest rates and volatilities will be averaged over several months for options premiums prediction for the past years when options were not traded. These estimated premiums may be smaller or larger than the actual premium if they had been traded.

Table 11. Interest Rates and Volatilities Implied by Black Model for February and April Put Options

Month	February Interest Rate	February Volatility	Out-of-the Money	April Interest Rate	April Volatility
November	182.00	16.50		1.00	14.60
December	370.00	16.00		77.11	15.55
January	-	-		70.00	13.35
February	-	-		300.00	14.45
March	-	-		-	-
			In-the-Money		
November	-10.00	12.10		-10.00	14.20
December	-20.00	9.61		-20.00	12.35
January	-	-		-7.00	11.50
February	-	-		-7.00	9.65
March	-	-		-	-

Source: Regression function time value, futures prices, and strike prices using Black model.

Table 12. Interest Rates and Volatilities Implied by Black Model for February and August Put Options

Month	February Interest Rate	February Volatility	Out-of-the Money	April Interest Rate	April Volatility
November	2.00	14.45		-	-
December	25.00	15.50		-	-
January	45.00	14.65		-	-
February	78.00	14.55		10.00	12.85
March	50.00	15.15		12.00	13.25
April	100.00	15.85		35.00	15.30
May	-	-		70.00	18.50
June	-	-		110.00	18.40
			In-the-Money		
November	-	-		-	-
December	13.00	14.90		-	-
January	-1.00	12.90		-	-
February	-2.00	12.40		-	-
March	-2.00	13.90		5.00	13.10
April	-1.00	14.30		6.00	14.60
May	-	-		-10.00	16.10
June	-	-		-5.00	16.10

Source: Regression function time value, futures prices, and strike prices using Black model.

Table 13. Interest Rates and Volatilities Implied by Black Model for October and December Put Options

Month	February Interest Rate	February Volatility	Out-of-the Money	April Interest Rate	April Volatility
April	18.00	13.70		-	-
May	16.00	17.20		-16.00	12.85
June	8.00	18.90		12.00	15.05
July	70.00	22.85		19.00	18.25
August	351.00	26.40		60.00	19.70
September	-	-		152.00	23.40
			In-the-Money		
April	-2.00	12.80		-	-
May	10.00	16.90		-	-
June	3.00	18.70		-5.00	14.20
July	-13.00	20.00		2.00	17.45
August	-32.00	17.70		-5.00	17.10
September	-	-		-2.00	18.30

Source: Regression function time value, futures prices, and strike prices using Black model.

CHAPTER 4

ALTERNATIVE MARKETING STRATEGIES FOR ARIZONA CATTLE FEEDLOTS

Organized trading in futures contracts for live cattle was begun in 1966 and initiated on the floor of the Chicago Mercantile Exchange. This commodity, however, does not satisfy many characteristics which the writers on futures markets believed were required for successful futures contract trading such as storability of the product and seasonal pattern of production and storage. Nevertheless, live cattle futures contracts have been traded in significant volume since its early introduction. Until recently, most Arizona producers of live cattle did not use futures trading. Options trading had only limited use by Arizona traders since it is a very new strategy.

In order to determine whether using put options on live cattle futures contracts provides good hedging opportunities for producers of cattle in Arizona, 24 marketing strategies will be evaluated in this study. These strategies represent two major feeding period lengths, 120 days and 270 days which are common time periods for feeding "yearling" steers and "calves." These time periods for feeding are not only common in Arizona feedlots but they

also represent the extreme range in feeding fairly well.

The study will cover the period between 1966, the first year that live cattle futures contracts were traded, and 1985. Cash and futures prices are available throughout this period but options premiums are not. The research on put options on live cattle futures contracts during the time that they have been traded will provide the basis for predicting what options premiums would have been in the 1966-85 time period if they had been traded.

The variability and average level of gross income will be the primary focus as the evaluations of alternative marketing strategies. The strategies will include simple cash sale with no hedging, hedging with live cattle futures contracts, and hedging using put options on live cattle futures contracts. Table 14 summarizes the 24 strategies that will be evaluated. Each of the strategies is discussed in more detail following the table. The basic unit of quantity will be 40,000 pounds, which is the quantity in one live cattle futures contract.

Table 14. Alternative Marketing Strategies for Live Cattle Feeding Industry

Cattle Marketing Strategies for Arizona Feedlots					
No.	Days On Feed	Type Hedge	Start Feeding	Sell Cattle	Futures Contract Month
1	120	none	March	July	none
2	120	futures	March	July	Aug.
3	120	options	March	July	Aug.
4	120	none	June	Oct.	none
5	120	futures	June	Oct.	Oct.
6	120	options	May	Sept.	Oct.
7	120	none	Sept.	Jan.	none
8	120	futures	Sept.	Jan.	Feb.
9	120	options	Sept.	Jan.	Feb.
10	120	none	Dec.	April	none
11	120	futures	Dec.	April	April
12	120	options	Nov.	March	April
13	270	none	March	Dec.	none
14	270	futures	March	Dec.	Dec.
15	270	options	Feb.	Nov.	Dec.
16	270	none	June	March	none
17	270	futures	June	March	April
18	270	options	June	March	April
19	270	none	Sept.	June	none
20	270	futures	Sept.	June	June
21	270	options	Aug.	May	June
22	270	none	Dec.	Sept.	none
23	270	futures	Dec.	Sept.	Oct.
24	270	options	Dec.	Sept.	Oct.

(1) Cash sale of cattle in July, 120 days feeding, no hedge. Under this strategy, producers will sell their cattle at the cash price that prevails 120 days after feeding begins with complete exposure to price risk. This strategy assumes that producers start feeding their animals in March and sell them in July. The results of this strategy will be used as a basis of comparison for the other strategies that have approximately the same feeding period but use one of the hedging programs.

(2) Cash sale of cattle in July, 120 days feeding, futures hedge. This strategy uses traditional futures contract hedging that involves selling August futures contracts at the time the cattle are placed on feed in March. It is assumed that the producer finds it inconvenient to deliver his own cattle on the futures contract or to purchase other cattle for delivery on the futures contract. Therefore, when the 120 days feeding period ends in July, the producer sells the cattle that have been on feed at the best available price and buys live cattle futures contracts to offset futures contracts that were purchased in March. This allows us to compare the results of no hedging with hedging using futures contracts. Note that with feeding beginning and ending at mid month, the August futures contract would have

slightly more than one month to trade after the hedge is closed out. Gross income is adjusted for brokerage charges and interest cost of margin money.

(3) Cash sale of cattle in July, 120 days feeding, options hedge. This strategy gives the producers of cattle the right, but not the obligation, to seek futures contracts at the option's strike price until they expire approximately one month before trading ends in the underlying futures contract. In this strategy cattle are placed on feed in March and sold in July as in the first two strategies. Put options on the August live cattle futures contract at several different strike prices are purchased in mid March at the time the cattle are placed on feed. At the time the cattle are sold at the best available price, an offsetting sale of the put options is made if the option has intrinsic value. Since a few days would remain before the expiration of the option, it would likely have some small amount of time value remaining. In order that the computations may be simplified, this small amount of time value is ignored. The effect of ignoring the time value at the time of offsetting the options in all of the options strategies will be to very slightly reduce the average adjusted gross income. Gross income

is adjusted for costs directly resulting from the option trading.

(4) Cash sale of cattle in october, 120 days feeding, no hedge. This strategy is identical to strategy (1) except that producers will place their cattle on feed in June rather than in March and sell fed cattle in October. The length of feeding will be 120 days. Using different starting and ending times for the 120 days feeding periods will allow assessment of whether there are systematic effects on the three basic strategies tied to the time of the year that the cattle are on feed.

(5) Cash sale of cattle in October, 120 days feeding, futures hedge. This strategy suggests that producers place the animals on feed in June and sell October futures contracts at the same time. The fed cattle are sold in mid October, and October futures contracts are purchased at this time which is just a few days before the end of trading in that contract. Other than that the feeding takes place at a slightly different time of the year, (5) differs from (2) primarily in that the hedge is closed out nearer the end of trading of the futures contract which may or may not result in the basis being more predictable.

(6) Cash sale of cattle in September, 120 days feeding, options hedge. This strategy is very similar to strategy (3) except that producers will place animals for feed in May and buy put options on the October live cattle futures contract at that time. The fed cattle are ready for market in September with the put option position being closed out at that time if the options have intrinsic value then. It is necessary for feeding to begin one month earlier in (6) than in (4) and (5) because if feeding in (6) begin in June, the option on the October futures contract would have expired before the 120 day feeding period would have ended.

(7) Cash sale of cattle in January, 120 days feeding, no hedge. This strategy is similar to strategies (1) and (4) but it has feeding beginning in the middle of September and ending in the middle of January.

(8) Cash sale of cattle in January, 120 days feeding, futures hedge. This strategy is similar to (2) except that feeding begins in September, ends in January and the hedging is on the February live cattle futures contract.

(9) Cash sale of cattle in January, 120 days feeding, options hedge. This strategy has the same assumptions that were discussed in strategy (3) except that feeding

begins in September, ends in January and the option is on the February futures contract.

(10) Cash sale of cattle in April, 120 days feeding, no hedge. This strategy is identical to (1), (4), and (7) except that feeding begins in December and ends in April.

(11) Cash sale of cattle in April, 120 days feeding, futures hedge. This strategy will be the same as (5) but animals are placed on feed in December, sold in April and April futures contracts are used in the hedge.]

(12) Cash sale of cattle in March, 120 days feeding, options hedge. This strategy is similar to (6) except that the cattle are placed on feed in November, sold in March and the option is on the April futures contract.

In order to see if different lengths of feeding periods affect the effectiveness of different hedging strategies, the strategies (1) through (12) will be repeated with 270 day feeding periods. The results of hedging over a 9 month period will be somewhat more suspect than for the 120 day feeding periods since futures and options are generally not very heavily traded 9 months into the future. The 270 days feeding programs will naturally begin with smaller animals that are generally referred to as calves.

(13) Cash sale of cattle in December, 270 days feeding, no hedge. This strategy suggests that producers place their animals on feed in the middle of March and offer them for sale in the middle of December at prevailing cash price.

(14) Cash sale of cattle in December, 270 days feeding, futures hedge. Under this strategy, producers are assumed to place their animals in March and sell December futures contracts then. The cattle will be sold in December. This means that futures position will be closed by buying December futures contracts only a few days before the end of trading on that contract.

(15) Cash sale of cattle in December, 270 days feeding, options hedge. This strategy is similar to (6) and (12) in that feeding must begin and end one month earlier than in the preceding two strategies in order that the option will not have expired before the cattle are ready for market. In February cattle go on feed and put options on the December futures contract on live cattle are purchased at several different strike prices. The cattle are sold in mid November and the put options are closed with a sale if they have any intrinsic value at that time.

(16) Cash sale of cattle in March, 270 days feeding, no hedge. Cattle go on feed in June and are sold in mid March at prevailing cash price.

(17) Cash sale of cattle in March, 270 days feeding, futures hedge. This strategy is identical to strategy (14) except that feeding begins three months later and the April futures contract is used in the hedge. The April futures contract position will be closed with a buy more than one month from the end of trading in that contract.

(18) Cash sale of cattle in March, 270 days feeding, options hedge. This strategy differs from (15) in that cattle will be fed over the same time period as the preceding two strategies and the option is on the April futures contract.

(19) Cash sale of cattle in June, 270 days feeding, no hedge. This strategy is identical to strategies (13) and (16) but producers are assumed to place their animals on feed three months later than in (16)

(20) Cash sale of cattle in June, 270 days feeding, futures hedge. This strategy is the same as strategy (14) except that producers are assumed to place their animals on feed six months later and the hedging uses the June futures contract. The June futures contract is bought only a few days before trading ends.

(21) Cash sale of cattle in May, 270 days feeding, option hedge. This strategy is similar to (15), but it assumes that feeding begins 6 months later. As in (15) the feeding must begin one month earlier than in the preceding two strategies so that the option (on June contract) will not have expired before the cattle are sold.

(22) Cash sale of cattle in September, 270 days feeding, no hedge. This strategy is the same as strategies (13), (16), and (19) but under this strategy the animals are assumed to be placed for feed in December and ready for sale in September at the prevailing cash price.

(23) Cash sale of cattle in September, 270 days feeding, futures hedge. This strategy is identical to strategy (17), but under this strategy feeding begins 6 months later and October futures contracts are sold to place the hedge.

(24) Cash sale of cattle in September, 270 days feeding, options hedge. This strategy is the same as strategy (18), except that in this case the producers are assumed to start feeding 6 months later and the hedge is begun by buying put options on the October futures contract.

Note that the cash prices data are collected from Phoenix market prices; the futures prices data are collected

from the Yearbook of Chicago Mercantile Exchange, and the premiums data are predicted using the Black model.

CHAPTER 5

SUMMARY OF RESULTS OF ALTERNATIVE MARKETING STRATEGIES

In the previous chapter, 24 alternative marketing strategies were outlined. The selection of these strategies was based on discussions with several Arizona cattle feeders to determine relevant alternative strategies.

Using these assumptions, the results of alternative marketing strategies are reported in this chapter. The alternative marketing strategies include simple cash sale, hedging by selling futures contracts, and hedging by buying put options at-the-money and 1, 3, 5 cents in-the-money and out-of-the-money during the period 1966 through 1985.

To evaluate the strategies, the study calculates the average income and variability of income of each alternative strategy. The measure of variability used in this study is standard deviation. The calculations reflect all marketing costs including brokerage costs in futures contracts, premiums and brokerage fees in option contracts, and foregone interest on the money used in margins on futures contracts and/or premiums on option and brokerage costs. The prices of cattle have been adjusted to the value of the dollar in 1982. (See Appendix B).

Tables 15 through 22 show how the alternative pricing strategies could have preformed during the period of 1966-85 if the commodity options had been available for cattle feeders in this period. These results of option strategies show that buying put options 1, 3 and 5 cents in-the-money on the August futures contracts are mostly superior to all other option alternatives using mean-variance analysis regardless of the producers' preferences toward risk.

Tables 15 through 18 show the results of alternative marketing strategies assuming that cattle feeders place their cattle for feeding 120 days. These tables also represent strategies 1 through 12 in Table 14.

From Table 15, which represents the gross income of cash, August futures contracts and options on August futures contracts, the highest average income is obtained from hedging by selling futures contracts, but it has the highest variability of income at the same time. On the other hand, buying put options at 5 cents deep in-the-money shows higher average income than cash sales in the same time and has the lowest variability of income, but its average income is slightly below the average income received from futures contract hedging. All option strategies in Table 16 show higher average incomes than cash and futures contracts hedging, but all option strategies have higher variability

of income than cash and futures contracts hedging at the same time.

Based on mean-variance analysis, it has been found that some strategies provide better alternatives for cattle feeders than the others, but the superiority is not clear. These better strategies are buying put options at different level of in- and out-of-money on February, August and October futures contracts with a 4-month feeding period. Selling cattle at prevailing cash prices in April are alternatives in the 4-month feeding periods. In the 9-month feeding period, selling cattle at prevailing cash price in December is the best alternative, while selling December futures contracts provides higher average income but the high variability of its income made it a worse strategy. The best strategy in selling the cattle after 9 months of feeding in April using different strategies is not clear. Selling cattle at prevailing cash prices in June is the best strategy if cattle are placed for feed in 9 months. The best strategy in selling the cattle in October after the 9-month feeding period is not clear because the strategy that has a higher average income has the highest standard deviation and vice versa.

Analyzing all the tables, Tables 15 through 22, gives us the idea that judgment among alternative marketing strategies is not easy because the strategy that might be

selected as a high average income has high variability of income and vice versa. Therefore, the selection of a specified strategy to be a superior strategy against the others cannot be done by using the mean-variance technique. Another technique for ranking most of the strategies in this study is needed in order to make better decisions among selected strategies and to make the study more useful for cattle feeders.

Stochastic Dominance Technique

Decision making using mean-variance analysis is difficult and cannot yield obvious judgments among these alternatives. This study will use a more sophisticated technique in order to get an efficient set of decisions. A stochastic dominance (SD) approach will be used as a decision tool in order to determine an efficient set of alternative marketing strategies in an uncertain environment. The reason for using this technique is that SD provides more discrimination in the analysis than the mean-variance technique. Also under the SD approach, the selection of an efficient set of alternatives can be ordered depending on the preferences of the decision makers. Finally, the stochastic dominance technique ranks most probability distributions for the specified alternative (Wilson and

Table 15. The Gross Income of Each Year for Cash, Futures, and Options Hedge Using August Futures Contracts and Assuming 4-month Feeding Period for the Period of 1966-85

Trading Year	Type of Hedge								
	Cash no hedge	Futures cont-tracts	Options						
			-0.05	-0.03	-0.01	0.0	0.01	0.03	0.05
	$/40,000 lb								
1966	28067	30960	28452	28952	29401	29602	29763	30025	30235
1967	29138	30549	29699	28742	28173	29353	29494	29742	29935
1968	29091	28177	28697	29466	28136	27941	27702	27544	27686
1969	30958	32060	30474	30220	30643	30828	30965	31206	31405
1970	29836	30566	29351	29098	29173	29358	29499	29718	29917
1971	28107	27845	27705	27469	27143	26948	26952	27161	27303
1972	31863	28855	31432	31190	30860	30665	30426	29879	29267
1973	37269	34736	36509	36223	35871	35672	35437	34921	34359
1974	33161	36713	33976	34474	34922	35127	35288	35611	35799
1975	33401	27873	33037	32811	32486	32290	32052	31496	30870
1976	25037	28707	26259	26809	27279	27484	27641	27894	28081
1977	26159	28844	26502	27036	27488	27693	27854	28099	28275
1978	31938	31651	31478	31230	30901	30701	30682	30900	31053
1979	35598	39376	36598	37103	37556	37756	37918	38200	38438
1980	34129	35371	33491	33345	33463	33943	34084	34344	34569
1981	29170	30343	28719	28534	28965	29145	29286	29523	29720
1982	26964	26822	26637	26422	26105	25910	26021	26021	26347
1983	24376	26077	24057	24395	24838	25023	25174	25414	25574
1984	23823	24401	23528	23317	23274	23459	23596	23976	23945
1985	23100	21360	23201	23406	23614	23998	24213	24374	24537
Mean -a	29559	30064	29440	29462	29564	29644	29702	29803	29866
S.D. -b	3991	4237	3943	3914	3894	3878	3841	3794	3753

Source: Phoenix Market Prices, Chicago Mercantile Exchange, and Black Model and the Prices Are Adjusted to the Value of Dollar in 1982.

a= Calcualted Average Income
b= Calculated Standard Deviation

Table 16. The Gross Income of Each Year for Cash, Futures, and Options Hedge Using October Futures Contracts and Assuming 4-month Feeding Period for the Period of 1966-85

Trading Year	Type of Hedge								
	Cash	Futures	Options						
	no hedge	con-tracts	-0.05	-0.03	-0.01	0.0	0.01	0.03	0.05
	$/40,000 lb								
1966	26873	27182	28615	27368	27038	26851	26988	27206	27358
1967	27453	27293	28837	28937	29367	29552	29689	29945	30132
1968	26343	26385	27434	27198	26873	26678	26439	26620	26757
1969	26262	28494	27842	28349	28794	28999	29156	29413	29617
1970	26494	27144	26931	26690	26986	27167	27308	27534	27721
1971	28168	26585	28175	27945	27624	27424	27185	26634	26549
1972	29449	30145	27952	27700	27370	27171	26932	26860	27013
1973	32832	36976	39325	39815	40268	40468	40629	40911	41144
1974	28417	26834	29040	29542	29991	30191	30352	30614	30819
1975	30164	29053	30895	30659	30329	30161	29895	29344	28726
1976	25518	30359	28761	29315	29785	29990	30147	30404	30593
1977	26426	24583	24359	24140	24343	24528	24665	24877	25042
1978	29350	27006	31123	31152	31573	31754	31895	32157	32372
1979	33634	34397	35977	35695	35347	35479	35620	35855	36062
1980	33273	33046	33843	33584	33250	33055	32819	32273	31896
1981	28419	30177	30149	29912	29583	29387	29144	28793	28940
1982	25074	24466	24559	25099	25543	25746	25903	26148	26314
1983	23150	22465	22501	22295	22537	22722	22859	23064	23213
1984	23260	23751	23110	22907	22603	22733	22870	23061	23187
1985	21631	21825	19005	19562	20018	20223	20380	20611	20760
Mean-a	27610	27908	28372	28393	28461	28514	28544	28616	28711
S.D.-b	3262	3858	4646	4637	4611	4602	4596	4586	4590

Source: Phoenix Market Prices, Chicago Mercantile Exchange, and Black Model and the Prices Are Adjusted to the Value of Dollar in 1982.

a= Calculated Average Income
b= Calculated Standard Deviation

Table 17. The Gross Income of Each Year for Cash, Futures, and Options Hedge Using February Futures Contracts and Assuming 4-month Feeding Period for the Period of 1966-85

Trading Year	Type of Hedge								
	Cash	Futures	Options						
	no hedge	con-tracts	-0.05	-0.03	-0.01	0.0	0.01	0.03	0.05
	$/40,000 lb								
1966	26440	26100	27360	27510	27780	27976	28240	28433	28643
1967	28077	30181	27772	28279	28706	28898	29058	29316	29516
1968	27480	26825	27093	26861	26536	26340	26099	26184	26323
1969	27848	26209	27482	27255	26932	26737	26495	25942	25792
1970	27751	27173	27355	27120	26794	26598	26357	26515	26657
1971	26223	25579	25832	25598	25273	25077	24836	24931	25072
1972	30832	27206	30421	30183	29856	29659	29419	28871	28256
1973	34656	30776	34110	33844	33505	33308	33068	32532	31945
1974	38872	35597	38143	37859	37510	37310	37072	36554	35989
1975	28070	32932	30377	30923	31389	31592	31752	32010	32212
1976	29238	33488	30940	31485	31950	32153	32313	32572	32776
1977	24969	28056	25710	26244	26719	26924	27083	27329	27502
1978	26323	24802	26052	25849	25542	25348	25106	24538	24472
1979	34003	32603	33452	33187	32845	32650	32406	31875	31988
1980	34834	38208	35514	36005	36469	36660	36821	37098	37328
1981	31914	36440	33770	34297	34754	34956	35117	35386	35609
1982	25906	29701	27234	27785	28256	28460	28619	28872	29061
1983	24429	24052	24165	23964	23661	23464	23356	23848	23654
1984	26041	22767	25771	25569	25262	25068	24825	24258	23606
1985	20135	22361	22879	23164	23416	23652	23842	23968	24015
Mean-a	28702	29053	29071	29149	29158	29141	29094	29036	29021
S.D.-b	4359	4602	4098	4124	4187	4223	4200	4271	4283

Source: Phoenix Market Prices, Chicago Mercantile Exchange, and Black Model and the Prices Are Adjusted to the Value of Dollar in 1982.

a= Calculated Average Income
b= Calculated Standard Deviation

Table 18. The Gross Income of Each Year for Cash, Futures, and Options Hedge Using April Futures Contracts and Assuming 4-month Feeding Period for the Period of 1966-85

Trading Year	Type of Hedge								
			Options						
	no hedge	Futures contracts	-0.05	-0.03	-0.01	0.0	0.01	0.03	0.05
	$/40,000 lb								
1966	31180	30954	32377	32132	31802	31605	31365	30820	30212
1967	27814	29263	27143	27653	28080	28277	28437	28695	28892
1968	28220	25991	28280	28052	27729	27534	27292	26739	26339
1969	30380	26629	29288	29062	28739	28544	28303	27749	27122
1970	29314	28751	29962	29721	29393	29197	28956	28409	27796
1971	29411	25450	28895	28666	28343	28147	27906	27353	26729
1972	29740	27957	30517	30277	29949	29752	29512	28964	28743
1973	35893	34080	37018	36758	36421	36223	35984	35446	34853
1974	33586	39553	37646	38156	38604	38805	38967	39255	39494
1975	31246	32121	25741	26254	26684	26887	27047	27303	27497
1976	30361	27571	25931	26490	26961	27165	27324	27577	27766
1977	25232	24811	24845	24631	24316	24289	24427	24627	24756
1978	31879	25656	30309	30107	29800	29606	29364	28797	28143
1979	41942	36144	39437	39169	38830	38632	38392	37857	37273
1980	32887	38700	21779	22292	22742	22943	23104	23389	23626
1981	31138	34958	32030	32557	33015	33217	33378	33647	33869
1982	28370	23266	27312	27080	26755	26791	26930	27138	27290
1983	27551	22413	25580	25376	25069	24875	24632	24066	23415
1984	24953	23693	26129	25922	25612	25418	25175	24611	23964
1985	20994	22892	22985	23533	23979	24177	24335	24574	24733
Mean-a	30115	29043	29160	29194	29141	29104	29042	28851	28626
S.D.-b	4311	5293	4732	4642	4588	4558	4521	4482	4473

Source: Phoenix Market Prices, Chicago Mercantile Exchange, and Black Model and the Prices Are Adjusted to the Value of Dollar in 1982.

a= Calculated Average Income
b= Calculated Standard Deviation

Table 19. The Gross Income of Each Year for Cash, Futures, and Options Hedge Using December Futures Contracts and Assuming 9-month Feeding Period for the Period of 1966-85

Trading Year	Type of Hedge								
	Cash	Futures	Options						
	no hedge	con-tracts	-0.05	-0.03	-0.01	0.0	0.01	0.03	0.05
	$/40,000 lb								
1966	27867	33380	28388	28868	29275	29454	29492	29736	29917
1967	27936	29912	26321	26014	25945	26103	26131	26322	26486
1968	27877	25852	26770	26472	26097	25876	25528	25635	25755
1969	28369	29572	25959	25661	25282	25366	25399	25581	25717
1970	25635	30041	26166	26628	27044	27227	27275	27499	27663
1971	30887	26979	28734	28445	28070	27849	28506	26916	26271
1972	32271	27722	28407	28109	27730	27513	27161	26583	26621
1973	32277	39349	32011	31682	32028	32187	32197	32430	32619
1974	27338	37468	36775	37232	37626	37804	37835	38098	38305
1975	30384	24962	27859	27577	27207	26990	26647	26050	25401
1976	26635	30086	26260	26717	27134	27312	27365	27589	27753
1977	26498	28118	26027	26498	26884	27067	27119	27335	27490
1978	31812	29181	28071	27776	27403	27182	26852	26250	25610
1979	35749	39088	35361	35027	34634	34409	34042	34129	34282
1980	32985	32296	35352	35836	36252	36431	36474	36710	36886
1981	27137	31126	30764	31299	31734	31917	31978	32173	32310
1982	23127	24720	24031	23761	23396	23179	23098	23253	23355
1983	24751	24110	22371	22112	22169	22333	22374	22531	22662
1984	24744	23929	23780	23520	23154	22938	22599	22164	22260
1985	22652	22462	22301	22041	22089	22252	22293	22450	22586
Mean-a	28347	29518	28085	28064	28058	28069	27968	27972	27997
S.D.-b	3495	4902	4143	4275	4409	4429	4474	4516	4650

Source: Phoenix Market Prices, Chicago Mercantile Exchange, and Black Model and the Prices Are Adjusted to the Value of Dollar in 1982.

a= Calculated Average Income
b= Calculated Standard Deviation

Table 20. The Gross Income of Each Year for Cash, Futures, and Options Hedge Using April Futures Contracts and Assuming 9-month Feeding Period for the Period of 1966-85

Trading Year	Type of Hedge								
	Cash	Futures	Options						
	no hedge	con-tracts	-0.05	-0.03	-0.01	0.0	0.01	0.03	0.05
	$/40,000 lb								
1966	32818	29315	32186	31884	31504	31288	30935	30359	29722
1967	27341	30221	27486	27938	28341	28519	28563	28796	28968
1968	28647	30989	28289	28738	29114	29293	29336	29569	29742
1969	29651	25610	29073	28779	28404	28183	27840	27256	26611
1970	30383	27343	29746	29448	29069	28848	28500	24919	27282
1971	29267	26280	28680	28386	28037	27790	27447	26863	26435
1972	30937	28752	30327	30034	29655	29433	29086	28507	27900
1973	37537	28411	36814	36503	36119	35898	35545	34974	34346
1974	34669	37778	36551	37012	37411	37589	37622	37881	38079
1975	25789	26639	25184	24891	25043	25202	25439	25624	25783
1976	24338	25960	25279	25763	26184	26367	26419	26637	26796
1977	25157	30850	27976	28464	28881	29064	29107	29339	29511
1978	30578	25409	30082	29806	29435	29219	28876	28277	27624
1979	40000	29703	39278	38966	38582	38361	38009	37442	36814
1980	20526	23127	20130	20556	20931	21110	21143	21397	21591
1981	28539	33744	30757	31237	31649	31827	31866	32110	32290
1982	27699	31000	28242	28696	29090	29291	29339	29567	29739
1983	25854	23583	25418	25154	24788	24571	24233	23628	22964
1984	26417	23577	25985	25721	25360	25143	24805	24200	23531
1985	23049	24406	22614	22585	22984	23143	23189	23376	23508
Mean-a	28960	28135	29005	29028	29029	29007	28865	28686	28462
S.D.-b	4727	3714	4672	4602	4500	4457	4410	4377	4376

Source: Phoenix Market Prices, Chicago Mercantile Exchange, and Black Model and the Prices Are Adjusted to the Value of Dollar in 1982.

a= Calculated Average Income
b= Calculated Standard Deviation

Table 21. The Gross Income of Each Year for Cash, Futures, and Options Hedge Using June Futures Contracts and Assuming 9-month Feeding Period for the Period of 1966-85

Trading Year	Type of Hedge								
	Cash	Futures	Options						
	no hedge	con-tracts	-0.05	-0.03	-0.01	0.0	0.01	0.03	0.05
	$/40,000 lb								
1966	29236	29065	28653	28346	28604	28767	28795	28995	29163
1967	29677	34023	27093	27109	27481	27639	27658	27899	28080
1968	28796	28694	27834	28091	28472	28630	28668	28893	29061
1969	34250	25977	31811	31524	31154	30932	30589	29998	29349
1970	29901	27506	27898	27231	26838	26621	26278	25688	25348
1971	29411	28476	29422	29124	28749	28528	28180	27597	27432
1972	31931	26152	30279	29985	29611	29389	29046	28462	27817
1973	37372	30185	35878	35575	35191	34970	34622	34048	33411
1974	27666	39534	45158	45592	45984	46174	46191	46462	46682
1975	36609	31534	33505	33296	33663	33822	33840	34073	34258
1976	28852	32933	27344	27797	28199	28378	28426	28653	28825
1977	25387	28090	26955	27410	27826	28009	28057	28283	28451
1978	34393	24633	34098	33839	33478	33261	32927	32318	31643
1979	36483	32250	39009	38693	38309	38088	37727	37167	36544
1980	33769	37987	33961	34431	34834	35012	35048	35302	35491
1981	31161	35746	32213	32688	33090	33269	33304	33556	33745
1982	27899	27914	28865	28562	28183	27962	27614	27771	27890
1983	25557	23040	25620	25345	24979	24758	24419	23040	24238
1984	23613	23919	23832	23561	23196	23296	23337	23497	23616
1985	20583	23278	21361	21586	21980	22139	22191	22386	22523
Mean-a	30127	29547	30539	30488	30491	30482	30346	30204	30178
S.D.-b	4475	4731	5438	5480	5505	5510	5506	5584	5496

Source: Phoenix Market Prices, Chicago Mercantile Exchange, and Black Model and the Prices Are Adjusted to the Value of Dollar in 1982.

a= Calculated Average Income
b= Calculated Standard Deviation

Table 22. The Gross Income of Each Year for Cash, Futures, and Options Hedge Using October Futures Contracts and Assuming 9-month Feeding Period for the Period of 1966-85

Trading Year	Type of Hedge								
	Cash no hedge	Futures con-tracts	Options						
			-0.05	-0.03	-0.01	0.0	0.01	0.03	0.05
	$/40,000 lb								
1966	28067	27390	27421	27119	26740	26523	26171	26249	26372
1967	29268	33339	30478	30967	31379	31557	31605	31840	32012
1968	27823	27244	27241	26947	26573	26351	26004	26163	26278
1969	27568	26990	27248	26696	26321	26100	25979	26150	26269
1970	27354	28852	26703	26767	27148	27307	27335	27558	27722
1971	28552	26281	28014	27731	27356	27139	26796	26205	25555
1972	28412	25237	27825	27532	27157	26936	26592	26004	25363
1973	38667	36800	37877	37560	37172	36951	36594	36035	35736
1974	28725	38008	34670	35136	35539	35713	35748	36007	36200
1975	31293	29124	30570	30263	29875	29658	29301	28734	28154
1976	25997	29485	26851	27333	27758	27937	27994	28205	28364
1977	24695	27249	24694	25161	25556	25735	25792	26002	26157
1978	31683	25286	31192	30916	30550	30329	29990	29391	28733
1979	36654	35740	35724	35394	35001	34780	34414	34304	34454
1980	34344	38334	35220	35685	36087	36266	36300	36554	36747
1981	30568	33960	31086	31536	31948	32127	32166	32408	32589
1982	24536	24612	24113	23854	23493	23475	23512	23676	23778
1983	22779	22618	22391	22143	21781	21565	21597	21748	21828
1984	23380	23218	22953	22689	22630	22794	22835	22990	23117
1985	18891	22433	19937	20451	20885	21068	21134	21325	21461
Mean-a	28463	29110	28610	28594	28547	28516	28393	28377	28344
S.D.-b	4687	5143	4764	4782	4808	4809	4768	4724	4747

Source: Phoenix Market Prices, Chicago Mercantile Exchange, and Black Model and the Prices Are Adjusted to the Value of Dollar in 1982.

a= Calculated Average Income
b= Calculated Standard Deviation

Eidman, 1985). Under these circumstances the mean-variance analysis is of limited value.

Ordinary Stochastic Dominance

The stochastic dominance analysis is based on the expected utility maximization problem. So, a specified risky strategy in the distribution dominates another risky strategy in the same distribution if the expected utility of the first one exceeds the expected utility of the second one. If a set of risky prospects are dominated by another set, the analysis will narrow the number of risky prospects by eliminating the ones that are dominated and the other sets that are not dominated according to the analysis are called stochastically efficient sets (R.P. Zenter et al, 1981).

In order to obtain the stochastically efficient set, one needs to compare the computative distribution function. Under the ordinary stochastic dominance approach, the utility function is not required to be specified.

This approach, contains three concepts of efficiency. These are first degree stochastic dominance (FSD), second degree stochastic dominance (SSD), and third degree stochastic dominance (TSD). These concepts depend on the assumptions of utility functions which suggest that the producers are preferring more to less for the (FSD), the producers are risk averse for the (SSD), and the producers

are assumed to be decreasing absolute risk aversion for the (TSD).

Generalized Stochastic Dominance

The generalized stochastic dominance approach is an extension of the second-degree stochastic dominance decision rule by Meyer. In his approach Meyer has added a flexibility to the new decision rule and provided it with more discriminating power in order to differentiate between different risk preferences.

Meyer's assumption in his development of this approach is based on the Arrow-Pratt absolute risk aversion coefficient which can be observed from the distribution of alternative outcomes (Meyer, 1977b). The Arrow-Pratt coefficient is based on utility function assumptions. It is minus the ratio of second derivative of utility function to the first derivative and can be seen in the following equation:

$$A - P = - U''/U'$$

This ratio suggests that as the coefficient is positive, it reflects that the decision maker is risk averse, and the negative coefficient reflects risk preferring decision maker. And 0 coefficient shows risk neutral decision maker. Therefore, under this approach the utility functions of risky prospects have to be specified. The specification depends on the risk preferences of decision makers. Based on

this specification, which includes upper and lower bounds of absolute risk aversion functions, the generalized stochastic dominance provides procedures for ordering a pair of risky prospects in particular distributions of alternatives. This approach has been applied to the results in Table 15 through 22. In some times, this approach is called stochastic dominance with respect to function (SDWTF).

Assumptions on the Application of SDWTF

Our data have been divided into two groups. The first one provides 36 strategies based on a 4-month feeding length period and it contains different hedging techniques (risky prospects). The other group or class provides 36 strategies based on a 9-month feeding length period and it contains different hedging techniques.

The Arrow-Pratt coefficient, upper and lower bounds, are assumed as follows:

(1) [0, .001] for risk averse decision makers

(2) [-.001, 0] for risk preferring decision makers

(3) [.0002, .001], [-.0002, .0002], and [-.001, -.0002] show the Decreasing Absolute Risk Aversion for minimum levels of income, higher levels of income, and maximum levels of income, respectively.

Results from Alternative Marketing Strategies Using Applied SDWTF

Meyer has provided sufficient procedures for choosing among alternative risky outcomes with regard to specified risk preferences. These procedures imply choosing between a pair of risky alternatives (strategies). The procedures and calculation criteria have been used in order to find the best alternative strategy with respect to upper and lower bounds of risk aversion of the decision maker. This study consists of 36 strategies in each distribution which means that each strategy will be tested against 35 strategies. However, the results will show a lot of observations to be analyzed. Instead, the best five strategies that dominate the rest of the strategies are selected for each range of absolute risk aversion function (Arrow-pratt).

To simplify the presentation of results running on the mainframe computer of the University of Arizona for generalized stochastic dominance, some labels are applied to the alternative marketing strategies used in this study. For example, Opt1-5 means the first option strategy in the distribution 5 cents out-of-the-money which means in Table 23 buying put options on August futures contracts. Table 23 reports these results with mean/variance toward each strategy for each risk preference standard of decision

makers. These results for 36 strategies and a 4 month feeding length period is assumed. Table 24 shows the same results for 36 strategies but a 9 month feeding length period is assumed.

As assumed before, the most dominant strategies with respect to the risk aversion function intervals are selected in order to make the analysis simple and clear. From Table 23, when the cattle feeders are assumed to be risk averse so that their bound of upper and lower coefficients are positive, buying put options on August futures contracts 5 cents in-the-money is the dominant strategy in the distribution. Meanwhile, it dominates all 35 strategies at the specified range. Note the dominant strategy means that if the producer is risk averse, then he will select the strategy over other strategies available in the same distribution. The risk preferring producer will not select this strategy because another strategy will be preferable to him in the same distribution. By looking to the E/V column in the table, it has high average income but not the highest. At the same time, it has the lowest variability of income among all strategies in the table. This tells us that when producers of live cattle are risk averse, they will choose an option hedge at 5 cents in-the-money provided on August futures contracts because it provides them with little risk and slightly higher income.

Table 23. The Dominant Alternative Strategies for Risk Aversion, Risk Preferring, and Decreasing Absolute Risk Aversion Decision Makers and 4-Month Feeding Period for the Period 1966-85*

Strategy	Mean	S.D.	Risk Aversion[1]	Risk Preferring[2]	DARA[3]
Cash 1	29,559.25	3890.00	-	-	-
Future 1	30,064.30	4129.75	-	-	-
Opt 1-5	29,440.15	3843.10	-	-	-
Opt 1-2	29,462.10	3815.81	-	-	
Opt 1-1	29,564.55	3795.52	5	-	-
Opt 10	29,644.80	3779.78	4	-	4
Opt 11	29,702.35	3744.00	3	-	3
Opt 13	29,803.40	3698.13	2	-	2
Opt 15	29,865.75	3657.83	1	-	1
Cash 2	27,609.50	3179.50	-	-	-
Future 2	27,908.30	3760.90	-	-	-
Opt 2-5	28,371.65	4528.84	-	-	-
Opt 2-3	28,393.20	4519.50	-	-	-
Opt 2-1	28,461.10	4494.41	-	-	-
Opt 20	28,513.95	4486.13	-	-	-
Opt 21	28,543.75	4479.63	-	-	-
Opt 23	28,616.20	4470.00	-	-	-
Opt 25	28,710.80	4474.34	-	3	-
Cash 3	28,702.05	4248.81	-	-	-
Future 3	29,052.80	4485.22	-	-	-
Opt 3-5	29,071.60	3994.20	-	-	-
Opt 3-3	29,149.05	4019.29	-	-	-
Opt 3-1	29,157.90	4081.13	-	-	
Opt 30	29,141.50	4116.09	-	-	-
Opt 31	29,094.20	4152.77	-	-	-
Opt 33	29,036.60	4163.27	-	-	-
Opt 35	29,020.80	4175.21	-	-	-
Cash 4	30,104.55	4202.14	-	1	5
Future 4	29,042.65	5159.11	-	2	-
Opt 4-5	29,115.20	4608.62	-	5	-
Opt 4-3	29,194.40	4524.63	-	5	-
Opt 4-1	29,141.15	4471.98	-	4	-
Opt 40	29,114.05	4448.25	-	-	-
Opt 41	29,041.50	4406.94	-	-	-
Opt 43	28,850.90	4368.39	-	-	-
Opt 45	28,625.60	4367.96	-	-	-

[1] [0, .001]
[2] [-.001, 0]
[3] [.002, .001] [19,005, 23,384.66] [-.0002, .0002] [26,384.66, 33,704.33] [-.001, -.0002] [33,764.33, 41,144.00]

*The numbers under risk preferences classes mean that two strategies are ordered with regard to dominant degree.

Table 24. The Dominant Alternative Strategies for Risk Aversion, Risk Preferring, and Decreasing Absolute Risk Aversion Decision Makers and 9-Months Feeding Period for the Period 1966-85.*

Strategy	Mean	S.D.	Risk Aversion[1]	Risk Preferring[2]	DARA[3]
Cash 1	28,343.10	3407.44	-	-	-
Future 1	29,517.65	4778.29	5	-	3
Opt 1-5	28,065.40	4038.60	-	-	-
Opt 1-2	28,063.75	4167.22	-	-	
Opt 1-1	28,057.65	4297.19	-	-	-
Opt 10	28,069.45	4336.62	-	-	-
Opt 11	27,968.25	4360.50	-	-	-
Opt 13	27,971.70	4460.44	-	-	-
Opt 15	27,997.45	4632.49	-	-	-
Cash 2	28,959.80	4607.60	-	-	-
Future 2	28,134.85	3620.48	-	-	-
Opt 2-5	29,004.85	4553.87	-	-	-
Opt 2-3	29,028.05	4485.50	-	-	-
Opt 2-1	29,029.05	4386.14	-	-	-
Opt 20	29,006.95	4344.00	-	-	-
Opt 21	28,814.95	4298.60	-	-	-
Opt 23	28,686.05	4266.35	-	-	-
Opt 25	28,461.80	4265.70	-	-	-
Cash 3	30,127.30	4362.00	-	-	-
Future 3	29,546.35	4611.76	2	-	3
Opt 3-5	30,544.45	5298.77	-	-	5
Opt 3-3	30,488.35	5341.35	-	5	4
Opt 3-1	30,491.05	5365.88	4	4	3
Opt 30	30,482.20	5370.05	1	3	1
Opt 31	30,345.85	5367.22	3	4	2
Opt 33	30,204.40	5442.06	5	2	2
Opt 35	30,178.35	5356.80	2	1	1
Cash 4	28,462.80	4568.38	-	-	-
Future 4	29,110.00	5013.30	-	-	5
Opt 4-5	28,610.40	4643.99	-	-	-
Opt 4-3	28,594.00	4661.06	-	-	-
Opt 4-1	28,547.45	4686.00	-	-	-
Opt 40	28,515.55	4687.68	-	-	-
Opt 41	28,392.95	4647.35	-	-	-
Opt 43	28,377.40	4605.00	-	-	-
Opt 45	28,344.45	4627.44	-	-	-

[1] [0, .001]
[2] [-.001, 0]
[3] [.0002, .002] [18,891.00, 28,154.67]
[-.0002, .0002] [28,154.67, 37,418.33]
[-.001, -.0002] [37,418.33, 46,682.00]

*The numbers under risk preferences classes mean that two strategies are ordered with regard to dominant degree.

Buying options on October futures contracts at 5 cents out-of-the-money is dominated by all strategies in the distribution because it reflects a high risk with a slightly lower average income. This makes this strategy the least desired by decision makers who do not want to take risks in marketing their products. Buying put options on August futures contracts one cent out-of-themoney, at-the-money, and 1, 3, 5 cents in-the-money provide the dominant strategies in the distribution when cattle feeders do not want to take risks. This provides the consistency of the model used in this test with the coefficients of utility functions assumed for risk averse. These strategies have higher average income than most of the strategies in the distribution while they have the lowest standard deviation.

In the same distribution, assuming that the decision makers are risk preferring, selling the cattle at prevailing cash prices in April would have provided a dominant strategy over all alternative strategies. This strategy provides the highest average income, which means that decision makers who like to take risks will prefer this strategy over all other strategies. Also, hedging by selling April futures contracts, buying put options on April futures contracts at 5, 3, and 1 cent out-of-the-money, and buying put options on October futures contracts 5 cents in-the-money are dominant over the rest of the strategies in the distribution.

For decreasing absolute risk aversion intervals which assumes that as the gross income of cattle producers increase, the producers' attitudes favorable toward taking risk increase and the risk averse attitudes decrease. The results show that most strategies are indistinguishable for Table 23 because the strategies that have been selected to be dominant for risk averse producers are almost the dominant strategies under the intervals.

For strategies where the cattle are assumed to be placed on feed for 4 months, the cattle feeders are found to be mostly indifferent among strategies because the period is so short that they cannot switch from risk averse to risk preferring in this short period of time. Therefore, they will select the same strategies. On the other hand, once feeders have 9 months for delivery of animals, the period is long enough so that they can switch and change their attitudes toward risk easily. Therefore, the results are consistent with the absolute risk averse function intervals range used in the stochastic dominance test because as income increases, the producers will select some strategies that provide higher income, taking some risk instead of risk averse attitudes.

Table 24 provides the same analysis as Table 23 except that the strategies in Table 23 are assumed to be on a 4-month feeding length period while the strategies in

Table 24 are assumed to be on a 9-month feeding length period. The same Arrow-Pratt coefficients are applied to Table 24. Results in Table 24 show that buying put options at-the-money on June futures contracts is the dominant strategy for risk averse while buying put options 5 cents in-the-money on the same futures contracts is the dominant strategy for risk preferring producers. The dominant strategies for both risk averse and risk preferring producers are found to be in buying options on June futures contracts but in different orders.

To illustrate the relationships between strategies with different dominant degrees (i.e., dominant strategy number 1, 2, ..., etc.), Figure 2 shows the cumulative probability distributions for strategies that have dominant power over each other. The results used in this figure are provided from Table 24 for risk averse decision makers. The cumulative probability distribution in Figure 2 shows that Opt 3-5 strategy dominates Cash 2 over all distribution of income, but it does not dominate Opt 35 at the same absolute risk aversion function.

Most of the dominant strategies for 4-month and 9-month feeding length period distributions are option strategies regardless of risk preferences of decision makers. But the dominance of these risky alternatives does not indicate the superiority of using options as alternative

techniques for trading cattle because as shown in tables 23 and 24, the strategy that dominates at specified levels of in- or out-of-the-money does not represent a necessary dominance for all options on different contracts. For example, buying put options on August futures contracts 5 cents in-the-money is a dominant strategy for the risk averse in Table 23, but this does not mean that buying put options at 5 cents in-the-money is a dominant strategy at any other time for risk averse if it used on different futures contracts. Selling the commodity at prevailing cash prices is the dominant strategy only for risk-preferring individuals on the 4-month feeding ending in April, which means that using this strategy might be substituted for option strategies if the decision maker wants to take risk in his trading decisions.

Producers may change their attitudes toward risk and the risk averse producers prefer risk in their decision as income increases. Option strategies seem to be the dominant strategies over cash and futures hedge techniques. This indicates that the dominance test toward different intervals of risk preference is consistent with the decision making that selects among marketing strategies. For instance, cash

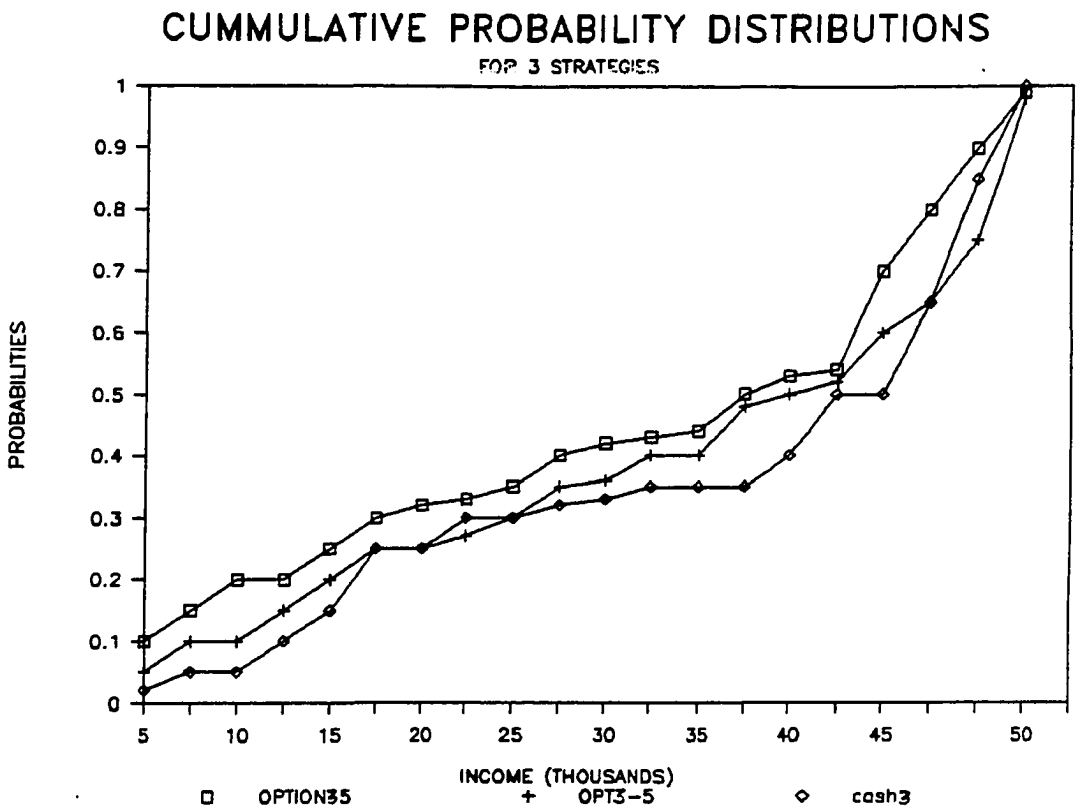

Figure 2. Illustration of probability distributions where opt 3-5 dominates Cash 3 but not opt 35.

strategy is mostly selected by producers who accept risk in trading their commodities. But options as a new trading technique has had limited use in trading cattle. So these cash strategies may be the best alternative for decision makers who prefer to take risk in the exchange. For example, selling cattle at prevailing cash prices in July after 4-month feeding is preferred to all option strategies over the risk interval range of [-.001, 0], but all options strategies are preferred to cash over the risk interval range of [0, .001]. The same results of stochastic dominance were used to demonstrate the dominant strategy if the strategies are limited to specific feeding periods. For example, the strategies in table 15 are tested alone and so on. The results are reported in tables 25 and 26.

Table 25. The Dominant Alternative Strategies for Risk Averse, Risk Preferring, and DARA Decision Makers for Each Set of Strategies Based on the Time of Trading and 4-Month Feeding Period for the Period of 1966-85.

Strategy	Risk Averse	Risk Preferring	DARA
Cash 1	-	2	-
Fut 1	-	1	-
Opt 1-5	-	-	-
Opt 1-3	-	-	-
Opt 1-1	-	-	-
Opt 10	-	-	-
Opt 11	3	-	3
Opt 13	2	3	2
Opt 15	1	-	1
Cash 2	-	-	-
Fut 2	-	-	-
Opt 2-5	-	-	-
Opt 2-3	-	-	-
Opt 2-1	-	-	-
Opt 20	-	-	-
Opt 21	3	3	3
Opt 23	2	2	2
Opt 25	1	1	1
Cash 3	-	-	-
Fut 3	-	-	-
Opt 3-5	-	-	-
Opt 3-3	1	1	-
Opt 3-1	2	2	1
Opt 30	3	3	2
Opt 31	-	-	-
Opt 33	-	-	-
Opt 35	-	-	-
Cash 4	-	1	Indifferent
Fut 4	-	2	"
Opt 4-5	-	-	"
Opt 4-3	-	-	"
Opt 4-1	3	3	"
Opt 40	2	-	"
Opt 41	1	-	"
Opt 43	2	-	"
Opt 45	2	-	"

Table 26. The Dominant Alternative Strategies for Risk Averse, Risk Preferring, DARA Decision Makers for Each Set of Strategies Based on the Time of Trading and 9-Month Feeding Period for the Period of 1966-85.

Strategy	Risk Averse	Risk Preferring	DARA
Cash 1	1	-	Indifferent
Fut 1	2	1	"
Opt 1-5	3	-	-
Opt 1-3	-	-	-
Opt 1-1	-	-	-
Opt 10	-	-	-
Opt 11	-	-	-
Opt 13	-	3	-
Opt 15	-	2	-
Cash 2	-	1	Indifferent
Fut 2	-	-	-
Opt 2-5	-	2	-
Opt 2-3	-	3	-
Opt 2-1	2	-	-
Opt 20	1	-	-
Opt 21	3	-	-
Opt 23	-	-	-
Opt 25	-	-	-
Cash 3	-	-	-
Fut 3	-	-	-
Opt 3-5	-	-	-
Opt 3-3	-	-	-
Opt 3-1	-	-	3
Opt 30	1	3	2
Opt 31	2	-	3
Opt 33	-	2	3
Opt 35	-	1	1
Cash 4	-	-	-
Fut 4	1	-	1
Opt 4-5	-	3	-
Opt 4-3	-	2	-
Opt 4-1	-	1	-
Opt 40	-	2	-
Opt 41	-	-	-
Opt 43	-	-	3
Opt 45	-	-	2

A review of the results from Table 24 which provides the dominant strategies when cattle feeders place their animal for a 9-month feeding period shows that buying put options on June futures contracts are the dominant strategies for risk averse and risk preferring decision makers except for using futures contracts which indicates that these strategies are the alternatives which will be selected by cattle feeders regardless of risk preferences of decision makers. This might reflect the fact that the cattle market is highly effective throughout the summer season.

CHAPTER 6

POTENTIAL USE OF OPTIONS ON LIVE CATTLE FUTURES CONTRACTS

Using futures contracts in live cattle trading has been provided for cattle producers in the United States since 1966. From that date until recently, the forward pricing for cattle has been acceptable for the majority of producers who used significant volume. Nevertheless, this active futures trade reported from the Chicago Mercantile Exchange shows that some producers of live cattle did not use this type of hedge. In Arizona, for example, most of the producers are doubtful about futures because they consider the futures trade as a high risk strategy. As suggested by many researchers, the futures trade might increase the losses of producers if they are exposed to failure of production and then they cannot deliver their product. So the question raised in this context is whether all cattle producers are determined to be risk averse. An empirical study for estimating risk preferences of swine producers in Minnesota by Wilson and Eidman shows that 76 percent of swine producers fell within the absolute risk aversion intervals of (-.002, .001) which reflect risk preferring attitudes of producers. Therefore, the assumption that

agricultural producers are risk averse decision makers is no longer valid. Hedging by buying put options on live cattle futures contracts became available in late 1984. It has been a short period of time for commodity options to be traded. For solving the lack of experience problem, the Black model has been applied in the predictions of option premiums in the years where options were not available. This model has been tested by many researchers, and in this study as well, and the predictions have proven to be consistent with the actual premiums. Using these predictions, the gross income minus direct marketing costs of each year for the period of study showed how options could have performed if the options were available to cattle producers.

In reviewing the average of income for all alternative strategies, it has been found that option strategies raised the average income over cash sales in years when cattle prices dropped substantially during feeding and lowered income when cattle prices were unchanged or rose during feeding. The users of options will generally be better off with continuous use of options because they will prevent immediate loss of money from using no hedging when prices decline or losing money on the futures position when prices rise.

The computation of average and standard deviation of gross income on 72 pricing strategies (56 are option strategies at several levels of in- or out-of-the-money put options) produced no clearly preferred strategies. The use of generalized stochastic dominance with absolute risk aversion function intervals has provided better analysis because it allows for producers with different risk preferences. The results show that the selection among alternative marketing strategies depends on the attitudes of cattle producers toward the risk.

The previous chapter indicates that the option hedges are affected by the futures contract month on which it is hedged. Option hedge was found to be effective in providing dominant strategies. For example, buying put options at 5 cents in-the-money may be the dominant strategy on a specified futures contract month but may not be the dominant strategy when another futures contract month is used. It has been found that when different options strategies of in- and out-of-the-money levels on specified futures contracts are dominant strategies, the degree of dominance will decrease as we move from in-the-money to out-of-the-money. Another observation from the results of stochastic dominance analysis is that options alternatives are found to be dominant strategies for risk averse and risk preferring

decision makers with the exception of one or two cash alternatives.

With the assumption of decreasing absolute risk aversion, which assumes that as a risk averse decision maker realizes more income he will be come more risk preferring, the results show that the time between hedging and delivery does affect the producers' attitudes toward risk as gross income changes. In the 4-month feeding period, the strategies that dominated with respect to decreasing absolute risk aversion intervals were found to be the dominant strategies with respect to decreasing absolute risk aversion intervals. On the other hand, with the assumption of 9-month feeding periods, the strategies that dominated with respect to risk preferring intervals were found to be the dominant strategies with respect to decreasing risk aversion intervals. Therefore, the cattle producers may switch from risk averse to risk preferring or reduce their risk averse function as the time between the hedging and delivery gets longer.

Commodity options seem to be the best alternatives for cattle producers based on the evidence provided by the generalized stochastic dominance approach throughout the period of study. The selection of a particular option strategy depends on the intervals of the absolute risk aversion function. The accuracy of selecting any option

strategy is based on the accuracy of the determination of the utility function of cattle producers.

As shown previously, the intervals of the absolute risk aversion function used in this study were consistent with the probability distribution of gross income of alternative marketing strategies. Without specifying these intervals, the stochastic dominance approach is useless.

The flexibility of commodity options allows the buyer of the put option to allow it to expire if the futures price of cattle is above the strike price and to exercise the option if the futures price of cattle is below the strike price is consistent with the nature of cattle feeding as a continuous production process and the highly fluctuating cattle prices. Options on live cattle have the potential to substantially affect the marketing and pricing of fed cattle.

APPENDIX A

APPENDIX A

The differential equations that are used in the Black model to estimate the value of commodity options are as follows:

$$w(x_1 t) = e^{r}(t - t^*)[XN(d_1) - c^* N(d_2)],$$

$$d_1 = \left[ln\frac{x}{c^*} - \frac{s^2}{2}(t^* - t)\right] \mid s\sqrt{(t^* - t)},$$

$$d_2 = \left[ln\frac{x}{c^*} - \frac{s^2}{2}(t^* - t)\right] \mid s\sqrt{(t^* - t)}.$$

where:

$w(x,t)$ = the value of commodity option,

c^* = the exercise price,

x = the futures price,

$(t^* - t)$ = the days to maturity,

$N(d)$ = the cumulative normal density function,

$xe^{n(t-t^*)}$ = the same as the value of an option on a security (Black and Scholes, 1973) that pays a continuous dividend at rate equal to stock price times the interest rate when the option can only be exercised at maturity,

r = interest rate (constant through time),

s^2 = the variance rate (constant through time),

Tax and transaction cost = zero.

APPENDIX B

Table 1-B. Deflated cattle prices (1982=100) cash and futures only

Sale Year	Cash		Feb. Futures		Aug. Futures	
	Jan.	July	Sept-1	Jan	Mar	July
1966	7051	7017	7043	7057	7963	7223
1967	7019	7285	7598	7052	7286	6911
1968	6870	7273	6870	7003	6920	7117
1969	6962	7740	6696	7071	7646	7346
1970	6938	7459	6946	7060	7632	7424
1971	6556	7027	6906	7036	6979	7016
1972	7708	7966	7067	7930	7216	7927
1973	8664	9317	8118	9044	9608	10202
1975	9718	8290	9404	10181	9290	8388
1976	7018	8350	7675	6451	6684	8015
1977	7310	6259	7704	6631	7091	6160
1978	6242	6540	6648	5858	6736	6047
1979	6581	7984	5873	6219	7444	7487
1980	8501	8900	8149	8464	9462	8505
1981	8708	8532	9076	8218	8760	8426
1982	7978	7293	8570	7429	7393	7076
1983	6477	6741	7184	6223	6357	6364
1984	6117	6094	5813	5878	6315	5869
1985	6510	5956	5865	6642	6089	5919

Table 2-B. Deflated Cattle Prices (1982=100) Cash and Futures 1966

Sale Year	Cash		April Futures				
	March	April	June-1	Nov-1	Dec-1	March	April
1966	8205	7795	7183	7307	7900	7991	7927
1967	6835	6953	7688	7530	7453	6959	7068
1968	7162	7155	7751	6710	6710	7151	7230
1969	7413	7595	6869	6668	6926	7808	7820
1970	7596	7329	7195	7146	7393	7892	7504
1971	7317	7353	6913	6744	6674	7355	7620
1972	7734	7435	7040	7135	7166	7532	7576
1973	9384	8973	7684	7911	8644	9848	9062
1975	8667	8397	9589	9788	9552	8323	8057
1976	6447	7811	7017	7383	7583	6777	7339
1977	6084	7590	7059	7180	6710	6151	7367
1978	6289	6308	7607	6244	6279	6200	6354
1979	7644	7970	6381	5851	6216	7591	7718
1980	10000	10486	7676	8242	8615	10122	10013
1982	7135	7785	8301	8561	8143	7011	7175
1983	6925	7092	7636	6866	5982	6805	7199
1985	6604	6238	5974	6016	6275	6623	6557
1986	5762	5248	6003	6205	6160	5641	5665

Table 3-B. Deflated Cattle Prices (1982=100) Cash and Futures

Sale Year	Cash		June Futures			
	May	June	Aug-1	Sept-1	May	June
1966	7337	7309	7522	7207	7253	7213
1967	6981	7419	8265	8014	7877	6932
1968	7126	7199	7369	7005	6921	6995
1969	8088	8563	6642	6647	8193	8605
1970	7017	7475	6776	6926	7196	7374
1971	7506	7353	7007	7131	7382	7321
1972	7716	7983	6913	6918	7950	8275
1973	9138	9343	7401	8084	9454	9780
1975	8311	6917	11945	9519	8055	6624
1976	8599	9152	8567	8041	8237	9228
1977	6795	7213	7624	7648	6893	6630
1978	6618	6347	7459	6880	6652	6193
1979	8626	8598	5820	5998	8380	8315
1980	9948	9121	7989	8320	9450	9304
1981	8252	8442	8992	9237	7987	8185
1982	7606	7790	8714	8992	7512	7852
1983	7374	6975	7188	7226	7295	7187
1984	6525	6389	6280	5923	6497	6494
1985	6075	5903	6217	6226	6132	6117
1986	5455	5146	6129	6125	5700	5440

Table 4-B. Deflated Cattle Prices (1982=100) Cash and Futures

Sale Year	Cash		Oct Futures				
	Sept	Oct	Dec-1	May	June	Sept	Oct
1964	6938	6653	0	0	0	0	0
1965	7205	6911	6950	7513	7571	7487	7481
1966	7017	6718	7249	7379	7289	7377	7185
1967	7317	6863	7845	7219	6986	6829	6997
1968	6956	6586	6903	6901	7013	7008	6974
1969	6892	6566	6877	7618	7560	6919	6983
1970	6838	6624	7284	7151	7038	6888	6850
1971	7138	7042	6630	6784	6813	7143	7174
1972	7103	7362	6914	7468	7617	7644	7417
1973	9667	8208	8034	9310	9606	8448	8558
1975	7181	7104	9368	7812	7076	7096	7437
1976	7823	7541	7671	6971	7779	8158	8023
1977	6499	6380	6853	7303	7531	5977	6313
1978	6174	6607	6855	6441	5947	6204	6372
1979	7921	7337	6345	8230	7182	7851	7730
1980	9163	8608	8783	9054	8613	8968	8397
1981	8586	8318	9214	7775	7982	8217	8009
1982	7642	7105	8221	7119	7330	7368	6870
1983	6134	6268	5918	6460	5986	5864	6107
1984	5695	5787	5691	5939	5639	5695	5779
1985	5845	5815	5954	5859	5872	5774	5723
1986	4723	5408	5986	5698	5568	5097	5492

Table 5-B. Deflated Cattle Prices (1982+100) Cash and Futures

Sale Year	Cash		Dec Futures			
	Nov.	Dec	Feb	Mar	Nov	Dec
1964	6618	6765	0	0	0	0
1965	6662	7020	7055	7085	7372	7762
1967	6751	6984	7464	7536	7282	7024
1968	6841	6969	6981	6923	7100	7376
1969	6646	7092	7124	7471	7044	7146
1970	6397	6409	7287	7328	6464	6231
1971	7325	7722	6786	6811	7680	7717
1972	7256	8068	7100	7020	7422	8081
1973	8238	8069	8837	9244	8543	8505
1975	6759	6835	10249	9375	6986	6899
1976	7095	7596	6528	6537	7855	7808
1977	6459	6659	7250	7285	6469	6418
1978	6532	6625	6862	6912	6236	6486
1979	7165	7953	6916	7376	7895	7975
1980	9091	8937	8914	9274	9049	8434
1981	8166	8246	9158	8722	7768	7648
1982	7201	6784	7945	7373	6918	6376
1983	6121	5782	6040	6148	6072	5729
1984	5697	6188	6120	6147	5910	6267
1985	6055	6186	5892	6007	6147	6168
1986	5685	5663	6015	5844	5807	5855

REFERENCES

Al-Sakkaf, Ghazi. "Put Options on Cotton Futures Contracts and Alternative Marketing Strategies," M.S. Thesis, Department of Agricultural Economics, University of Arizona, 1986.

Black, Fischer. "The Pricing of Commodity Contracts," Journal of Financial Economics, Vol. 3, 1976, pp. 167-79.

Black, Fischer, and M. Scholes. "The Pricing of Options and Corporate Liabilities," Journal of Political Economy, Vol. 81, May/June 1973, pp. 637-54.

Catlett, L.B., and M. Boehlje. "Commodity Options, Hedging and Risk Premiums," North Central Journal of Agricultural Economics, Vol. 4, No. 2, July 1982, pp. 95-101.

Darwin, M.P., E.S. Carl, and L.S. Thomas. "The Systematic Downward Bias in Live Cattle Futures: A Further Evaluation," Journal of Futures Markets, Vol. 5, No. 1, 1985, pp. 11-20.

Firch, R.S. and A. Al-Sakkaf. "Cotton Put Options: Low Price Insurance?" 1986 Proceedings Beltwide Cotton Production Research Conferences, National Cotton Council, 1986, pp. 319-22.

Gorman, W.D., T.R. Schureman, and F. Hacket. "Evaluation of Selected Hedging Strategies for Cattle Feeders," Research Report, New Mexico Agricultural Experiment Station, November, 1979.

Heifner, R.G. and G. Plats. "Efficiency of Options Compared to Fixed Price Contracts for Shifting Revenue Risk in Crop Production." Technical paper.

Mensie, E, and T.S. Archer. "Hedging as a Marketing Too for Western Cattle Feeders," Technical Bulletin No. 203, Agricultural Experiment Station, University of Arizona, May, 1973.

Meyer, J. "Second Degree Stochastic Dominance with Respect to a Function," International Economics Review, Vol. 18, 1977b, pp. 477-87.

Michael, T.B. "Commodity Options: A New Risk Management Tool for Agricultural Markets," Federal Reserve Bank of St. Louis Review, Vol. 65, No. 6, June/July 1983.

Pluhar, D.M., C.E. Shafer, T.L. Sporleder, "Evaluation of Trading Techniques for Live Cattle Futures," Research REport, Texas Agricultural Experimental Station, Oct., 1984. pp. 71-76.

Roskin, P., M.J. Cochran, "International Transformation of Scale for the Pratt-Arrow Absolute Risk Aversion Coefficient: Implications for Generalized Stochastic Dominance," Western Journal of Ag,. Econ., Vol. 11, No. 2, 1986, pp. 204-210.

Sanmo, A., "On the Theory of Competitive Firm Under Price Uncertainty," American Economic Review, Vol. 61 (1971). pp. 65-73.

Wilson, P.N., V.P. Eidman, "Dominant Interprise Size in the Swine Production Industry," American Journal of Ag. Econ., Vol. 67, No. 2, May 1985. pp. 279-88.

Wilson, P, V.R. Eidman, "An Empirical Test of the Internal Approach for Estimating Risk Preferences," Western Journal of Ag. Econ., Vol. 8, No. 2. 1983. pp. 170-82.

Zentner, R.P., D.D. Green, T.L. Hickenbotham, V.R. Eidman, "Ordinary and Generalized Stochastic Dominance: A Primer," Staff paper No. Department of Agricultural and Applied Economics, University of Minnesota, St. Paul, 1981.