EXPLORING THE USE OF TECHNICAL INDICATORS AS PRICING GUIDES IN FEEDER CATTLE PRODUCTION CRITERIA

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TABLE OF CONTENTS

List of Tables.. iv

List of Figures....................................... vi

Acknowledgments....................................... vii

CHAPTER

1. INTRODUCTION.. 1
   1.1 Background...................................... 2
      1.1.1 Hedging.................................... 2
      1.1.2 Cash Speculative Positions................. 7
      1.1.3 Hedging Strategies......................... 7
   1.2 Problem... 10
   1.3 Objective....................................... 12
      1.3.1 Pricing Institute.......................... 12
      1.3.2 Decision Models............................ 14
   1.4 Procedure....................................... 16
   1.5 Working Hypothesis.............................. 17

2. LITERATURE REVIEW AND THEORY........................ 18
   2.1 Literature Review............................... 18
   2.2 Theoretical Considerations...................... 24
      2.2.1 Decision Structures........................ 24
      2.2.2 Technical Analysis......................... 27
         2.2.2.1 Usefulness of Technical Indicators.... 29
         2.2.2.2 Selection of Technical Tools.......... 30

3. MODEL AND VARIABLE DEVELOPMENT...................... 34
   3.1 Short Term Models............................... 34
      3.1.1 PLD (Price Linked to Divergence)........... 36
      3.1.2 Live Cattle................................ 41
      3.1.3 Corn....................................... 43
      3.1.4 Dummy Variables............................ 44
      3.1.5 Regression Residuals....................... 46
   3.2 Long Term Models................................ 47
      3.2.1 PLT (Price Linked to Trend)................ 49
      3.2.2 Live Cattle................................ 50
      3.2.3 Dummy Variables............................ 52
      3.2.4 Corn....................................... 56
   3.3 Decision Criteria............................... 57
      3.3.1 Profit Opportunities....................... 57
      3.3.2 Decision Process........................... 58

4. DATA.. 62
4.1 Futures Price Data........................ 62
4.2 Cash Price Data........................... 63
4.3 Cost Data................................. 63
4.3.1 Non-Cattle Costs........................ 64
4.3.2 Cost Series............................. 64
4.3.3 Cattle Costs............................ 65

5. RESULTS..................................... 58
5.1 Model Evaluation Criteria................. 68
5.2 Model Evaluation.......................... 73
5.2.1 Fall to Spring Models................... 73
5.2.2 Spring to Fall Models................... 75
5.2.3 Diagnostic Issues....................... 78
5.2.4 Re-Estimated Models..................... 79
5.3 Return Analysis........................... 82
5.3.1 Simulation Design....................... 82
5.3.2 Simulation Results...................... 90
5.3.3 Out-of-Sample Testing................... 92

6. SUMMARY AND CONCLUSIONS..................... 96

APPENDIX

1. CALCULATION OF RELATIVE STRENGTH INDEX...... 102

2. DERIVATION OF NON-CATTLE COST COMPONENTS, 1980-85 COST SERIES, MEAN CASH PRICES, BASIS, AND WEIGHTS.......... 105

3. DEMONSTRATION OF THE CALCULATION OF THE RETURNS USING ESTIMATED AND ACTUAL CATTLE COSTS........ 117

BIBLIOGRAPHY.................................. 119

ENDNOTES...................................... 124

ABSTRACT...................................... 125

VITA.. 126

LIST OF TABLES

Table Page

1. Summary of the dates, events, and decisions relevant to the fall-to-spring, spring to fall, and fall-to-fall production alternatives.............................. 3

2. Example of Basis Risk using a Short Hedge...... 6

3. Summary of historical cash returns, and improvements offered by futures prices adjusted for basis during the fall-to-spring, spring-to-fall and fall-to-fall production programs....................... 8

4. A summary of the significant dates relating to the fall-to-spring, spring-to-fall, and fall-to-fall feeder cattle production programs................................ 26

5. Sample calculation of the PLD1 variable........ 40

6. An example of correcting the PLD5 variable with a forecasting residual................ 48

7. Sample calculation of PLT index................ 51

8. Sample calculation of LCT index................ 53

9. Summary of daily pricing decision process using forty, fifteen, five, and one day price forecasts in matrix format........... 61

10A. A summary of the relevant statistics for the fall-to-spring regression models........... 69

10B. Summary of the relevant statistics for the forecasting variables in the fall-to-spring models............................ 70

11A. A summary of the relevant statistics for the spring-to-fall regression models........... 71

11B. Summary of the relevant statistics for the forecasting variables in the spring-to-fall models............................... 72

12. A summary of the relevant statistics for the re-estimated regression models............. 80

13. A summary of the relevant statistics for the forecasting variables in the re-estimated regression models.......................... 81

14A. Summary of the returns from the simulations for for the fall-to-spring production program................................. 84

14B. A summary of total and mean hedging returns, cash returns, the improvements to hedging, and the percentage of the futures price captured at the particular margin levels for the fall-to-spring program..... 85

15A. Summary of the returns from the simulations for the spring-to-fall production program................................. 86

15B. A summary of total and mean hedging returns, cash returns, the improvements to hedging, and the percentage of the futures price captured at the particular margin levels for the spring-to-fall program..... 87

16A. Summary of the returns from the simulations for the fall-to-fall production program................................. 88

16B. A summary of total and mean hedging returns, cash returns, the improvements to hedging, and the percentage of the futures price captured at the particular margin levels for the fall-to-fall program....... 89

17. Summary of returns from the simulation for the out-of-sample test................... 93

18. A summary of the results of the turning point analysis for the out-of-sample period..... 94

LIST OF ILLUSTRATIONS

Figure Page

1. Graphical illustration of Divergence/Convergence.. 37

2. Graphical illustration of the derived demand for feeder cattle.................................. 42

3. Illustration of the PLD1 and the PLD5 with the stream of futures price closes................ 54

4. Illustration of the PLT and the PLD15 with the stream of futures price closes................ 55

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CHAPTER ONE

Introduction

This research addresses methods of eliminating or minimizing price risk associated with the final sale price of feeder cattle produced in a backgrounding or grazing program. This price risk is defined as the possibility of the final return to the program being less than the expected return due to unpredictable fluctuations in price.

The feeder cattle producer faces price risk from the initiation of the production program until the cattle are sold. In anticipation of a fall-to-spring, spring-to-fall, or fall-to-fall program, the price risk centers around a variant of one key question: do anticipated profit opportunities justify placing calves on one of the production programs? If so, the producer will initiate a program and be exposed to price risk.

Fall-to-Spring.-- This program starts a 450 pound weaned calf on a high-energy backgrounding program until it reaches a sale weight of 600-700 pounds in the spring. The key question the producer must resolve is: do profit opportunities warrant initiating the program; or conversly, do they suggest foregoing the winter feeding program and selling the weaned calves in the fall?

Fall-to-Fall.-- This program places the weaned calf on a low-energy wintering program in the fall, preparing it for placement on a forage program in the spring. The calf would then be sold as a 700-800 pound feeder the following fall. In this case, the producer faces the crucial hold/sell decision in the early spring.

Spring-to-Fall.-- This program places a 500-600 pound calf on a grazing program in the spring to be sold as a 700-800 pound feeder in the fall. In contrast to the fall-to-fall program, cattle are presumed to be purchased rather than retained from a wintering program. In the early spring, the crucial decision is to purchase/forego rather than hold/sell. Table 1 presents the production alternatives offerred by the three production programs.

1.1 Background

If the producer's decision is to hold or buy the calves, the present situation offers two alternatives for managing price risk. The first alternative is to adopt a hedging strategy by taking a short position in the futures market to protect the sale price of the cattle. The second alternative is to adopt a cash speculative position.

1.1.1 Hedging.-- Basically, there are two types of hedge from which the producer may choose. The first is a basic hedge. In this case, the producer places a short hedge on the cattle and a long hedge on the hedgeable costs at the beginning of the program. The futures positions are left in place until the animal's sale or input purchases are realized. Any losses in the cash market are compensated by gains in the futures market.

The second type of hedge is a multiple or selective hedge.

Table 1. Summary of the dates, events, and decisions relevant to the fall-to-spring, spring-to-fall, and fall-to-fall production alternatives.

Relevant Dates	fall-to-spring program decisions/events	fall-to-fall program decisions/events	spring-to-fall program decisions/event
Feburary	Calf born	Calf born	Calf born
October 15th	Hold/Sell/Buy	Wintering	-
April 15th	Sell Feeders	-	-
May 15th	-	Hold/Sell	Buy/Forgoe
October 15th	-	Sell feeders	Sell feeders

Selective hedging is defined as placing and lifting a hedge in response to signals that anticipate changes in direction of price trends. The hedge is placed when there is a negative price risk in the cash market and lifted when that risk is no longer present.

Multiple or selective hedging allows the producer to place a hedge when the futures market is anticipated to trend down in the case of a short hedge and lift the hedge when the market is anticipated to trend up. This hedging strategy has the advantage of allowing the producer protection from adverse price movements without sacrificing gains offered in the cash market when it is trending in a favorable direction. This advantage is important because the sacrifice of profit potentials might discourage producers from using the hedging option.

Franzmann and Shields point out the advantages of multiple hedging and some of the frustrations it may alleviate for a feedlot operator in the following statement:

> "One of the more difficult aspects of hedging is choosing the proper time to place and lift hedges. Not infrequently a current analysis indicates that the placement of a sell hedge is desirable. Several days later a news development may result in the market moving sharply higher for several weeks whereupon it may again appear that a sell hedge is desirable. This situation may be repeated several times over the hedging period. Producers who hedge to forward price cattle often become displeased with hedging and futures markets under these conditions. Profits are limited by the maintenance of the hedge while at the same time costs rise as a result of the interest charges on increased margin funds. Multiple hedging tends to alleviate these problems." (1)

Although the situation in this quote is directly applicable to the feedlot operator, the producer running a feeder or stocker program faces an analagous situation when they forward price their cattle with a futures hedge.

Although the multiple hedging option alleviates some of the problems encountered by using the basic hedge, it too has associated problems that could disenchant the producer with hedging. By its nature, multiple hedging requires trading activity that may appear too speculative to be treated as hedging. For this reason, regulatory agencies might deny the hedger using the multiple hedging option the associated tax advantages they have historically enjoyed. This prospect might discourage the use of this alternative for managing price uncertainty.

Whichever hedging strategy the producer chooses to employ, basis risk is faced. The basis is the difference between the cash price at the point of sale and the futures price. Basis risk occurs as a result of variations in the relationship between the cash and futures price. The basis translates the returns delivered by the futures market in a hedging program into a cash return.

The underlying assumption supporting the success of a hedging program is that the expected basis at the beginning of the program will be close to the actual basis at the end of the program. If the realized basis varies excessively from the

Table 2. Example of Basis Risk using a Short Hedge

DATE	CASH	FUTURES	BASIS
OCT.15	TARGET PRICE = FUT.PRICE + BASIS $82.78 + 3.05 = $85.83/CWT.	SELL 1 APR. FDR.CTL FUTURES @ $82.78/CWT.	3.05(EST)
APR. 2	SELL CATTLE LOCALLY @ $70.25/CWT.	BUY 1 APR. FDR.CTL. FUTURES @ $68.40/CWT FUTURES GAIN $14.38/CWT	1.85(ACT)

NET PRICE = CASH PRICE +/- FUTURES GAIN OR LOSS

TARGET PRICE =	$85.83	BASIS ESTIMATE OCT. 15 =	$3.05
NET PRICE =	$84.63	ACTUAL BASIS APR.2 =	$1.85
DIFFERENCE =	$1.20	DIFFERENCE =	-$1.20

THE -$1.20 REPRESENTS THE LOSS TO THE PRODUCER RESULTING FROM EXCESSIVE NEGATIVE BASIS VARIATION.

expected basis, the returns from hedging will be variable, with final profits being above or below those expected. As a result, returns from hedging could be lower than those the producer would have received as a cash speculator.

Table 2 provides an illustration of basis risk. It demonstrates the impact on the expected return of a drastic difference between the expected basis at the beginning of the hedging program and the actual basis at the program's conclusion.

1.1.2 Cash Speculative Position.-- The second alternative avail able to the producer is the cash speculative position. This position has no protection from price risk. The producer is completely exposed to price variation in the cash market. This position is, however, free of the basis risk that would be associated with any hedging strategy.

1.1.3 Hedging Strategies.-- Using a hedging strategy profitably requires the successful management of some key problems. The producer must determine the best price at which a hedge should be placed. To accomplish this, the producer might use some criteria to determine the best price. For example, when the cost of production plus some given profit margin could be locked in or when the individual operator "feels" the market is offering the best price relevant to the time frame where a hedge would be considered, the hedge could be placed.

Examination of historical returns from hedging during the

Table 3. Summary of historical cash returns and improvements offered by the futures prices adjusted for basis during the fall-to-spring, spring-to-fall, and fall-to-fall feeder cattle production programs. (Hereford x Angus steers, Roanoke, 1980-1985)

Quartile of futures price range	Percentage of time futures price is in quartile during hedging period.	Mean improvement in return	Standard Deviation of return
	------------------$/cwt.	--------------------	
	fall-to-spring program		
1	15.93	-3.62	3.77
2	25.93	-1.58	3.66
3	34.24	1.64	3.93
4	23.90	4.07	3.76
	spring-to-fall program		
1	13.43	-3.46	2.45
2	30.40	-1.33	2.46
3	32.25	1.45	2.59
4	23.92	5.71	3.21
	fall-to-fall program		
1	13.36	-2.83	2.04
2	29.06	-0.77	2.34
3	32.31	1.80	2.61
4	25.27	6.11	3.10

1980-1985 period reveal that after adjusting for basis, daily futures price quotes during the decision period offerred an average improvement over the cash speculative position 58% of the time for a fall-to-spring program, 58% of the time for a fall-to-fall program, and 56% of the time for a spring-to-fall grazing program. These results are presented on table 3.

These opportunities occurred in the top two quartiles of the futures price range for all three programs. The quartiles break the range of prices seen from the onset of the decision period to the final weeks of the production phase of a backgrounding or grazing program. The quartiles have been ordered such that the lowest 25% of the prices are in the first quartile and the top 25% are in the fourth quartile. The existence of such returns present the producer with the possibility of capturing added returns. Managing the timing of the decision to forward price and secure the returns being offered then becomes the key to capturing those added returns.

In summary, the present situation allows the producer three options: the basic hedge, the multiple hedge, and the cash speculative position. The first two have specific problems: large margin requirements and the sacrifice of cash gains during favorable price moves in the case of the first and a difficult "managing" task and possible tax problems in the case of the second. Such disadvantages discourage use. However, as table 1 reveals, with the proper timing tools added returns could be captured using a basic hedging strategy. The cash speculative unlike a hedging strategy there is no exposure to basis risk.

1.2 Problem

The profitability of a cattle program is dependent on several factors. If the producer is a cash speculator, the returns received will be a function of the cash costs, opportunity costs, and ultimately the cash price received at the end of the stocker program. If the producer is using a hedging strategy, the returns realized at the end of the program will be dependent on the same factors as in the cash case. The cash price received at the end of the program (implicitly represented in the basis), the stream of futures prices that provide the hedging opportunities, and the basis are all determinants. The primary thrust of this research will be to address the effective analyses and utilization of the profit opportunities manifested in the stream of futures prices during the decision and production periods of a backgrounding or grazing program.

The problem is that the producer, when managing a hedging strategy, lacks a systematic method to determine the direction of the futures price trend and the type of hedging opportunities to expect in the future as the stream of futures prices develops. The producer must determine whether the best pricing opportunity the market will offer has passed or an improved profit environment during the period relevant to a particular hedging program can be expected to manifest later. Whether the producer is con sidering starting calves on a spring-to-fall (March-April to October-November) grazing program or a fall-to-spring (October-November to March-April) backgrounding program, a forecast of the stream of profit opportunities that will materialize during the approximate six months required for the calves to be ready for sale, would be helpful in making the hold-price/sell decisions.

The hold-price/sell decision process is really two related decisions. The first is the hold/sell decision. This decision is dependent on the overall environment of the profit level. If the profit level is too low and the probability of improvement is low, the producer should make the decision to sell the calves. If the market environment is favorable, the producer should make the decision to hold/price or simply hold and wait to price at a later date.

The second part of the decision is the forward pricing decision. The producer must determine the best time to forward price. A resolution of these two decisions may occur simultaneously, but that need not be the case. The decision to hold may be answered with the affirmative while the forward pricing decision is still pending.

The producer needs to know with some assurance whether if today at time "t" the best profit opportunity that the present price environment will offer has been observed; or if a better price will develop at some time later in the relevant pricing period. If the current pricing opportunity is best ,the producer should place the hedge immediately. If on the other hand better opportunities can be expected, the producer should delay the pricing decision. More information to guide these decisions is needed.

1.3 Objective

The general objective of this research is to develop decision models which may be employed by a producer or a pricing agency to assist the producer in making the hold/sell decision, and related, the decision on forward pricing if ownership is extended through the stocker phase.

1.3.1 Pricing Agency.--If a pricing agency or a producer could assume the function of identifying the windows of profit opportunity offerred by the price environment, the producer may make a more informed forward pricing decision. The pricing agency could handle the hedging program and allow the producer to avoid direct involvement with the futures market. This would alleviate some of the problems that producers face individually when they hedge using the futures market.

The producer faces the following problems:

1) A basis variability that may on occasion represent more risk exposure then the pure price risk present in a speculative cash position.

2) A feeder cattle futures contract size of 44,000 pounds (Chicago Mercantile Exchange) that is not suited for the smaller producers.

3) Possible difficulties in arranging the credit for the maintainence margin required for the duration of the hedge.

4) A less than thorough understanding of the futures market, its use, and an inability to implement a legitamate hedge program.

These issues may discourage the use of hedging as a means for capturing higher returns. Management of such issues would be shifted to a pricing agency. (2).

The agency, in laying off its exposure to price risk, will have to hedge and as a result, face some of the same problems associated with hedging that the producer has faced. The agency will still face the problems posed by basis risk. However, with the greater resources at its disposal for making a better estimate of basis than the producer and the increased number of trades, the deviation between the expected and the actual basis might be smaller and thus improve the results of a hedging program. The agency can expect the basis to "average out" while due to relatively infrequent use of the market, the producer cannot. Any residual risk, would have to be reflected as a cost in the forward price the agency offerred to the producer.

The problem associated with the contract size would be alleviated because the agency would be pricing cattle from several producers at a time and would be able to treat them as a pool for hedging purposes. There still might be a "lumpiness" problem, but it should be less severe than the problem faced by the individual producer. Since this agency will have substantially more financial resources than an individual producer, its access to credit for maintenance margin accounts should be superior. Also, lenders should be more confident in extending credit to the agency since its management presumably will have more expertise in handling a hedging program.

In summary, if a forward pricing agency were in place, the producer, assisted by the decision models and the forward pricing services offered by it, should be able to handle the price related risks more successfully.

1.3.2 Decision Models.-- The general objective is divided into the following two sub-objectives:

1) To develop a long term econometric model (approx. 40 days) to serve the dual role of signaling the point at which the short term models should begin searching for a pricing opportunity and guide the decision to place the calves on a program as the decision period expires if the hold-sell/price decision has not yet been made. The second role of the long term model is to give the producer a forecast of the price environment over the duration of the decision period and a forecast from the end of the period to a point into the production phase where, for the purposes for this study, the producer will be assumed to be committed to completing the program.

2) The second sub-objective is to develop a series of iterative decision models to forecast profit opportunities over shorter one, five,and fifteen day time horizons to guide the producer's pricing decision.

The decision period represents the period in which the producer is considering placing calves on one of the production programs. A duration of 40 business days for the long term model was chosen because 40 days from the last day in the decision period places the producer at a point in the production phase where the producer is committed to the program. Also, forty days represents the length of the decision period. From the beginning of the decision period, the producer is given an indication as to whether at any point during this period a profitable hedging opportunity will materialize.

The short term time horizons were chosen to facilitate a decision process that calls for a progressively stronger incentive to take advantage of a pricing opportunity as the current and expected price environment deteriorates.

The shorter time horizons facilitate that incentive by representing the earlier portions of the longer term time horizons. This facilitates a decision process that forces the pricing decision as early as possible, where prices should be better, in the nearby forecasting horizon of the closer longer term model.

Each day re-investigates the sequential model analysis, beginning with the 40 day model. Once the forty-day model has indicated that prices will be lower forty-days from day "t", the search for a price is initiated. The fifteen-day model then reinforces that incentive when it signals the deterioration of the pricing environment over the next fifteen days. This then activates the five day model. Once the five-day model signals a deteriorating price environment over the next five days the one-day model is activated. The activation of the one day model signals the highest imperative to price. When the price forecast for "t+1" is lower then the price on day "t", the price on day "t+1" is used to initiate a hedge. The pricing initiative at every level is dependent on all preceding longer term models maintaining a status supporting the search for a price.

The breakdown of the time periods represent somewhat less then half of the next highest time horizon, with the exception of the one day model. Each model, as the time horizon decreases, represents a higher imperative to find a price at which to hedge.

1.4 Procedure

These decision models and related decision criteria will be developed by identifying technical indicators that may have an impact on the developing profit opportunities. The indicators will be used to model a picture of what the pricing environment will look like during the period within which the producer will be making the decision to place calves on a program to be ready for sale at the end of the program. The objective will be for the producer to use such criteria to stand at any point during the decision period and determine the profitablility of placing the calves on a program.

Once the decision has been made, the producer must be able to stand at any point in the hedging period and determine the best time to take advantage of a pricing opportunity offered in the futures market. The criteria should reveal the proper time to lock in a price in period t or direct the producer to wait with some probablilty that the profit environment will improve in periods t+n.

1.5 Working Hypothesis

The hypothesis is that technical indicators, taylored to forecast short term changes in trend, and also indicators to identify longer term trends can provide information about pricing environments over given time horizons in the future.

Working from this hypothesis, econometric models can be developed using technical indicators to make updated predictions about the pricing environment that will develop across the hedging period over one, five, fifteen, and forty day time horizons.

Together, the long and short term models will be used in a decision criteria to guide the hold/sell/forward pricing decision.

CHAPTER TWO

This chapter will present the literature review and a discussion of some of the theoretical considerations supporting the development of the decision models.

2.1 Literature Review

This review of literature examines the use of risk management techniques. Particularly, different types of hedging programs that improve returns using technical systems alone or in combination with a fundamental system to trigger buy and sell signals on the futures markets.

Kim Anderson and John Ikerd developed a strategy for managing the risks associated with livestock production. They have presented a system that summarizes the probable subjective and objective risks associated with production; death loss, an unexpected feed conversion rate, and more importantly, an unfavorable market price for the finished livestock. For the purposes of this study, the probabilities were developed using the known probability associated with sums achieved from throwing a pair of die. Excessively high and low returns are associated with the low probability sums. More likely returns are associated with the more likely sums. This then gives the producer a menu of risk/return combinations. Depending on the level of risk the producer is willing to bear, a production technique with an appropriate risk level may be selected. Using the developed probabilities the producer can develop expected returns for different production alternatives and then choose the production alternative with the highest expected return. These techniques give the producer the ability to knowledgeably manage the unavoidable risks involved with earning a return.

C.D. Miyat and D.L. McLemore completed a study examining the effectiveness of different hedging strategies using elementary hedging strategies, moving average strategies, and point and figure strategies. These strategies were tested on Winter and Spring backgrounding programs in Tenessee. The effectiveness of the different program was evaluated by mean-variance analysis. The elementary hedging strategies came in two basic types. The first type initiated a hedge in the event that the futures price, adjusted for the local basis, exceeded a predetermined breakeven level for the backgrounding operation. The second type initiated a hedge if the futures price adjusted for the local basis exceeded the present local cash price. These two strategies had two variations. The first was a basic hedge. The second and third variations used margin requirements as a filter for lifting hedges. The moving average strategy used different combinations of moving averages to trigger buy and sell signals. These signals were used to hedge selectively. Some of the moving averages were used with penetration rules to restrict the number of false signals generated by the moving averages. The point and figure strategies used the buy and sell signals generated by the system using trailing stops to lift the hedges. All of the strategies were compared to a cash speculative position.

All of the strategies demonstrated at least one variation that exhibited superior returns and lower variances than the speculative cash position. The results of the study seemed to be dependent on the backgrounding program being used. Basically, each program had a stategy that demonstrated superior returns and lower variances. A drawback of this study's credability was that there was no out of sample test of the optimum strategies.

John R. Franzmann and Jerry D. Lehenbauer performed a study examining the effectiveness of moving averages as a tool for hedging the costs and the returns to feeder cattle producers. There results showed that a 4-day/8-day linearly weighted moving average using a five-cent penetration rule yielded the best mean variance returns with respect to a cash speculative position. No out of sample test was conducted in this study.

Robert R. Brown and Wayne D. Purcell used a combination of technical and fundamental indicators to form hedging strategies for feeder cattle producers. They developed econometric models to forecast feeder cattle prices over one to six month time horizons. The technical tool used was a 5-10 day moving average. The optimum strategy used only the 5-10 day moving average in a multiple hedging strategy. The hedges were placed on a sell signal and lifted on a buy signal. The strategies that used the ecometric model in tandem with the moving average used the models to make the decision to hedge and then allowed the moving average to establish the timing. These strategies performed superior to the cash speculative position but inferior to the strategy that used the moving average alone. Again there was no out of sample test completed.

John R. Franzmann and Mike E. Shields examined the use of moving averages in employing a multiple hedge. They studied the variation of returns to a cattle feeder when different combinations of the inputs and outputs are hedged. In this case, the cost of the feed, the feeder cattle, and the selling price of the finished cattle were hedged in various combinations. The results showed that the best mean variance returns were yielded by the strategies that multiple hedged feeder cattle input and slaughter cattle output leaving feed unhedged and the strategy that hedged all the inputs and the outputs.

Louis P. Lukac, Wade Brorsen and Scott H. Irwin examined twelve different technical trading systems. They tested several different systems over several different commodities. Four of the twelve systems generated returns statistically above zero. Those systems were, channel, directional parabolic, MII price channel, and the dual moving crossover.

The channel system sets up a price interval; when the price stream breaks through the top of the price interval a buy signal is generated. Conversely, when the price stream breaks through the lower barrier, a sell signal is generated.

The MII price channel system is similiar to the channel system with the exception that a buy signal is triggered when the price in day t is above the price in the first day of the interval. A sell signal is triggered when the price is lower then the price in the first day of the interval.

The directional parabolic system, developed by J. Welles Wilder, is a combination of two systems. It combines the directional movement system and the parabolic time/price system. The directional movement system measures the level of positive and negative directional movement. It derives positive and negative indicators and triggers signals when the indicator series cross. When the positive indicator crosses above the negative indicator, a buy signal is triggered. When the negative indicator crosses above the positive indicator, a sell signal is triggered. In the parabolic time/price system a linear equation determines levels for stops. When the price exceeds the stop a signal is generated. The directional parabolic system triggers a signal only when both the directional movement system and the parabolic time/ price system trigger the same signal.

The dual moving average crossover system employs a long and short term moving average. When the short term moving average moves above the long term average, a buy signal is generated. When the short term moving average moves below the long term average, a sell signal is generated.

These four systems achieved statistically significant above average returns. The entire simulation was performed by optimizing the parameters for the systems using three years of previous data then testing the system on the fourth year of data. This procedure allowed each year of results to be generated using parameters that were generated using a different data set, and as a consequence are cross validating.

Lee H. Minor studied the effectiveness of the RSI for establishing major trend reversals for a combination of twelve commodities, currencies, and precious metals during the 1976-1984 period. Minor studied the hypothesis that a major reversal will occur when the RSI penetrates the 50 level. A downtrend indicated when penetrated from above and an uptrend indicated when penetrated from below. The study examined the use of the RSI for different variations of the oscillator. The variations in the durations of the price changes were as follows: one-day, three day, five-day, and ten-day. The results reported that the ability for the RSI to accurately forecast changes in trend was not statistically significant when the RSI was formulated using day-to-day changes. There were statistically significant results that were useful for forecasting when the RSI was formulated using five-day changes in price. A major conclusion of this study was that the RSI is more useful for identifying trend reversals when the RSI penetrates its extreme values rather than using the penetration of the 50 level as a signal of a change of trend.

Jiler (1965) examined buying and selling activity preceding major reversals. He also examined the use of technical tools in determining strength of ongoing price movements and consolidations preceding turning points. (3)

2.2 Theoretical Considerations

2.2.1 Decision Structure

The feeder cattle producer, whether planning a fall-to-spring, fall-to-fall, or a spring-to-fall program, faces the same series of business decisions. If the producer owns the calves, he faces the decision to hold or sell them. If the producer plans to buy the calves for a stocker program, the profitabilty of the program will determine the prudence of purchasing the calves.

A production program may either be continued by retaining ownership, or initiated by purchasing calves. Selling the calves or foregoing their purchase will abort the program. The common factor a producer faces making either the decision to hold/sell or buy/forego is that it depends on the profit opportunities that the market may offer. They are also both subjected to the same time constraints presented by the nature of the Virginia feeder cattle market structure.

Special Graded Sales--The graded cattle sales in Virginia occur over a three month period in the Spring (March, April, and May) and four months in the Fall (August,September, October, and

November). The graded sales offer the producer an opportunity to market their cattle in an environment where buyers are inclined to make higher bids. These sales tend to average $3.00 to $6.00/cwt. more than the weekly sales (4). This is a consequence of the grading and pooling procedures at these sales. The uniform quality of lots inclines the buyers to pay higher price at one of these sales versus one of the regular weekly auctions (5).

As a consequence of the graded sale schedule the producer faces the production schedule in table 4. The producer has a forty day period to make the hold/sell decision. If the decision is to hold, the producer has six months to bring the cattle to one of the graded sales.

The Decision Period--During the decision period, the producer reviews the financial consequences of a program. The existence of profitable pricing opportunities during this period or the production phase of the program gives the producer the opportunity to lay off the price risk.

After reviewing the profit opportunity offerred each day, the producer can decide to hold the cattle if an adequate profit opportunity can be captured. If by the end of the decision period the producer has not made the hold decision, the producer is now faced with the need to make the hold/sell decision or not have the cattle ready for a graded sale. To make this decision the producer will have to look at the available profit opportunity

Table 4. A summary of the significant dates relating to the fall-to-spring, spring-to-fall, and fall-to-fall feeder cattle production programs.

	DECISION PERIOD		PRODUCTION PERIOD
Program	Initiation date	Decision date	Sale date
Fall-to-Spring	August 15th	October 15th	March 15th
Spring-to-Fall	March 15th	May 15th	October 15th
Fall-to-Fall	March 15th	May 15th	October 15th

and the profit opportunities that may be available during the production phase of the program. If the producer decides that future opportunities will be better than those currently available at the end of the hold/sell decision period, the producer may decide to hold with the intention of forward pricing during the production phase. If the forecasted opportunities available during the production phase are lower than the profit opportunity available at the end of the decision period, selling the calves immediately would be the prudent choice.

2.2.2 Technical Analysis

In order to achieve the goals presented in the objective section, this research will use technical analysis of the futures market as a tool to forecast futures prices over long and short term time horizons. Technical analysis was chosen as a tool because of the ease and availability of the operative information. Daily futures price quotes are readily and cheaply available to the public.

Technical analysis is the study of the market as it manifests in a continuing price anthology. This type of examination differs from the alternative method of market analysis, fundamental analysis, that searches for the underlying supply and demand conditions that will bring about changes in market behavior. The supporting assumption of technical analysis is that historical prices in some form may be used to forecast future price behavior.

<u>The efficient Market Hypothesis</u>--The efficeint market hypothesis defined by Salih N. Neftci and Andrew J. Policano is as follows:

> "An efficient market is characterized by a large number of well informed participants who make decentralized decisions continously as new information becomes available. Collectively, these decisions translate into market prices. Thus, the commodity or capital asset in question will be priced at a reliable estimate of its intrinsic value. Price changes will reflect new information and since the occurrence of this new information is itself random, price changes should follow a martingale difference. Consequently, if a market is efficient in this sense, then any strategy which uses commonly available information cannot perform better than the average in the long run".(6)

This issue relates directly to the use of technical tools in this study. The use of technical indicators to improve returns in the short run relates directly to how the market participants process new information in the market. Since these participants are in fact human beings that interpret and react to information differently and at different rates, it follows that there might be some lag over which the market participants come to a consensus on a new price after receiving a new bit of relevant information. These lags would allow for the development of trends which are discernable by technical indicators.

Holbrook Working, in the development of his model of an anticipatory market, proposed the concept of gradualness in price changes resulting from additonal information. Gradualness is caused by new information being interpreted differently at different times and at different rates. This gradualness suggests that initial moves are forecasts of future short term price moves (7).

2.2.1.1 Usefulness of Technical Indicator--The price anthology represents the economic and psychological consensus of the effect of given pieces of information at a given time. The flow of random unpredictable information, once revealed, induces trends as deliberation by market participants for a new consensus of the intrinsic value of the particular commodity occurs. Trends exhaust themselves as the old information is replaced by updated information. The stream of new information changes the consensus and begins a new trend. Extended periods where there are no trends are examples of sideways trading where the market is either oscillating around the consensus of the intrinsic value as more informed traders adjust for the market activity of less informed traders or there is confusion as to the economic impact of new information.

With this in mind, what is observed when examining futures market prices over time is a repetition of upward and downward trends, the exhaustion of both, and sideways or consolidation activity. The task of the technical indicators is to assist in the identification of trends and their exhaustion. This would allow the producer to make the hold-price/sell decision during the decision period and, as the decision period expires, have enough information to finally make the decision based on what the profit opportunities will look like during the weeks of the production phase of the feeder or stocker program.

If the hold/sell decision is to hold the cattle, the producer, using the same techniques used during the decision period can continue the review process until the best profit opportunity is identified. The type of decision models the producer will then need are short-term models that forecast the profit opportunities over a shorter time horizon and longer-term models with time horizons that will forecast the price environment over several weeks at a time.

2.2.2.2 Selection of Technical tool.--The nature of the indicator chosen to perform the short term forecasting task falls into the category of technical analysis called Character-of-the-Market analysis (hereafter referred to as COM). This type of analysis, as the name might imply seeks to discover the true nature of a given price move. The identification of the "true nature" can be described as the separation of the component of the price movement that reflects the true value of the commodity and the portion reflecting the buying and selling activity of less informed traders.

A premise of COM analysis is that the true supply and demand picture at any one time is being blurred by less informed market participants that are not reacting "properly" to available information in the market. "Properly" is defined as the type action that the "professional" trader would take after receiving a given piece of information. This premise supports the description of a market where professional traders are responding to correct the under/overreactions of less professional or amateur traders. (8)

Oscillators, a category of tools utilized for conducting COM analysis will be the foundation for the technical indices used in this analysis. An oscillator measures the rate of change of prices in a market. Its nature is to change rapidly when the market is approaching a point of trend exhaustion and adjust more slowly during the trends. The two basic assumptions concerning the use of oscillators are presented here as stated by Richard J. Tewles, Charles V. Harlow, and Herbert L. Stone.(9)

> 1. A price rise or price decline can become overextended if it gathers too much velocity. If the price of any commodity enjoys an unusual price gain that is compacted into a short time span, the presumption is that buying is temporarily exhausted and part of the gain will be retraced. Such a market is said to be overbought. The opposite kind of price action would lead to an oversold market. By constructing an oscillator the technician seeks to monitor excessive rates of price change that could lead to exhaustions and subsequent price reversals.
>
> 2. A price trend can simply peter out as it steadily loses momentum. In this case a price trend continues but generates less and less energy until it dies. A top is signaled when, for instance, the price continues to make new highs for the move but the oscillator moves from large positive to small positive numbers. The reverse is true for a bottom. Used in this way an oscillator is a tool for measuring the exhaustion of a price trend.

These two assumptions tie directly into the underlying premises of the COM analysis used herein.

In the econometric framework within which this study will be conducted, the dependent variable will be the closing price offerred by the futures market in t+n days. The key independent variable in the short term models, a technical index, will be a derivative of the Relative Strength Index (RSI) oscillator, developed by J. Welles Wilder Jr..

There are two properties of the RSI of pertinence to this study. The first, is the index's ability to measure the strength of the trend. Ranging in value from zero to one, when the RSI is less then 0.5 the market is trending down. Conversely, when it is greater then 0.5 the market is trending up. A numerical calculation of the RSI may be found in appendix 1.

The second property of importance is the tendency for the RSI to lead price movements as a trend exhaustion is occurring. This property is particularly useful since the ability to forecast a change in the profit environment is a major objective of this research. This property will be referred to as divergence/ convergence.

The divergence/convergence of the RSI and price stream is used, through a mathematical manipulation, to generate an index. This index will reinforce signals for a continuation of an existing trend when the stream of RSI's and prices are moving in the same direction or give signals for a reversal when the stream of RSI and price values relatively diverge.

Relative divergence is defined as the slope of the trend of the RSI being less steep then the slope of the price trend. Absolute divergence is defined as the slopes of the two streams moving in opposite directions. Convergence occurs when the slope of the RSI stream is steeper then the slope of the price stream in the same direction.

The technical variable to be used in the long term forecasting model uses a measure of trend based on a summation of forty day differences in price. This summation, linked to the price level by a moving average, is used as a projection of trend for the next forty days.

A more detailed discussion of the mechanics of these variables and the other variables in the forecasting models will be presented in the "Variable and Model development" section of the next chapter.

CHAPTER THREE

Model and Variable Development

This chapter will develop the forecasting models, their variables, and discuss the decision criteria in which the futures price forecasts will be used. These criteria will provide a framework from which profit opportunities can be identified.

As stated earlier, short and long term models will be developed. The short term models are specified for one, five, and fifteen-day forecasts. The long term model will be specified for a forty-day forecast. Since the one, five, and fifteen-day models have a similiar specification they will be discussed as a group leaving the forty-day model for separate discussion.

As the fall-to-fall and spring-to-fall programs have the same production and decision periods, they will use the same models. The fall-to-spring program, addressing different periods, will use a model specified to reflect its particular economic conditions.

3.1 Short Term Models

The general specification for the one, five, and fifteen-day fall-to-spring models, where the signs on the Beta's indicate the expected relationship, are as follows:

One-day forecast:

$$\mathrm{Close}(t+1) = A + B1(\mathrm{PLD1}) + B2(\mathrm{CLOSL}) - B3(\mathrm{CLOSC}) + B4(\mathrm{DJ}) + B5(\mathrm{DG}) + e(t)$$

Five-day forecast:

$$Close(t+5) = A + B1(PLD5) + B2(CLOSL) - B3(CLOSC) + B4(DG) + B5(DG) + e(t)$$

Fifteen-day forecast:

$$Close(t+15) = A + B1(PLD15) + B2(CLOSL) - B3(CLOSC) + B4(DJ) + B5(DG) + e(t)$$

The general specification for the one, five, and fifteen spring-to-fall models are as follows:

One-day forecast:

$$Close(t+1) = A + B1(PLD1) + B2(CLOSL) - B3(CLOSC) - B4(DF) - B5(DD) + e(t)$$

Five-day forecast:

$$Close(t+5) = A + B1(PLD5) + B2(CLOSL) - B3(CLOSC) - B4(DF) - B5(DD) + e(t)$$

Fifteen-day forecast:

$$Close(t+15) = A + B1(PLD15) + B2(CLOSL) - B3(CLOSC) - B4(DF) - B5(DD) + e(t)$$

where:

CLOSE(t+n) = the futures price n days into the future;

PLD1 = Price linked to divergence over a one day time horizon;

PLD5 = Price linked to divergence over a five day time horizon;

PLD15 = Price linked to divergence over a fifteen day time horizon;

CLOSL = The six month distant live cattle futures price on day t;

CLOSC = The futures price of corn appropriate to the feeding period on day t;

DD = The dummy variable for the December live cattle futures contract on day t;

DF = The dummy variable for the Feburary live cattle futures contract on day t;

DJ = The dummy variable for the June live cattle futures contract on day t;

DG = The dummy variable for the August live cattle futures contract on day t;

3.1.1 PLD.--The value PLD (Price Linked to Divergence) is generated using the presense of divergence/convergence between the feeder cattle futures price and Relative Strength Index (RSI) streams. When the market becomes overbought or oversold, the RSI reacts with a loss of momentum and and a reduction in its rate of change. As this occurs before the change in the rate of the price stream, the two streams diverge. The PLD variable quantifies relative divergence, absolute divergence, and convergence. The general form of that quantification is as follows:

$$DIV = [\{C(t)-C(t-1)\} + \{RSI(t)-RSI(t-1)\}] * Sign\{C(t)-C(t-1)\}$$

where "C" is the closing price.

$$PLD = (N \text{ day sum of } DIV) * (N \text{ day moving average})$$

See figure 1 for an illustration of divergence/convergence.

As the general form indicates, there are two steps in calculating PLD. The first, quantifies the divergence present

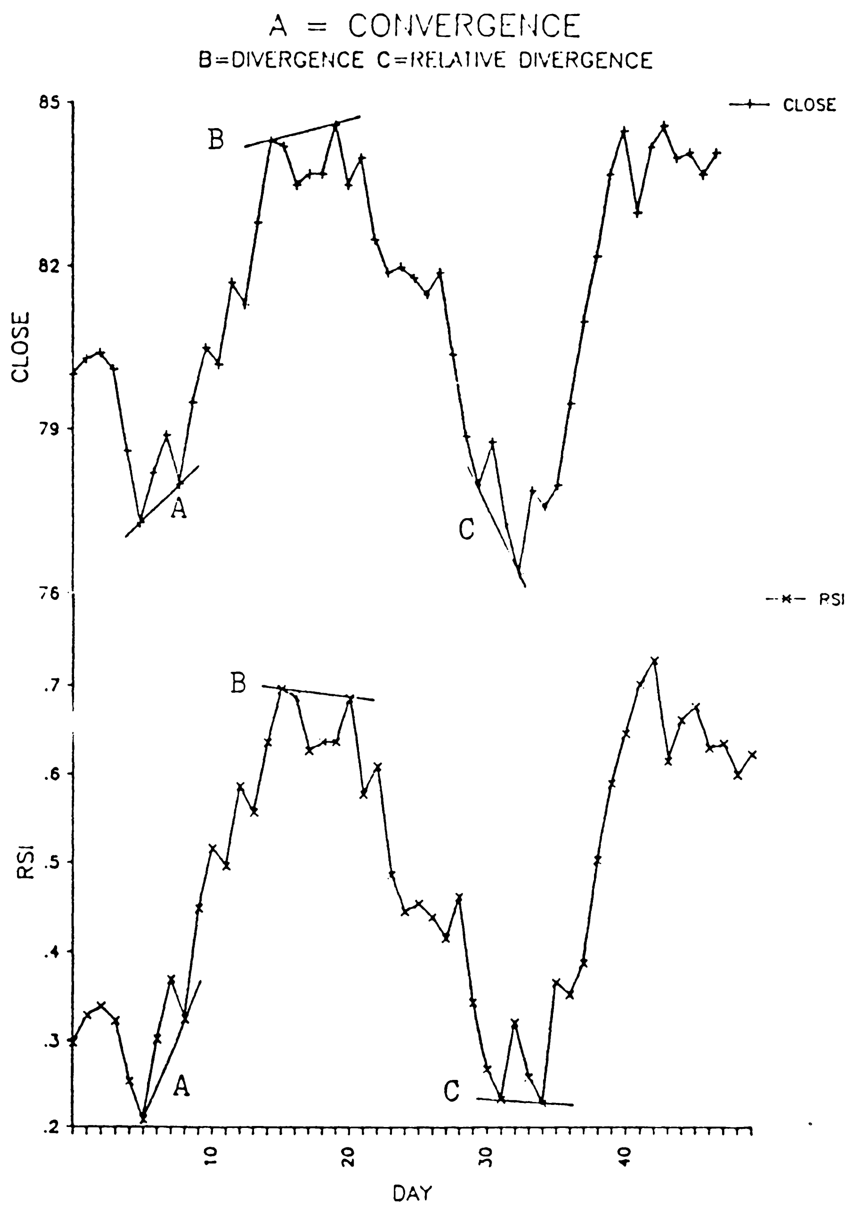


Figure 1. Graphical illustration of Divergence/Convergence

each day, generating DIV. The second, modifies the price level captured by a moving average, by adding to it a summation of DIV over n days. This process forms the PLD forecasting index. A more detailed explanation of each step follows.

DIV's calculation begins by taking the first differences for the closing price and the RSI for day t and t-1 and multiplying them together. This product is multiplied by the sign of the closing price's first difference such that the sign of the product will be consistent with the direction of the price stream. These values are called DIV. Values of DIV will support the trend until the RSI and price stream begin to diverge. Its values will then penalize the trend by adding a value with a rate of change that is much slower than the rate of change of the price stream. Values of DIV are summed over n days to yield a value of net divergence/convergence.

The RSI and price stream begin exhibiting relative divergence gradually as the trend shows signs of exhaustion; perhaps several days before the price stream actually turns down. A summation captures the gradualness of this phenomenon by accumulating the divergence that has occurred over the past n days. This quantifies the effect of the overbought/oversold situation as it evolves over n days. The level of the net accumulation measures the magnitude of the forecasted reversal. A reversal of greater magnitude, i.e. one occuring over the next fifteen days compared with one occuring over five days should accumulate divergence over a longer time period. Longer term reversals would be expected to gather information to support that reversal over a longer period. Conversely, shorter term corrections would be expected to respond to more recent but possibly unconfirmed information.

The length of the summation of DIV was based on the performance of different summations in the forecasting models' performance. The formulation that best added to the models ability to accurately forecast turning points was employed. The duration selected for the summation for PLD1 was one day. The duration for PLD5 and PLD15 was six days.

The DIV summations were tied to a relevant price level by adding them to a moving average of the feeder cattle futures prices. Durations for the moving average were chosen dependent on the time horizon of the forecast. Since PLD1 is used in the one-day model a three-day moving average was chosen to reflect responsiveness to the current price level. PLD5 and PLD15 are used in models with longer time horizons and thus use moving averages reflecting a greater responsiveness to longer term price moves. A five-day moving average was used for PLD5 and a fifteen-day moving average was used for PLD15. A numerical example of the calculation of PLD1 is presented in table 5.

Table 5 illistrates the composite nature of the PLD variable. The smoothed yet current properties of the moving average are augmented by the properties of the divergence element. The rel-

Table 5. Sample calculation of the PLD1 variable.
(Price data taken from April 1980 feeder cattle futures contract)

Date	Close	First difference of the closing price.	RSI	RSI first difference	Three day moving average	Divergence	PLD1
7/29/79	78.90	.	.266	.	.	.	.
7/30/79	78.00	-.90	.230	-.0351	.	-.0316	.
7/31/79	78.80	.80	.320	.0898	.	.0718	.
8/01/79	77.30	-1.50	.257	-.0633	78.03	-.0950	77.50
8/02/79	76.40	-.90	.227	-.0300	77.50	-.0270	77.23
8/03/79	77.90	1.50	.367	.1400	77.20	.2100	79.30
8/06/79	77.60	-.30	.352	-.0150	77.30	-.0045	77.26
8/07/79	78.00	.40	.388	.0360	77.83	.0144	77.97

*The one day of divergence is multiplied by a scaling factor of 10.

ative strength of the divergence/convergence element injects strength/weakness into the trend.

3.1.2 Live Cattle. --The demand for Feeder Cattle is a derived demand. As such, it is a reflection of the final demand for beef at the retail level of the industry. The retail demand is transmitted to the feeder cattle producer through the descending levels of the market ladder. The retailer reflects consumer demand to the meatpackers. The meatpackers then reflect retail demand to the slaughter cattle producers. Slaughter cattle producers then translate that demand into demand for feeder cattle by bidding the price of feeders up or down depending on the profitabilty of feeding a feeder to slaughter weight. The levels of the market ladder are separated by the marketing margins and costs associated with each level. See figure 2 for an illustration of the derived demand for feeder cattle.

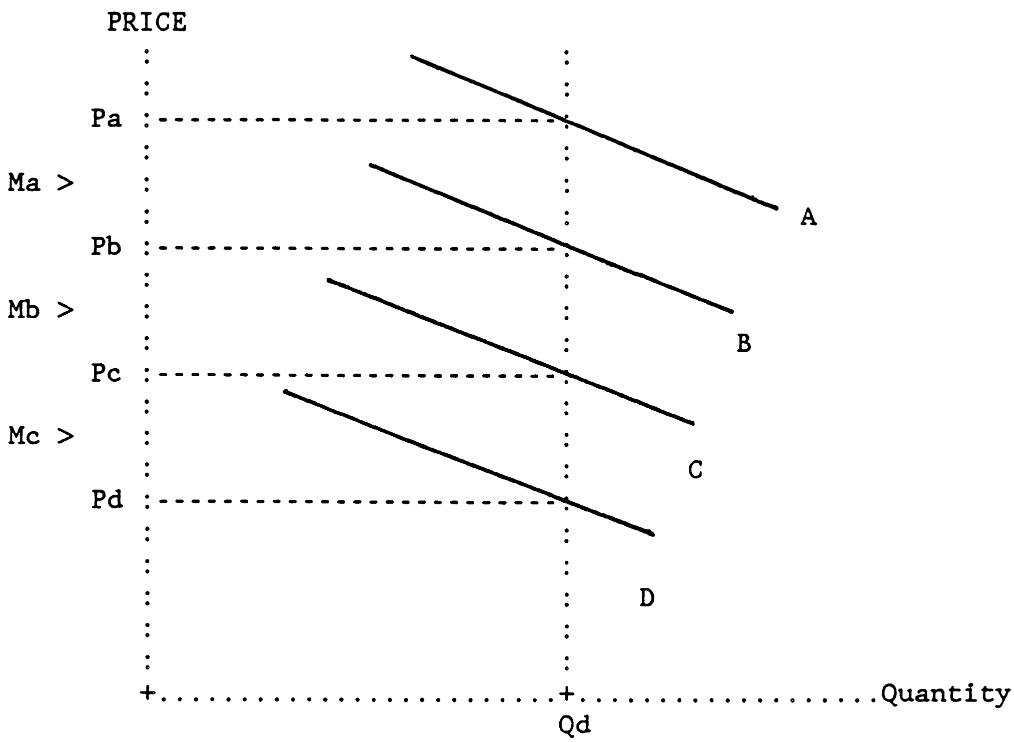
The profitability of feeding cattle is dependent on the following factors:

1) The demand for slaughter cattle.

2) The cost of feed.

3) The supply of slaughter cattle.

The first and third factors will interact to establish a market clearing price for slaughter cattle. This anticipated price is the futures price for slaughter cattle on their sale date. That futures price and the anticipated cost of inputs determine the



A - Demand schedule for Retail beef. (Final Demand)
B - Demand schedule at meatpacker level. (Derived demand)
C - Demand schedule for slaughter cattle. (Derived demand)
D - Demand schedule for feeder cattle. (Derived Demand)
Pa - Retail price of beef.
Pb - Price of beef at meatpacker level.
Pc - Price of slaughter cattle.
Pd - Price of feeder cattle.
Ma - Marketing margin and retailing costs.
Mb - Marketing margin and processing costs.
Mc - Marketing margin and feeding costs.
Qd - Supply of beef at time "t".

Figure 2. Graphical illustration of the derived demand for feeder cattle.

anticipated profitability for feeding cattle which in turn determines the price offerred for feeders. An increase in the futures price for slaughter cattle will increase the anticipated profitability of feeding cattle. This will in turn increase the demand for feeder cattle resulting in an increased price. With this relationship in mind, the sign on the live cattle variable should be positive.

At the termination of the production program, the producer will sell the calves as feeder cattle. Upon reaching a feedlot, those calves should reach a slaughter weight of 1100 pounds in approximately 140 days. During the decision period of the production program, the forecasting model will use live cattle futures contracts which are pricing the calves at their slaughter weight approximately one year hence. Thus, the fall-to-spring forecasting model will use the October contract of the next contract year. The spring-to-fall/fall-to-fall forecasting models will use the April contract of the following contract year.

3.1.3 Corn. --Since the principle input in a feeding program is feed, the relevant feed price used will be the price of corn. The futures contract for corn coinciding with the initiation of the feeding program is used as the best estimate of the price of corn at the initiation date. The fall-to-spring forecasting models use the May futures contract. The spring-to-fall forecasting models use the December contract.

The sign of the corn variable is a function of its relationship with the profitability of feeding cattle. The distant futures price for slaughter cattle and the futures price for corn form the expected profitability for bringing feeders to slaughter weight. As an expected profitability is the best guide that a cattle feeder would have for making a profitable bid for feeder cattle, it becomes the principle factor of the demand for the feeder cattle. This demand, together with the supply of feeder cattle, will determine the price that the feeder cattle producers will receive.

The profitabilty of feeding cattle varies inversely with the price of corn; since that profitability varies directly with the price offered for feeder cattle, the price of corn varies inversely with the feeder cattle price. This would give the price of corn, in these models, a negative sign.

3.1.4 Dummy Variables--As was explained in the live cattle section, at the onset of the decision period where forecasting begins, live cattle futures prices from almost a year in the future are required. At this time, the preferred live cattle contract is not always available. As a consequence, prices from the next available contract were used. This substitution makes the use of dummy variables necessary. Live cattle contracts that are not pricing slaughter cattle approximately 140 days from the sale of the feeder cattle are pricing slaughter cattle for different supply and demand conditions. To account for these differing pricing conditions dummy variables for each alternate contract month will adjust the forecast when an alternate contract month is used. The dummy variables take on a value of one when a particular contract is used and a zero otherwise. Since the economic relationship between slaughter cattle prices and feeder cattle prices should not change from one contract month to another, intercept dummies are used to adjust for the shifts in price level that occurs between the different contract months. The preferred contract month will be used as the par contract.

Cash cattle prices do follow some seasonal pattern, higher in the spring and lower in the fall. The impact this has on the dummy variables is that contract months that are pricing cattle for months where the cash prices are seasonally higher will trade at a premium to contract months that are pricing cattle where the cash prices are seasonally lower. As a result, in the fall-to-spring program where the distant October is par and the alternate contract months are August and June, the sign on their dummies should be negative, adjusting for the premium associated with the non-par contract months. In the spring-to-fall program where the distant April contract is par and the alternate contract months are December and Feburary, the sign on their dummies should be positive, adjusting for the discount associated with the non-par contract months.

3.1.5 Regression Residuals.-- To improve the short term models' ability to accurately forecast turning points, the residuals obtained from the one and five-day regressions will be utilized to re-estimate the models. This adjusting new forecasts with the old "errors" will have the effect of correcting the effect of a missed turning point such that the new forecast will be forced to respond to the change in trend. The logic behind this step is that between the time a forecast is made and the actual price is observed n days hence, new and unobserved information enters into the market that causes the forecast to differ from the observed price. This difference is the residual. By adjusting the next forecast with the residual, the new and unobserved information is brought back into the model.

Each model will be adjusted by adding a residual to the trend measuring explanatory variable. In the case of the five-day model, the residual realized from the most recent one-day forecast will be added into the PLD value used for the next five-day forecast. The fifteen-day model will be adjusted by adding the most recent five-day forecast residual into the PLD value used for the next fifteen-day forecast.

Adjusted models for fall-to-spring program

Five-day model:

$$\text{Close}(t+5) = A + B1(\text{PLD5R}) + B2(\text{CLOSL}) - B3(\text{CLOSC}) + B4(\text{DJ}) + B5(\text{DG}) + e(t)$$

Fifteen-day model:

Close(t+15) = A + B1(PLD15R5) + B2(CLOSL) - B3(CLOSC)

+ B4(DJ) + B6(DG) + e(t)

Adjusted Models for Spring to Fall program

Five-day model:

Close(t+5) = A + B1(PLD5R) + B2(CLOSL) - B3(CLOSC)

- B4(DF) - B5(DD) + e(t)

Fifteen-day model:

Close(t+15) = A + B1(PLD15R5) + B2(CLOSL) - B3(CLOSC)

- B4(DF) - B5(DD) + e(t)

The explanatory variables in these adjusted models have the same definition as the variables in the unadjusted case. Where an "R" has been appended, the variable has been adjusted by a residual. The R appended to the PL variables signifies that the variable has been adjusted by a residual from the most recent one day forecast. An R5 appended to the PL variable signifies that the PL variable was adjusted with the most recent five day forecast. A numerical example is presented in table 6.

3.2 Long Term Model

The primary purpose of the long term model is to forecast the closing futures price forty days from day "t". The long term model for the fall-to-spring program is defined as follows:

Table 6. An example of correcting the PLD5 variable with a one forecasting residual.
(Price data taken from April 80 feeder cattle contract)

Date	Close	Forecasts from one day model (Yhatl)	Difference between the close and yhatl. (Resl)	PLD5 generated for five day model	Sum of PLD5 and Resl. (PLD5R)
8/22/79	83.70	79.77	3.92	82.61	86.53
8/23/79	84.10	79.81	4.29	84.40	88.69
8/24/79	84.40	80.06	4.34	83.84	88.18

$$Close(t+40) = A + B1(PLT) + B2(LCT) - B3(CORN20) + B4(TDJ) + B5(TDG) + e(t).$$

The long term model for the spring-to-fall program is defined as follows:

$$Close(t+40) = A + B1(PLT) + B2(LCT) - B3(CORN20) - B4(TDF) + B5(TDD) + e(t).$$

where:

Close(t+40) = Closing price for feeder cattle at t + 40;

PLT = A technical measure of the forty day trend in feeder cattle prices;

LCT = A technical measure of the twenty day trend in live cattle prices;

CORN20 = A twenty day moving average of the corn futures price;

TDJ = June dummy for the live cattle futures contract;

TDG = August dummy for the live cattle futures contract;

TDF = February dummy for the live cattle futures contract;

TDD = December dummy for the live cattle futures contract;

3.2.1 PLT-- The technical variable in this forecasting model is PLT (Price Linked to Trend). This variable is a combination of a twenty-day moving average and an average of the past 20-day differences in the feeder cattle futures price on day t and t-40, t-1 and t-41, t-2 and t-42.....t-20 and t-60. The 20-day average of the forty-day difference is a measure of the average

40-day trend. This average is then added to a twenty-day moving average current to day t, smoothing the current relevant price level and then projecting it forty days into the future by the average forty-day moving difference. The general form for the calculation is as follows:

PLT = {20 day sum[C(T)-C(T-40)]}/20 + {20 day moving average}
where "C" is the closing price.

A twenty-day moving average was chosen to establish the current price environment. As the goal is to capture a forty-day trend, an average of the forty-day differences will measure such a trend. A twenty-day average is conjectured to be large enough to smooth the differences preventing short term price movements from biasing the trend measurement but short enough to prevent the measure from responding too slowly.

This variable should vary directly with the feeder cattle futures price and have a positive sign. A numerical example of PLT's calculation can be found in table 7.

<u>3.2.2</u> <u>Live</u> <u>Cattle</u>--Since the long term trend of live cattle prices influences the profit outlook for feeding cattle, it should affect the long term price trend of feeder cattle prices. To account for this, a measure was developed to capture the long term trend of live cattle. This measure LCT (Live Cattle Trend) is a twenty day average of a twenty day moving difference. The general form for the calculation is as follows:

LCT = {20 day sum[C(T)-C(T-20)]}/20

Table 7. Sample calculation of the PLT index. (Price data taken form the April 1980 Feeder cattle futures contract)

Date "t-40"	Date "t"	Close "t"	Close "t-40"	Difference between price on "t" and "t-40".	Average 40-day difference	20-day moving average	PLT
7/5	5/8	84.30	88.50	-4.2	.	.	.
7/6	5/9	84.20	87.30	-3.1	.	.	.
7/9	5/10	83.50	88.00	-4.5	.	.	.
7/10	5/11	83.70	87.00	-3.3	.	.	.
7/11	5/14	83.70	86.30	-2.6	.	.	.
7/12	5/15	84.60	85.10	-.5	.	.	.
7/13	5/16	83.50	83.90	-.4	.	.	.
7/16	5/17	84.00	84.00	0.0	.	.	.
7/17	5/18	82.50	84.00	-1.5	.	.	.
7/18	5/21	81.90	85.50	-3.6	.	.	.
7/19	5/22	82.00	85.80	-3.8	.	.	.
7/20	5/23	81.80	86.30	-4.5	.	.	.
7/23	5/24	81.90	86.50	-4.6	.	.	.
7/24	5/25	81.60	85.90	-4.3	.	.	.
7/25	5/29	81.90	84.60	-2.7	.	.	.
7/26	5/30	80.40	83.10	-2.7	.	.	.
7/30	6/01	78.00	82.80	-4.8	.	.	.
7/31	6/04	78.80	81.30	-2.5	.	.	.
8/01	6/05	77.30	80.30	-5.2	.	.	.
8/02	6/06	76.40	80.20	-3.8	-3.24	81.81	78.56
8/03	6/07	77.90	81.10	-3.2	-3.19	81.49	78.30
8/06	6/08	77.60	81.90	-4.3	-3.25	81.16	77.91
8/07	6/11	78.00	82.10	-4.1	-3.23	80.89	77.66

where "C" is the closing price.

A twenty day difference was chosen to reflect the need to capture a longer term trend. Although a forty day trend was desired, futures prices from the desired contract month were not available early enough to generate a forty day measure. Two earlier months were used to facilitate the construction of the trend measure for the twenty day measure.

A twenty day moving difference average was chosen to smooth the effects that shorter term price movements could have on the trend measure. This measure should vary directly with feeder cattle and have a positive sign. A numerical example of LCT's construction can be found in table 8.

A graphical illustration of the technical variables is shown in figures 3 and 4.

3.2.3 Dummmy Variables-- As was the case with the short term models, the preferred live cattle contract may not be trading early enough to accomodate the construction and use of LCT early in the forecasting period.

Measures of LCT have been constructed from earlier contract months for use during the forecasting period when the appropriate measure of LCT is not available. The LCT measure constructed from the earlier contract months will be used until measures from the appropriate futures contract are available.

To account for the differing supply and demand conditions that the LCT's from earlier contracts represent, dummy variables

Table 8. Sample calculation of the LCT index. (Price data taken form the April 1980 Live cattle futures contract)

Date "t-20"	Date "t"	Close "t"	Close "t-20"	Difference between price on "t" and "t-20".	Som of 20-day difference	LCT
7/18	6/20	70.35	69.50	.85	.	.
7/19	6/21	70.25	70.70	.45	.	.
7/20	6/22	70.50	71.65	-1.15	.	.
7/23	6/25	70.00	70.35	-.35	.	.
7/24	6/26	70.30	71.40	-1.10	.	.
7/25	6/27	69.60	71.50	-1.90	.	.
7/26	6/28	67.70	70.50	-2.80	.	.
7/27	6/29	66.20	69.90	-3.70	.	.
7/30	7/02	64.75	69.75	-5.00	.	.
7/31	7/03	64.50	71.05	-6.55	.	.
8/01	7/06	63.20	71.75	-8.55	.	.
8/02	7/09	63.80	72.10	-8.30	.	.
8/03	7/10	65.00	72.25	-7.25	.	.
8/06	7/11	64.10	71.95	-7.85	.	.
8/07	7/12	63.90	72.50	-8.60	.	.
8/08	7/13	65.35	71.00	-5.65	.	.
8/09	7/16	66.35	71.20	-4.85	.	.
8/10	7/17	67.50	70.25	-2.75	.	.
8/13	7/18	69.00	70.35	-1.35	.	.
8/14	7/19	69.10	70.25	-1.15	-85.85	-4.29
8/15	7/20	68.17	69.60	-1.43	-88.13	-4.41
8/16	7/23	69.25	68.95	.30	-88.28	-4.41
8/17	7/24	69.62	69.22	.40	-86.73	-4.34
8/20	7/25	68.12	68.90	-.78	-87.16	-4.36

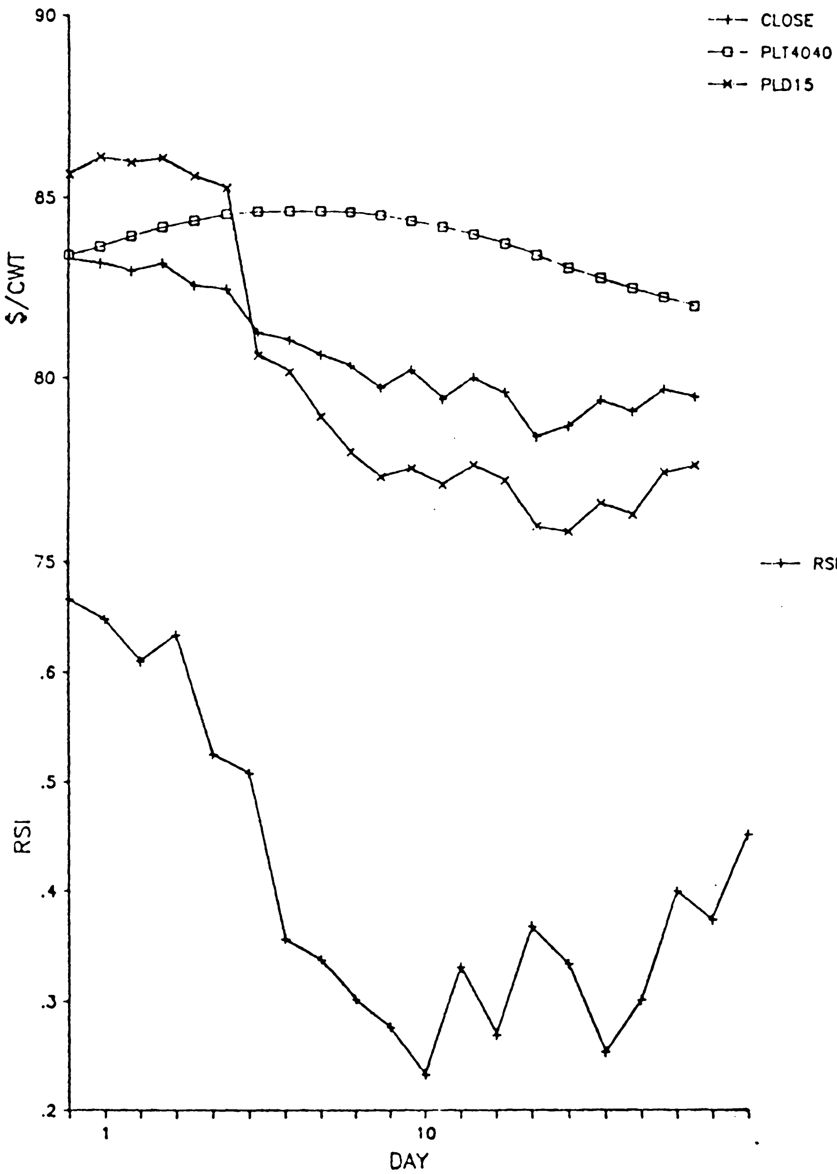


Figure 3. Illustration of PLD1 and PLD5 with stream of futures price closes.

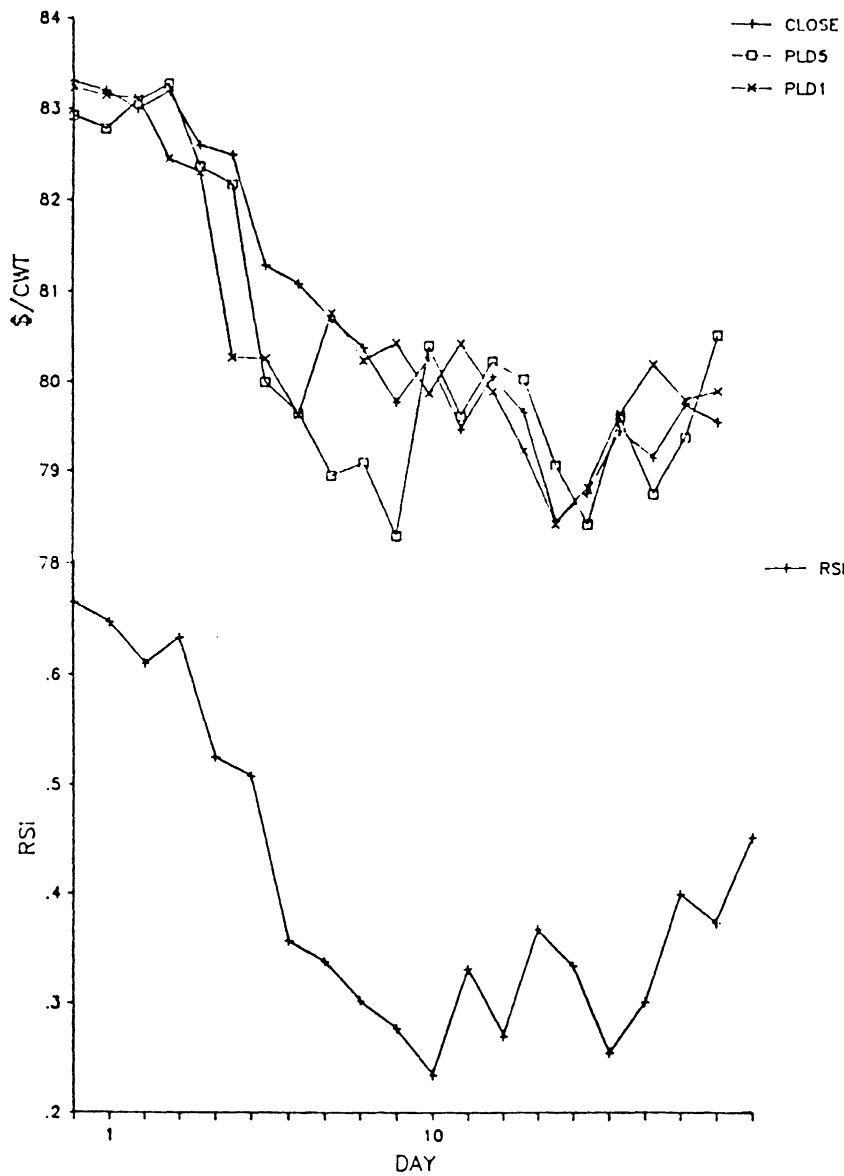


Figure 4. Illustration of PLT and PLD15 with stream of futures price closes.

will be used when an alternate non-par contract month is used.

<u>In the fall-to-spring</u> model, the par contract is the distant October. This contract is pricing cattle for a period where cash prices are seasonally lower. It will thus trade at a level that is at a discount to the earlier contract months. Given that the slope of the price trends for each live cattle contract are the same and their only difference is price level, as a result of seasonality, the dummies for the earlier contracts have a diminished influence on a given change in the trend of the feeder cattle future. This is a direct result of their higher price level; a given percentage change in the par contract price will yield a larger trend value for the alternate contract. Thus, a larger trend value will induce the same changes in the feeder cattle trend as the comparitively smaller change in the par contract. As a result of the diminished influence, the dummies for the alternate contract months should have a positive sign.

<u>In the spring-to-fall</u> model, the par contract is the distant April. This contract is pricing cattle for a period where cash prices are seasonally higher. It will thus trade at a level that is at a premium to the earlier contract months. Using the converse of the logic for the dummies in the fall-to-spring case, the dummies will carry a negative sign.

<u>3.2.4</u> <u>Corn</u>.-- As a principle factor in affecting the profitability of feeding cattle, its general price level should also be a factor in the longer term trend of the prices offered

for feeder cattle. This level was captured bu using a twenty-day moving average of the appropriate corn futures price. A twenty-day moving average was used to capture a smoothed price level that would be responsive to the longer term expectation of the profitability of feeding cattle. The level of the price of corn should vary inversely with the trend of the feeder cattle price and will thus have a negative sign. The fall-to-spring forecasting model utilizes the May contract. The spring-to-fall utilizes the December contract.

3.3 Decision Criteria

This section discusses the framework that will coordinate the observed profit opportunities formed by the futures price forecasts into guides for the producer's hold/sell/forward price decision.

3.3.1 Profit Opportunities. Generating a profit opportunity that can be used in a decision making process requires the following three steps:

1) estimating the cost of the cattle for the program;
2) estimating the non-cattle costs of the program; and
3) estimating the sale price of the cattle at the end of the program.

Before the decision date is reached the cost of the cattle is estimated using the feeder cattle futures contract adjusted for an estimated value of the basis. The estimate of the sale price of the cattle is calculated using the futures price on the date the decision is made to hold/price and adjusting it with an estimate for basis on the purchase/decision date. After the decision date, the actual cost of the cattle purchased on the decision date is used.

3.3.2 Decision Process. The initiation date, the decision date, and the sale date are the dates which are critical to the successful completion of the production programs. The initiation date begins the decision period. The decision date marks the end of the decision period. The sale date is the date the cattle are sold.

In the case of the fall-to-spring and fall-to-fall programs, the initiation date is August 15th, the decision date is October 15th, and the sale date is April 15th. In the case of the spring-to-fall program, the initiation date is March 15th, the decision date is May 15th, and the sale date is October 15th.

As discussed earlier, each one of these dates marks the necessity to make a particular decision. The initiation date marks the point where the producer begins considering the viability of a program. That viability is determined by the anticipated profit at the end of the program. Hedging opportunities, offered by the futures market, provide an opportunity for the producer to lock in a profit level prior to the sale of the cattle. The ability to review each day, and if satisfactory capture a profitable hedging opportunity during the decision period allows the producer to make an informed hold/sell/forward price decision. The decision date marks the last day the hold/sell decision can be made.

The review process, begining on the initiation date, will begin with daily observation of the long term forecast. When the long term forecast indicates profit opportunities available forty days hence are inferior to the present opportunity, the producer should (if the opportunities are profitable) make the hold decision and begin searching for a price at which to hedge. If at the decision date, the present opportunities are not profitable and the outlook is poor, the producer should sell the cattle and forego an extension of the program.

If the opportunities are profitable and the longer term forecasts have indicated that prices will be inferior in forty days the producer would use the shorter term models as guides for actually pricing the cattle. When the fifteen-day model indicates that the prices over the next fifteen days may be inferior, the producer can then observe the five-day model and wait for the five-day model to indicate that the price environment over the next five days will deteriorate. Once this occurs, forecasts from the one-day model can be observed until prices turn for the worse. At that point, a foward pricing target would have been identified and acted upon.

This process is one of successive triggers. The longer term models act as triggers that invoke the shorter term models. The purpose of this type of process is to successively identify better short term profit environments until the best pricing opportunity can be found. The longer term model is the key this process. As long as it signals that prices in the long term are going to be better, the producer should continue to delay the pricing decision.

Once the decision date has been reached, the producer must use the long term model to determine whether to hold or sell. If the outlook is poor and the present opportunity is poor, the cattle should be sold and the stocker program should be foregone. If the outlook is good and the present opportunity is poor, an affirmative hold decision can be made and the pricing decision delayed until the forecast indicates a worsening price environment. The pricing decision framework can be found in matrix format on table 9.

Table 9. Summary of daily pricing decision process using forty, fifteen, five, and one day price forecasts in matrix format.

40-DAY	15-DAY	5-DAY	1-DAY	ACTION
YES	-	-	-	WAIT
NO	YES	-	-	WAIT
NO	NO	YES	-	WAIT
NO	NO	NO	YES	WAIT
NO	NO	NO	NO	PRICE

* "Yes" signifies an improving profit environment where "No"signifies a detiorating profit environment.

CHAPTER FOUR

Data

This section will discuss the data used to generate the decision models and test the decision criteria's effectiveness in generating superior returns through hedging. Daily futures prices for feeder cattle and live cattle from the Chicago Mercantile Exchange and corn futures price from the Chicago Board of Trade were used to generate both pricing opportunities and estimate the basis levels used to generate cost data. Cash prices for feeder cattle were used to generate cash returns. The cost data that facilitated the generation of hedging and cash returns were generated using feeder cattle production budgets developed by the Departments of Animal Science and Agricultural Economics at Virginia Tech.

4.1 Futures Price Data

The regression models used daily futures price quotes to generate the parameters for the models. The period used to estimate the parameters was 1980-1985. The primary reason for selecting this period was the necessity to match futures price data with the available cash price data. Although futures price data were available from 1975-1985 the feeder cattle cash price quotes are not consistent through the entire period. The grading change in 1979 prevents hedging returns in the 1975-1979 period from being directly comparable to the hedging returns in the 1980-1985 period.

4.2 Cash Price Data

The cash feeder cattle prices used were cash quotes from the Virginia Graded Feeder Cattle sales at the Roanoke market. Roanoke was chosen because it is representative of a typical Virginia market. The Roanoke market had suffecient volume and variety of breeds to present a pricing situation that is representative of the true value of the cattle and not aberrations resulting from thin market conditions. Mean values of the weight, lot size, and price were used to generate the cash returns at the market each year for Hereford X Angus Steers with Medium and Large & Medium frames with #1 muscle scores. This particular type was chosen because it represents a large portion of the total volume that moves through the sales each year. A summary of the mean weights, prices, and basis used each year may be found in appendix 2.

4.3 Cost Data

The costs for calculating the returns to the production programs fall into two categories, fixed and variable. Since the production decisions being analyzed are short term decisions relating to one production period, the fixed costs of the operation will not be included in the decision criteria. The decision criteria are designed to help the producer make a production decision based on an estimate of the cost conditions for a particular period rather than an analysis of the long term viability of the enterprise. An itemized discussion of the operating cost components of the production budgets follows.

4.3.1 Non-Cattle Costs.--The production budgets are itemized as appropriate with the feeding method used and the starting weight of the calf. In the case of the fall-to-spring program, the starting weight used was 450lbs. A hay program was used and the sale weight was 600-700lbs.

The fall-to-fall program uses a budget for a calf starting at 450 pounds in the fall and selling it at 800 pounds the following fall. Hay was used in the fall portion of the program.

The spring-to-fall program uses a budget for a calf starting at 600 pounds in the spring and selling at 800 pounds the following fall. An itemization and derivation of each item in the production budgets may be found in appendix 2.

4.3.2 Cost Series.-- These budgets were calculated using 1986 cost figures. In order to generate a cost figure for each year during the 1980-1985 testing period either the actual value of the component was used or when that was not available an index was used to generate a cost figure. The following items were actual values--Hay, Soymeal, Corn, Salt and Gasoline (used to index the hauling expense). These values were attained from the Virginia Agricultural Statistics Bulletin. The remaining items in the budgets were indexed using indexes of the prices paid by farmers (based on 1977 prices) from the "Agricultural Prices 1985 Summary" and values generated from some of the previously mentioned actual values. Each item used an index as follows-- the hauling expense is indexed using the gasoline index generated from the actual value of gas during the relevant period. Medical expenses used a medical service index from the Agricultural Price Summary. Supply expenses used a supplies index found in the Agricultural Price Summary. Pasture, Hired Labor and Overhead expenses use a wage rate index found in the Agricultural Price Summary. The Taxes and Insurance expense uses the tax index found in the Agricultural Price Summary. The interest expenses use an interest rate index found in the Agricultural Price Summary. A complete listing of the Agricultural Price Summary indexes, generated indexes, and the actual cash values can be found in appendix 2.

4.3.3 Cattle Costs-- Each day of the decision period, the producer requires an estimate of the cost/value of the cattle that will be purchased or sold by the decision date. This cost estimate is required to generate a return through hedging that can be used to make the production decision.

This estimate of the cost is generated on any particular day in the decision period by taking the futures price of the nearby contract and adjusting it for basis. The basis is estimated by using an econometric model developed for the particular market, sex, and season of the sale. These models were developed by Robin

Ernst [1989], a fellow researcher in the Department of Agricultural Economics at Virginia Tech.

Parameter estimates, with accompanying t-values, for models for both the spring and fall sales are reported as follows:

Spring Model

$$\begin{aligned}BASIS = {} & \underset{(29.84)}{32.96} \underset{(-30.76)}{-.044WEIGHT} \underset{(-4.80)}{-.0505NUMBER} \underset{(-9.10)}{-5.16MUSCLE2} \\ & \underset{(-3.62)}{-2.54FRAMELG} \underset{(-3.12)}{-1.64FRAMELM} \underset{(-12.52)}{-7.37FRAMESM} \\ & \underset{(-8.40)}{-4.54HEREFORD} \underset{(-3.19)}{-1.34ANGUS} \underset{(-2.72)}{-1.48CHARLAIS} \underset{(.62)}{+.226MAYFUT}\end{aligned}$$

Fall Model

$$\begin{aligned}BASIS = {} & \underset{(13.99)}{11.46} \underset{(-11.83)}{-.014WEIGHT} \underset{(3.11)}{+.018NUMBER} \underset{(-8.90)}{-3.23MUSCLE2} \\ & \underset{(-2.22)}{-1.38FRAMELG} \underset{(-5.06)}{-2.03FRAMELM} \underset{(-11.70)}{-5.24FRAMESM} \\ & \underset{(-9.27)}{-3.43HEREFORD} \underset{(-1.86)}{-.58ANGUS} \underset{(-1.13)}{-.43CHARLAIS} \\ & \underset{(-9.52)}{-3.85SEPTFUT} \underset{(-12.36)}{-4.22NOVMBFUT}\end{aligned}$$

where:

WEIGHT = The sale weight of the cattle.

NUMBER = The lot size.

MUSCLE2 = A dummy variable for cattle with #2 muscle score.

FRAMELG = A dummy variable for lots of cattle classified with a large frame size.

FRAMELM = A dummy variable for lots of cattle classified with a Large-Medium frame size.

FRAMESM - A dummy variable for lots of cattle classified with a Small frame size.

HEREFORD - A dummy variable for lots containing Herefords.

ANGUS - A dummy variable for lots containing Angus.

CHARLAIS - A dummy variable for lots containing Charlais.

MAYFUT - A dummy variable for the May feeder cattle futures contract.

SEPTFUT - A dummy variable for the September feeder cattle futures contract.

NOVMBFUT - A dummy variable for the November feeder cattle futures contract.

CHAPTER FIVE

The results of the regression modeling will be examined in two sections. The first section will examine the preliminary results of the forecasting models. The second will evaluate the statistical integrity of each model and report the final forms of the models if re-estimation was necessary. The preliminary results for the fall-to-spring and spring-to-fall models can be found in tables 10a-b and 11a-b respectively.

5.1 Model Evaluation Criteria

The three criteria for evaluating and modifying the regression models in order of importance are as follows:

1) Consistency of results with economic theory.
2) Performance of the model in the accurate forecasting of turning points.
3) The statistical significance of the parameter estimates.

These criteria will be used to scrutinize the parameter estimates by first checking the sign on the estimate to be assured that it is consistent with economic theory. If the sign is incorrect and a re-evaluation of the theory fails to justify the sign, the variable will be dropped from the model. If the sign is correct and the variable is statistically insignificant, how well the model performs in predicting the turning points will determine if the variable will be left in the forecasting model for testing in the pricing decision framework.

Table 10a. A summary of the relevant statistics for the fall to spring regression models.

Model	N	R-Square	Adjusted R-Square	F value	RMSE	Durbin Watson	Accuracy
1-Day	1282	.9247	.9244	3134.921	2.015	.648	48.48%
5-Day	1151	.9195	.9192	2618.915	2.080	.763	52.69%
15-Day	1059	.7776	.7766	737.229	3.480	.300	53.30%
40-day	914	.6382	.6358	266.695	4.327	.191	60.83%

Table 10b. Summary of relevant statistics for forecasting variables in the fall to spring models.

Variable	Parameter Estimate	t-values	Variance Inflation Factor
ONE-DAY MODEL			
Intercept	-11.114	-13.740	0.000
PLD1	.272	22.483	3.197
CLOSC	-.051	-26.542	1.804
CLOSL	1.223	49.633	4.257
CG	-1.720	-9.570	1.084
CJ	-3.248	-16.181	1.142
FIVE-DAY MODEL			
Intercept	-.978	-1.074	0.000
PLD5R1	.607	33.023	5.718
CLOSC	-.023	-9.788	2.235
CLOSL	.557	15.621	7.973
CG	-.667	-3.486	1.111
CJ	-.681	-2.494	1.286
FIFTEEN-DAY MODEL			
Intercept	4.254	2.677	0.000
PLD15R	.459	14.438	6.004
CLOSC	-.028	-6.952	2.360
CLOSL	.668	10.578	8.702
CG	-.770	-2.396	1.092
CJ	-.170	-.353	1.287
FORTY-DAY MODEL			
Intercept	28.246	17.265	0.000
PLT	.600	36.696	1.109
CORN20	-.000	-0.024	1.033
LCT	-.072	-.923	1.305
TDP	14.276	12.505	1.027
TDJ	9.262	9.337	1.179
TDG	.709	.431	1.002

Table 11a. A summary of the relevant statistics for the spring to fall regression models.

Model	N	R-Square	Adjusted R-Square	F value	RMSE	Durbin Watson	Accuracy
1-Day	1256	.9892	.9891	22872.597	.641	.898	67.54%
5-Day	1151	.8963	.8959	1982.071	1.850	.458	52.08%
15-Day	1073	.7251	.7238	563.366	2.765	.209	56.61%
40-day	933	.3359	.3323	93.872	3.654	.053	58.99%

Table 11b. Summary of relevant statistics for the forecasting variables in spring to fall models.

Variable	Parameter Estimate	t-values	Variance Inflation Factor
ONE-DAY MODEL			
Intercept	-2.156	-6.899	0.000
PLD1	.907	102.604	9.001
CLOSC	-.007	-9.278	3.034
CLOSL	.161	11.014	12.095
CF	.079	1.683	1.193
CD	.255	4.077	1.400
FIVE-DAY MODEL			
Intercept	.063	.064	0.000
PLD5R1	.626	27.488	6.461
CLOSC	-.018	-8.288	2.725
CLOSL	.465	11.672	9.034
CF	.357	2.639	1.138
CD	1.760	8.581	1.192
FIFTEEN-DAY MODEL			
Intercept	5.876	3.782	0.000
PLD15R	.302	12.923	3.561
CLOSC	-.028	-9.099	2.261
CLOSL	.756	15.344	5.311
CF	.299	1.465	1.082
CD	2.689	9.250	1.092
FORTY-DAY MODEL			
Intercept	32.973	19.178	0.000
PLT	.364	16.134	1.378
CORN20	.029	8.238	1.120
LCT	-.120	-2.591	1.171
TDD	-.709	-1.783	1.303
TDF	1.968	7.189	1.099

The abiltity of the forecasting models to predict turning points was evaluated by comparing the stream of forecasted prices with the stream of actual futures prices.

At a 5% level of significance the critical value for the F-value to reject the null hypothesis that the paramater estimate are simultaneously equal to zero is 2.01. The critical value for the t-test is a 5% level of significance is 1.96.

5.2 Model Evaluation

The models will be evaluated in groups. The evaluation of the fall-to-spring models will precede an evaluation of the spring-to-fall models.

5.2.1 Fall-to-spring models.--

In the one-day model, all of the parameter estimates have the expected sign. The most significant variable in this model is the live cattle variable. The parameter estimate indicates that a $1/cwt. increase in the price of live cattle on day t-1 will increase the price of feeder cattle $1.22/cwt. on day t. A $1/cwt. increase in the Price Linked to Divergence (PLD) index indicates an increase of $.27/cwt. A $1/bu. increase in the price of corn on t-1 suggests a $5.09/cwt. decrease in the price of feeder cattle on day t. The parameters on the dummy variable for the August and June live cattle contract months indicate that whenever these months are used in place of the October contract, $1.72/cwt. and $3.24/cwt. respectively are subtracted from the forecast.

<u>In the five-day model</u>, all of the parameter estimates have the expected sign. The most significant variable in this model is the PLD index. The parameter estimate indicates that a \$1/cwt. increase in the value of the PLD index on day t will increase the price of feeder cattle \$.61/cwt. on day t+5. The parameter estimate on live cattle indicates that a \$1/cwt. increase in the price of live cattle on day t will increase the price of feeder cattle \$.55/cwt on day t+5. The parameter estimate on corn indicates that a \$1/bu. increase in the price of corn on day t suggests a \$2.23/cwt. decrease in the price of feeder cattle on day t+5. The parameters on the dummy variable for the August and June live cattle contract months indicate that whenever these months are used in place of the October contract, \$.67/cwt. and \$.68/cwt. respectively should be subtracted from the forecast.

<u>In the fifteen-day model</u>, all of the parameter estimates have the expected sign. The most significant variable in this model is the PLD index. The parameter estimate indicates that a \$1/cwt. increase in the value of the PLD index on day t will increase the price of feeder cattle \$.46/cwt. on day t+15. The parameter estimate on live cattle indicates that a \$1/cwt. increase in the price of live cattle on day t will increase the price of feeder cattle \$.67/cwt. on day t+15. The parameter estimate on corn indicates that a \$1/bu. increase in the price of corn on day t suggests a \$2.84/cwt. decrease in the price of feeder cattle on

day t+15. The parameter on the August and June dummy variables indicate that whenever these months are used in place of the October contract \$.77/cwt. and \$.17/cwt should respectively be subtracted from the forecast.

In the forty-day model, the only variable that is significant is the feeder cattle trend measuring variable. The parameter estimate on the PLT variable indicates that a \$1/cwt. increase in PLT on day t will will increase price of feeder cattle on t+40 by \$.60/cwt. The insignificance of the other variables suggests that over the forty-day period the feeder cattle market has already interpreted any information those variables posessed. That information has already been reflected in the feeder cattle price. The model will be re-estimated excluding the insignificant variables.

Concluding the evaluation of the regression results, the forty-day model will be re-estimated excluding the corn and live cattle trend variables.

5.2.2 Spring-to-fall models.--

In the one-day model, all of the parameter estimates have the expected sign. All the variables with the exception of the February dummy variable are significant. Although insignificant, the t-value on the February dummy variable is greater then one and does provide some information. As a consequence the February dummy will remain in the model.

The most significant variable in this model is the Price Linked to Divergence (PLD) index. A $1/cwt. increase in PLD indicates an increase of $.91/cwt in the price of feeder cattle on day t+1. A $1/bu. increase in the price of corn on t-1 suggests a $.68/cwt decrease in the price of feeder cattle on day t. Since it is unlikely that the price of corn would change one dollar in a day, the small parameter suggests the variable has very little influence. The parameter estimate on the live cattle variable indicates that a $1/cwt. increase in the price of live cattle on day t-1 will increase the price of feeder cattle $.16/cwt. on day t. The parameters on the dummy variable for the December and February contract months indicates that whenever these months are used in place of the April contract, $.25/cwt. and $.08/cwt. are respectively added to the forecast.

<u>In the five-day model</u>, all of the parameter estimates have the expected sign. The most significant variable in this model is the PLD index. The parameter estimate indicates that a $1/cwt. increase in the value of the PLD index on day t will increase the price of feeder cattle $.63/cwt. on day t+5. The parameter estimate on live cattle indicates that a $1/cwt. increase in the price of live cattle on day t will increase the price of feeder cattle $.47/cwt on day t+5. The parameter estimate on corn indicates that a $1/bu. increase in the price of corn on day t suggests a $1.87/cwt decrease in the price of feeder cattle on day t+5. The parameters on the dummy variables for the February

and December live cattle contract months indicate that whenever these months are used in place of the April contract, \$.35/cwt. and \$1.76/cwt. respectively should be added to the forecast.

In the fifteen-day model, all of the parameter estimates have the expected sign. All the variables with the exception of the February dummy variable are significant. Although insignificant, the t-value on the February dummy variable is greater then one and does provide some information. As a consequence, the February dummy will remain in the model. The most significant variable in this model is live cattle. The parameter estimate on live cattle indicates that a \$1/cwt. increase in the price of live cattle on day t will increase the price of feeder cattle \$.76/cwt on day t+15. The parameter estimate on the PLD index indicates that a \$1/cwt. increase in PLD on day t will increase the price of feeder cattle \$.30/cwt. on day t+15. The parameter estimate on corn indicates that a \$1/bu. increase in the price of corn on day t suggests a \$2.87/cwt decrease in the price of feeder cattle on day t+15. The parameter on the February and December live cattle dummy variables indicate that whenever these months are used in place of the April contract \$.30/cwt. and \$2.68/cwt respectively should be added to the forecast.

In the forty-day model, the only variable that is significant and correctly signed is the feeder cattle trend measuring variable (PLT). The parameter estimate on PLT indicates that a \$1/cwt. increase in PLT on day t will will increase price of feeder cattle on t+40 by $.37/cwt. The incorrect signs on the other variables suggests that over the forty-day period the feeder cattle market has already interpreted any information those variables posessed.

The spring-to-fall program has elements of uncertainty in the pricing mechanism that are not present in the fall-to-spring program. Bids for feeder cattle are being formed based on feed price expectations from the new crop year. This additional element of uncertainty may further reduce the time period where the corn and live cattle futures prices on day t are relevant to the feeder cattle price on t+40. New information about the new crop and thus feeding conditions would be the major influencing factor. The corn and live cattle futures price variables may be capturing a spurious relationship. The model will be re-estimated excluding the those variables.

Concluding the evaluation of the regression results, the forty-day forecast will be re-estimated without the corn or live cattle variables.

5.2.3 Diagnostic Issues

The Variance Inflation Factors (VIF) and the Durbin-Watson statistics indicate that multicollinearity is not a problem in these models. However, serial correlation is present. A VIF greater than 10-15 is generally considered the threshold where multicollinearity becomes a problem. The live cattle variable in the spring-to-fall model approached the threshold with a value of 12.09. Since however, it did not excede this range, multicollinearity is not a problem (10).

All of the models demonstrated a Durbin-Watson statistic well below two, indicating that serial correlation is a problem. The presense of serial correlation in a regressive model does not result in biased parameter estimates, but it does have the effect of exaggerating the variances around the estimates (11).

Another issue deals with the models that are adjusted by the residuals of shorter term models. Since the parameter estimates for the adjusted models are generated using the same data set used to generate the parameter estimates of the unadjusted parameters, the assumption that the parameters have the properties associated with Ordinary Least Square parameter estimates does not hold. Consultation with the Virginia Tech Statistics department resulted in the conclusion that the integrity of the parameter estimates can be supported by testing them on out-of-sample data.

5.2.4 Re-estimated models

The results of the model re-estimations can be found in table 12 and 13 for both management programs. The re-estimated forty-day models showed improvement in the turning point accuracy test.

An interesting observation concerning the regression is the diminishing effect of the forecasting variables over the longer

Table 12. A summary of the relevant statistics for the re-estimated regression models.

Model	N	R-Square	Adjusted R-Square	F value	RMSE	Durbin Watson Stat.	Accuracy
Fall-to-Spring							
40-day	1019	.5381	.5376	1185.893	4.640	.128	63.63%
Spring-to-Fall							
40-day	1030	.2538	.2531	350.039	3.736	.042	59.84%

Table 13. Summary of the relevant statistics for the forecasting variables in the re-estimated models.

Variable	Parameter Estimate	t-values	Variance Inflation Factor
FALL-TO-SPRING			
Intercept	4.636	26.171	0.000
PLT	.569	34.437	1.000
SPRING-TO-FALL			
Intercept	42.716	33.556	0.000
PLT	.357	18.709	1.000

time horizons. The decline in significance of the corn and live cattle futures price on day t demonstrates the gradual reflection of that information in the feeder cattle futures price.

Another point concerning the regression models is the appropriateness of regression type techniques where forecasting very short term turning points is the goal. High R-squares do not necessarily translate into a high degree of forecasting accuracy for making weekly or daily forecasts.

5.3 Return Analysis

The forecasts from the forecasting models have been tested in the previously described decision framework. A simulation was conducted for each production program, generating simulated hedging returns. The simulation period was 1980-1985. The 1986 production year was reserved for the out of sample testing.

The simulation functions under the assumption that if at the decision date a sell signal has not been given, a hold decision is assumed. A sell signal given after the decision date is an indication of the simulations failure to find a price at which to hedge. The producer will then complete the production phase of the program as a cash speculator.

5.3.1 Simulation Design.--The simulation program generates returns by executing the following steps:

1) Establishing the cost of the production program.

2) Executing the decision criteria, comparing available and forecasted opportunities.

Establishing the cost of the production program is dependent on the point in time the cost is being generated. The non-cattle-costs are constant throughout the decision and production periods. An estimate of the cattle cost is generated daily throughout the decision period until the decision date; after which, the purchase price of the cattle on the decision date is used. The estimation of the cattle cost is calculated using the nearby futures contract and an estimation of basis on the decision date.

As the cost structure used in this study may not be representative of all producers, different margin levels were incorporated into the cost structures to reflect the varying production conditions that exist among different producers. Varying the margin also serves as a sensitivity analysis for the decision framework.

As the initial trigger in the decision framework is dependent on the cost structure, changing that structure will influence when the price search is initiated. The variation of the margin level achieves the goal of enhancing or retarding the incentive to price. Negative margin levels will encourage the decision framework to price sooner, where positive margins force waiting until a profit opportunity that is higher than the cost plus the margin has been found.

The margin analysis begins at a level of zero and is decreased in $1.50/cwt. increments until no new pricing actions are taken. The margin level is then reset at zero and

Table 14a. Summary of returns from simulation for the fall to spring production program.

Year	Action Date	Action	Percent of futures price range captured	Action price	Margin	Cattle Cost	Non-Cattle cost	Sale basis (est)	Sale basis (act)	Cash Sale price	Cash return	Hedge return	Difference between hedged and cash return
				-------	-------	-------	-------	-------	$/cwt.	-------	-------	-------	-------
81	08/28/80	Price	56%	78.30	0.00	59.11	19.33	3.86	-2.35	68.25	-10.19	-2.49	7.70
81	09/10/80	Price	66%	68.25	3.00	59.11	19.33	3.86	-2.35	68.25	-10.19	-1.29	8.90
81	10/15/80	Sell	94%	82.80	4.50	59.11	19.33	3.86	-2.35	68.25	-10.19	2.01	12.20
82	08/19/80	Price	88%	68.30	-3.00	48.46	21.71	2.32	-2.28	63.56	-6.61	-4.15	2.46
82	01/14/82	Sell	39%	60.70	-1.50	48.46	21.71	2.32	-2.28	63.56	-6.61	-11.76	-5.14
83	02/16/83	Price	90%	70.80	-3.00	46.93	21.99	2.25	-3.06	66.92	-2.00	-1.18	.82
83	01/10/83	Sell	66%	68.80	-1.50	46.93	21.99	2.25	-3.06	66.92	-2.00	-3.18	-1.18
84	09/14/83	Price	14%	64.60	-3.00	44.68	24.04	2.35	-2.14	66.17	-2.55	-6.26	-3.71
84	02/16/84	Sell	66%	68.30	-1.50	44.68	24.04	2.35	-2.14	66.17	-2.55	-2.56	-0.01
85	01/30/85	Price	95%	73.50	0.00	46.73	23.14	2.12	-2.84	66.31	-3.56	0.79	4.35
85	12/26/85	Sell	78%	72.00	1.50	46.73	23.14	2.12	-2.84	66.31	-3.56	-0.71	2.85

Table 14b. A summary of total and mean hedging returns, cash returns, the improvements to returns due to hedging, and the percentage of the futures price captured at the particular margin levels for the fall to spring program.

Margin	Number of actions taken at margin level	Total returns from hedging during simulation period.	Total cash returns during simulation period.	Total improvement in returns from hedging period.	Mean return from hedging during simulation period.	Mean cash return during simulation	Mean improvement in returns from hedging.	Mean percentage of futures price range captured.
		$/cwt.						
-3.00	5	-13.29	-24.91	11.60	-2.65	-4.98	2.32	68.60%
-1.50	5	-19.20	-24.91	5.70	-3.84	-4.98	1.14	79.00%
0.00	5	-19.20	-24.91	5.70	-3.84	-4.98	1.14	79.00%
1.50	5	-20.70	-24.91	4.20	-4.14	-4.98	.84	75.60%
3.00	5	-19.50	-24.91	5.40	-3.90	-4.98	1.08	77.60%

Table 15a. Summary of returns from simulation for the spring to fall production program.

Year	Action Date	Action	Percent of futures price range captured	Action price	Margin	Cattle Cost	Non-Cattle cost	Sale basis (est)	Sale basis (act)	Cash Sale price	Cash return	Hedge return	Difference between hedged and cash return
				--------	--------	--------	--------	--------	$/cwt.	--------	--------	--------	--------
80	04/07/80	Price	23%	69.00	0.00	58.22	5.88	1.38	-5.82	69.24	5.14	-.93	-6.06
80	04/21/80	Price	54%	73.10	4.50	58.22	5.88	1.38	-5.82	69.24	5.14	3.18	-1.96
80	05/15/80	Sell	38%	71.10	6.00	58.22	5.88	1.38	-5.82	69.24	5.14	1.08	-4.06
81	04/06/81	Price	95%	72.40	0.00	57.37	6.78	1.35	-6.26	62.13	-2.02	1.99	4.01
81	05/26/81	Sell	52%	67.30	6.00	57.37	6.78	1.35	-6.26	62.13	-2.02	-3.11	-1.09
82	07/21/82	Price	59%	66.30	0.00	52.31	7.19	-.81	-2.51	63.67	4.17	4.29	.12
82	07/12/82	Sell	49%	65.40	7.50	52.31	7.19	-.81	-2.51	63.67	4.17	3.39	-.78
83	08/16/83	Price	30%	60.40	0.00	52.37	7.32	-.71	-3.11	56.38	-3.31	-2.40	.91
83	08/16/83	Sell	30%	60.40	1.50	52.37	7.32	-.71	-3.11	56.38	-3.31	-2.40	.91
84	03/29/84	Price	75%	66.60	0.00	52.37	7.34	-.68	-4.97	60.96	1.25	1.92	.67
84	05/23/84	Price	53%	65.70	4.50	52.37	7.34	-.68	-4.97	60.96	1.25	1.02	-.23
84	05/17/84	Sell	53%	65.70	7.50	52.37	7.34	-.68	-4.97	60.96	1.25	1.02	-.23
85	03/29/85	Price	98%	70.20	0.00	57.29	8.33	-.94	-2.90	56.00	-9.61	-9.62	-0.01
85	05/15/85	Sell	81%	68.00	7.50	57.29	8.33	-.94	-2.90	56.00	-9.61	-5.26	4.35

Table 15b. A summary of total and mean hedging returns, cash returns, the improvements to returns due to hedging, and the percentage of the futures price captured at the particular margin levels for the spring to fall program.

Margin	Number of actions taken at margin level	Total returns from hedging during simulation period.*	Total cash returns during simulation period.	Total improvement in returns from hedging period.	Mean return from hedging during simulation period.	Mean cash return during simulation	Mean improvement in returns from hedging.	Mean percentage of futures price range captured.
				$/cwt.				
0.00	5	-3.82	-9.52	5.70	-.76	-1.90	1.14	71.40%
1.50	5	-3.82	-9.52	5.70	-.76	-1.90	1.14	71.40%
3.00	5	-3.82	-9.52	5.70	-.76	-1.90	1.14	71.40%
4.50	5	-4.72	-9.52	4.80	-.94	-1.90	.96	67.00%
6.00	5	-9.82	-9.52	-.30	-1.96	-1.90	-.06	58.40%
7.50	5	-6.36	-9.52	4.06	-1.27	-1.90	.81	53.40%

* 1980 production period excluded from totals and means to allow this program to be directly comparable to the other programs.

Table 16a. Summary of returns from simulation for the fall to fall production program.

Year	Action Date	Action	Percent of futures price range captured	Action price	Margin	Cattle Cost	Non-Cattle cost	Sale basis (est)	Sale basis (act)	Cash Sale price	Cash return	Hedge return	Difference between hedged and cash return
				--$/cwt.-------------------------------------									
81	06/01/81	Price	50%	67.10	-6.00	52.59	17.96	1.35	-6.26	62.13	-8.42	-9.71	-1.29
81	05/26/81	Sell	52%	67.30	-4.50	52.59	17.96	1.35	-6.26	62.13	-8.42	-9.51	-1.09
82	07/21/82	Price	59%	66.30	-3.00	47.95	20.22	-.81	-2.51	63.67	-4.50	-4.38	.12
82	07/12/82	Sell	49%	65.40	-1.50	47.95	20.22	-.81	-2.51	63.67	-4.50	-5.28	-.78
83	08/16/83	Price	30%	60.40	-13.50	52.71	20.90	-.71	-3.11	56.38	-17.23	-16.32	.91
83	08/16/83	Sell	30%	60.40	-12.00	52.71	20.90	-.71	-3.11	56.38	-17.23	-16.32	.91
84	05/23/84	Price	53%	65.70	-6.00	48.01	23.54	-.68	-4.97	60.96	-10.59	-10.82	-.23
84	05/23/84	Sell	53%	65.70	-4.50	48.01	23.54	-.68	-4.97	60.96	-10.59	-10.82	-.23
85	05/17/85	Price	82%	68.10	-6.00	52.51	21.53	-.94	-2.90	56.00	-18.04	-8.84	9.20
85	05/15/85	Sell	81%	68.00	-4.50	52.51	21.53	-.94	-2.90	56.00	-18.04	-8.94	9.10

Table 16b. A summary of total and mean hedging returns, cash returns, the improvements to returns due to hedging, and the percentage of the futures price captured at the particular margin levels for the fall to fall program.

Margin*	Number of actions taken at margin level	Total returns from hedging during simulation period.	Total cash returns during simulation period.	Total improvement in returns from hedging period.	Mean return from hedging during simulation period.	Mean cash return during simulation	Mean improvement in returns from hedging.	Mean percentage of futures price range captured.
				$/cwt.				
-13.50	5	-50.07	-58.78	8.71	-10.14	-11.75	1.74	54.80%
-12.00	5	-50.07	-58.78	8.71	-10.14	-11.75	1.74	54.80%
-6.00	5	-50.07	-58.78	8.71	-10.14	-11.75	1.74	54.80%
-4.50	5	-49.97	-58.78	10.99	-9.99	-11.75	2.19	55.00%
-3.00	5	-49.97	-58.78	10.99	-9.99	-11.75	2.19	55.00%

*Results for margin levels -10.50 thru -7.50 are identical to the results for the -12.00 margin.

increased in \$1.50/cwt. increments until a level where no new pricing actions are taken. Although a simulation was conducted at every margin increment, only those increments that induced a change in the action or the action price were reported.

An estimation of the basis for the sale date is calculated to facilitate the generation of a daily profit opportunity throughout the program. The hedged returns at the end of the program are the futures price captured in the hedging program adjusted for the actual basis on the sale date. The cash returns are the actual sale price minus the cattle and non-cattle costs. The results of the simulations are reported on tables 13,14,15, and 16. An example of the calculation of the returns may be found in appendix 3.

<u>5.3.2</u> <u>Simulation</u> <u>Results</u>.--Tables 14a,15a, and 16a present the return information, the sale and purchase prices of the cattle, the actual and estimated basis, the hedging price in the case of a pricing action, the selling price in the case of a sell signal, and the costs of the program. The action price and the return information in the case of a sell signal is based on the outcome of the program had a hedging program been initiated at that price.

Tables 14b,15b, and 16b present the simulation results in aggregated form. The total and mean hedging, cash and improvement in the returns are presented for the simulation period at the various margin levels. Also reported is the mean percentage of the futures price range captured by the decision framework. Following is a discussion of the aggregate results for each program.

The fall-to-fall program showed the greatest improvements in returns from programmed hedging vs. cash speculation. Although the decision framework performed poorest, in terms of the percent of the price range captured, the high cost structure of this program provided the greatest opportunity for improving returns. A point of interest particular to this program is that only with a negative margin could a hold/price signal be triggered. That signal then locked in a negative return illustrating the relatively poor potential for profit with this production program.

The spring-to-fall program, relative to the other programs experienced the smallest improvement in returns from hedging. This reflects the smaller opportunity to improve returns given the much lower cost structure associated with this production program. The best improvements ocurred at incremental margin levels of $0.00 to 3.00/cwt..

The fall-to-spring program, like the other programs did exhibit improved returns through hedging. Relative to the other programs the simulations for this program captured the highest percentage of the futures price range. The best improvements in the returns were captured when the margin level was set at -3.00.

In conclusion, the results from the simulation indicate that all of the programs were unprofitable. This could be a function of a cost structure that may be higher than that of the typical producer. Of the three programs, the spring-to-fall program was the most profitable. This would reflect the lower feed requirements and thus lower costs associated with this program. The fall-to-fall program was most unprofitable. This is a function of the added costs of feeding during the winter months.

5.3.3 Out of Sample Testing

The out of sample test results are reported on tables 17 and 18. The 1986 production year showed the fall-to-spring and spring-to-fall programs to be most profitable. The fall-to-fall program was the least profitable of all the programs. The fall-to-spring program showed the greatest improvements in returns due to hedging. Three pricing actions were triggered, the highest showing an improvement of \$13.05/cwt. at 98% of the futures price range. The lowest level of improvement occured at the \$0.00 margin level. A sell signal was triggered at the \$1.50/cwt. margin level.

By comparing the turning points of the forecasted futures price series with the turning points of the actual futures price series, a measure of forecast accuracy was developed. The accuracy of the fall-to-spring models in forecasting turning points was as follows. The one-day model showed a 10.4% improvement in accuracy during the out-of-sample period. The performance of the five-day model declined 5%. The fifteen-day's model im

Table 17. Summary of returns from simulations for the out of sample test.

Year	Action Date	Action	Percent of futures price range captured	Action price	Margin	Cattle Cost	Non-Cattle cost	Sale basis (est)	Sale basis (act)	Cash Sale price	Cash return	Hedge return	Difference between hedged and cash return
				$/cwt.									
Fall to Spring													
86	10/07/85	Price	98%	69.00	-3.00	37.38	22.24	2.39	4.55	54.00	.88	13.94	13.05
86	01/28/86	Price	72%	66.92	-1.50	37.38	22.24	2.39	4.55	54.00	.88	11.85	10.97
86	02/18/86	Price	11%	63.20	0.00	37.38	22.24	2.39	4.55	54.00	.88	8.13	7.25
86	01/28/86	Sell	72%	66.92	1.50	37.38	22.24	2.39	4.55	54.00	.88	11.85	10.97
Spring to Fall													
86	08/18/86	Price	94%	63.95	9.00	42.38	8.51	1.26	-2.40	56.50	5.62	10.66	5.05
86	08/18/86	Sell	94%	63.95	10.50	42.38	8.51	1.26	-2.40	56.50	5.62	10.66	5.05
Fall to Fall													
86	08/18/86	Price	94%	63.95	-3.00	40.22	24.09	1.26	-2.40	56.50	-7.81	-2.76	5.05
86	08/18/86	Sell	94%	63.95	-1.50	40.22	24.09	1.26	-2.40	56.50	-7.81	-2.76	5.05

Table 18. A summary of the results of the turning point analysis for the out-of-sample period.

Model	Number of observations	Percentage of turning points forecasted correctly
----------------Fall-to-Spring-------------------		
One-day	200	53.50%
five-day	195	43.59%
fifteen-day	185	55.14%
forty-day	96	11.46%
----------------Spring-to-Fall-------------------		
One-day	190	73.68%
five-day	185	55.14%
fifteen-day	175	49.14%
forty-day	96	66.28%

proved 3.5%. The forty-day model experienced an 82.2% decline in performance.

The results of the spring-to-fall models out-of-sample test were as follows. The one-day model showed a 9.1% improvement in performance. The five-day model's performance improved 3.1%. The fifteen-day model' performance declined 13.1%. Finally, the forty-day model's performance improved 12.4%.

The variation in accuracy from the in-sample to the out-of-sample period may be a result of the previously discussed serial correlation present in the models and the problems associated with the re-introduction of the regression residuals into the short term forecasting models. However, given that the hold/price /sell decision framework was still able to capture futures prices in the top half of its range indicates that the coordination of the forecasting models may lower the probability and risk of acting on an inaccurate forecast.

CHAPTER SIX

SUMMARY AND CONCLUSIONS

The Virginia feeder cattle producer faces exposure to price risk without an attractive method for transferring that risk. Reliance on hedging to transfer that risk poses particular problems for the smaller Virginia producer. For the small producer, the large contract size and limited access to credit to cover margin requirements are impediments. Also, the lack of a thorough knowledge of the futures market and an accurate estimate of basis at the point of sale are additional barriers to a sucessful hedging program.

To alleviate some of the difficulties the Virginia producer faces, a proposed pricing institute would offer a forward pricing alternative. By taking advantage of the greater accessability of credit that an agency would presumably have over the individual producer and pooling the production of many producers, a pricing institute could manage the hedging task.

To facilitate the profitable management of the hedging function, the pricing institute would require a method for identifying and forecasting favorable hedging opportunities. This research concentrates on exploring the usefulness of technical and fundamental indicators used in an econometric context in conjunction with a decision framework to identify such opportunities.

Two types of technical variables have been developed. The first uses the divergence/convergence between J. Welles Wilder Jr.'s Relative Strength Index (RSI) and the stream of futures prices. These phenomena were mathematically quantified and linked to a moving averege to form the Price Linked to Divergence index (PLD). This variable was developed for use in the one, five, and fifteen-day short term models.

The second type of technical variable measures the most recent forty day trend. It is calculated by taking a twenty day moving average of the most recent forty day differences in price. This number is than added to a twenty day moving average of the futures prices to form the Price Linked to Trend index (PLT). This variable was developed for use in the long term forty-day model.

The long and short term models work together in a decision framework to identify a favorable profit opportunity. The decision framework is a series of successive hurdle values designed to initiate the incentive to find a hedging opportunity as soon as the long term model forecasts that futures prices will deteriorate.

In this study forecasting models were developed for the fall-to-spring and spring-to-fall production periods. A fall-to-fall production alternative was also developed using the spring-to-fall models. In the in-sample testing period (1980-1985), a simulation of the forecasting models used in the decision framework generated improved returns from hedging relative to the cash returns for all three production programs. The out-of-sample period (1986) also demonstrated improved returns for all three production programs.

As there were four or less observations per program for the out-of-sample test, making an inference about the performance of the models in the out-of-sample environment is difficult. Consequently, a comparison of the in/out-sample decision models' daily performance in forecasting turning points , where there are over 100 observations, was used as a better guide of the models out-of-sample performance. The most striking differences between accuracies in the in and out-of sample testing periods occurred in the cases of the fall-to-spring's 40-day and 5-day models. These two models experienced declines in performance of 82.3% and 17.3% respectively. For the models that showed improvement in accuracy, increases ranged from 3.1% to 12.4%. The remaining model, the spring-to-fall fifteen-day model declined in accuracy by 13.1%.

The extreme variations in accuracy between the in and out-of-sample testing periods may be manifestations of the statistical problems associated with the forecasting models. The first, serial correlation, which has the effect of inflating the variances of the regression parameter estimates and in turn decreases the reliability of the forecast. The second problem relates to the construction of the short term technical variables. A violation of the supporting assumptions of the ordinary least squares estimation procedure may have occurred resulting in biased estimators, which will also decrease the reliability of the models.

The major conclusion derived from this research is that, for the sample of data tested, econometric forecasting models using technical variables can be used in a decision framework to deliver returns through hedging that on average are superior to cash returns. Despite the somewhat ambiguous performance of the individual forecasting models, when they are used in a framework where a simultaneous signal from all the models is required for a pricing action, on average, futures prices in the upper half of the futures price range were captured.

As discussed earlier, an incorrect signal to price can only occur if all the forecasting models are incorrect simultaneously. This lowers the probability of recieving an incorrect pricing signal. There are four possible return scenarios after the resolution of the hold/sell decision. The producer can be correct in the decision to hold the cattle; or, the hold decision will be incorrect and the producer will realize a loss. If the producer correctly sells the cattle at the end of the decision period, a loss will be avoided; conversely, if the cattle are incorrectly sold a profit is foregone. Using the system developed in this study improves the likelihood of making a correct decision, and thus reduces the chance of a loss or foregone profit.

As shown in table three, during the study period, producers of

HerefordXAngus large-medium steers delivered to the Roanoke market could receive superior returns through hedging if they could capture prices in the top two quartiles (top 50%) of the futures price range. The results of this study show that such prices were in fact captured using the methods discussed above.

The results from the simulations indicate that on average the spring-to-fall program is the most profitable. The fall-to-fall program is the least profitable. The particular profits captured by individual producers is dependent on their particular cost structure.

One of the key areas for further investigation is the fine tuning of the technical variables. Examining different formulations of the RSI which might be better expressors of divergence/convergence phenomena. Also, a further optimization of the mathematical calculations that capture the divergence or convergence is warranted. Work in both of these areas might improve the individual forecasting ability of the models. In the area of the decision framework, use of the forecasting accuracies of the individual models could be used to develop a joint probability of getting a correct signal from the decision framework. That probability could then be used to calculate an expected return during the decision period.

Finally, other areas relevant to this research include, continued review of out-of-sample performance as data becomes available, exploration of the use of alternative estimation techniques, and testing in different markets on different types of cattle.

APPENDIX I

CALCULATION OF RELATIVE STRENGTH INDEX

Computation of 9-day Relative Strength Index

The nine day RSI is constructed by first calculating a nine day moving average of the upward (U) and downward (D) price movements. The RSI for day "t" is then calculated by dividing U by the the sum of U and D. Ensueing RSI's are calculated in the same fashion as the initial RSI using a different calculation of U and D. U and D on day "t+1" are calculated by multiplying the U or D from day "t-1" by eight and then adding that product to the price movement on day "t". This sum is then divided by nine, yielding the new U or D. At this point the calculation of the new RSI value is identical to the initial case. Table A-1 illustrates using sample data from the April 1980 feeder cattle futures contract the generation of RSI.

Column one is the date at which the closing futures price has been taken. Column two is the closing price. Column three contains the positive changes in price. Column four contains the negative changes in price. Column five contains "U" and column six contains "D". Column seven contains the calculated RSI values.

Table A-1 Calculation of Nine-day Relative Strength Index.

Date	Close	Positive Difference	Negetive Difference	U	D	RSI= U/(U+D)
12/17/79	87.30	.	.	.	.	.
12/18/79	86.10	0.00	1.20	.	.	.
12/19/79	85.50	0.00	.60	.	.	.
12/20/79	85.70	0.20	.00	.	.	.
12/21/79	85.90	0.20	.00	.	.	.
12/26/79	86.30	0.40	.00	.	.	.
12/27/79	85.20	0.00	1.10	.	.	.
12/28/79	85.50	0.30	0.00	.	.	.
12/31/79	84.80	0.00	0.70	.	.	.
01/02/79	86.40	1.60	0.00	0.30	0.40	0.42
01/03/79	85.70	0.00	0.70	0.27	0.43	0.39

APPENDIX II

DERIVATION OF NON-CATTLE COST COMPONENTS, 1980-85 COST SERIES, MEAN CASH PRICES, BASIS, AND WEIGHTS.

Table A-2 Itemized list of non-cattle production cost components for fall-to-spring, spring-to-fall, and fall-to-fall programs for the 1985-86 production year.

Item	Fall-to-Spring	Spring-to-Fall	Fall-to-Fall
Sale Weight(lbs.)	650	825	800
---------------------------$/cwt-------------------------------			
Haul	0.19	0.16	.15
Hay	7.25	0.00	8.10
Corn	4.89	0.00	0.00
Salt&Mineral	0.14	0.10	0.38
Medical	1.55	1.21	2.11
Supplies	0.31	0.36	0.88
Fall Pasture	0.97	0.00	0.00
Summer Pasture	0.00	0.08	6.19
Fence	0.04	0.05	0.08
Machinery	1.23	0.04	1.05
Equip/Struct.	0.21	0.15	0.17
Overhead&Misc	0.31	0.24	0.25
Hired Labor	0.23	0.24	0.36
Taxes&Insurance	0.17	0.00	0.12
Insurance on Cat.	2.58	3.05	1.08
Interest on Exp.	1.90	0.21	2.09
Haul to Mkt.	1.44	1.14	1.60
Total	23.37	7.03	24.07

Table A-2a Calculated Annual Production Costs for fall-to-spring, spring-to-fall, and fall-to-fall programs during the 1980-1985 period.

Year	Fall-to-Spring	Spring-to-Fall	Fall-to-Fall
		$/cwt.	
1980	19.33	5.88	17.96
1981	21.71	6.78	20.22
1982	21.99	7.19	20.90
1983	24.04	7.32	23.54
1984	23.14	7.34	21.53
1985	22.24	7.13	21.77

Table A-2c List of indexes used to generate 1980-1985 cost series. The base year is 1977.

Year	Fence	Wage	Int.	Taxes	Med.	Mach.	Supp.	Gas	Salt	Misc.Mach.
1980	128	126	174	115	139	136	134	198	122	128
1981	134	137	211	123	151	152	147	226	169	152
1982	135	144	241	124	156	165	152	212	169	135
1983	138	148	250	129	159	179	152	204	210	138
1984	138	151	255	132	161	181	146	197	184	138
1985	136	154	242	133	157	178	143	195	206	136

Description of Cost derivations

Steers purchased in the Fall and sold in the Spring (100 head)-

The budgets are based on the following assumptions.

Cattle have medium frames.

<u>Weights and Prices</u>

Fall			Spring	
Weight	Price	Gain	Weight	Price
350	$70.00	200	550	$72.00
450	$68.00	200	650	$67.00
550	$66.00	200	750	$63.00

These prices are the average of the past five years.

<u>DEATH LOSS</u>
Death loss is 3% for 350lb. calves, 2.5% for 450lb. calves and 2.0% for 550lb. calves.

Calves are purchased around October 15 and sold around April 15 so they are on the farm about 180 days.

<u>FEED REQUIREMENTS</u>

Steer starting wt. (lbs.)	350	450	550
Per day gain (lbs.)	1.1	1.1	1.1
Ave. wt. on farm (lbs.)	450	550	650
Ave. TDN/day (lbs.)	6.7	7.8	8.8
-Fall pasture			
TDN 10/15 to 11/20 35 days of grazing (lbs.)	196	238	280
AUM from pasture	.65	.80	.93

(AUM means animal unit month of pasture which = 300 lbs. of TDN.)

Hay wintering system 11/20-4/15 148 days

TDN required (lbs.)	990	1140	1391
.07 lbs. bw of gr/day (lbs.)	490	590	695
TDN from above grain (lbs.)	382	460	542
TDN from hay (lbs.)	608	680	849
Hay (TDN/.48*1.1) (lbs.)	1395	1560	1945
Hay (tons)	.70	.78	13.0

LABOR REQUIREMENTS FOR 100 HEAD	Oper. Hrs.	Hired Hrs.
Oct. buy and deliver - 1 man	12	-
medication - 3 men @ 5hrs.	5	10
pasture checking @ 1 hr./day	15	-
Nov. pasture checking, 1/2 mo.	10	-
feeding and checking, 1/2 mo.	20	-
Dec. feeding and checking	46	-
Jan. medication - 3 men @ 5 hr.	5	10
Feb. feeding and checking	46	-
March feeding and checking	23	-
April feeding and checking	23	
selling - 3 men @ 4 hrs.	4	8
Total	278	28

HAULING AND MARKETING			
Wt.	350	450	550
Haul to farm/head - $	1.00	1.20	1.30
Haul to mkt./head - $	1.30	1.40	1.50
Market/head - $	6.00	7.00	8.00
Total - $	8.30	9.60	10.80

SUPPLIES	
1 Fly tags - $	1.00
ID tags - (in above)	
Other supplies	1.00
Total - $	2.00

MEDICAL			
IBR, P13, ETC. - $	1.00	1.00	1.00
1 worming - $	1.50	2.00	2.50
2 implants - $	3.60	3.60	3.60
general - $	3.00	3.00	3.00
lice treatment	.50	.50	.50
Total - $	9.60	10.10	11.60

MACHINERY FOR 100 HEAD

A vehicle will be used to check the cattle while on pasture. Cattle will be checked daily for the first two weeks and then three times a week thereafter. Travel per trip is 1.5 miles for a total of 53 miles/month @ .20 per mile for a total of $7 V.C. for the hay system.

Hay 148 days @ 1.2 hrs./day =175 hrs.

Operating costs

Hay: 175hrs. * $4.50 = $790 + $7 = $797

Fixed costs

Hay: 175hrs. * $3.50 = $612

Steers purchased in the spring and sold in the fall (100 head)-

The budgets are based on the following assumptions.

Cattle have medium frames.

Weights and Prices

Start wt.	Price	Gain	Sale wt.	Price
400	$70.00	250	650	$67.00
500	$65.00	235	735	$65.00
600	$60.00	225	820	$61.00

DEATH LOSS

Death loss is 1%

Cattle are purchased around April 15 and sold around Nov. 1 so they are on the farm about 200 days.

FEED REQUIREMENTS PER HEAD

Yearlings will be pastured all the time they are on the farm.

Steer starting wt. (lbs.)	400	500	600
Per day gain (lbs.)	1.5	1.4	1.3
Ave. wt. on farm (lbs.)	525	620	710
Ave. TDN/day (lbs.)	7.9	9.3	10.4
TDN 3/15 to 6/15, 62 days(lbs.)	196	238	280
AUM 3/15-6/15	1.55	1.82	2.05
TDN 6/16-8/31, 78 days (lbs.)	615	725	810
AUM 6/16-8/31	2.05	2.43	2.70
TDN 9/1-11/1, 60 days (lbs.)	500	590	655

AUM 9/1-11/1	1.67	1.96	2.18
Total AUM	5.27	6.21	6.93

(AUM = animal unit months = 300 lbs. TDN)

<u>LABOR REQUIREMENTS FOR 100 HEAD</u>		Oper. Hrs.	Hired Hrs.
Apr.	buy and deliver - 1 man	12	-
	medication - 3 men @ 5hrs.	5	10
	pasture checking @ 1 hr./day	15	-
May	pasture checking, 1/2 mo.	10	-
June	medication - 3 men @ 5 hrs.	5	10
	pasture checking, etc.	15	
July	medication - 3 men @ 5 hr.	5	10
	pasture checking	15	
Aug.	pasture checking	15	-
Sept.	medication - 3 men @ 5 hrs.	5	10
	pasture checking	15	
Oct.	pasture checking	15	
	selling - 3 men @ 4 hrs.	4	8
	Total	125	48

<u>HAULING AND MARKETING</u>

Wt.	400	500	600
Haul to farm/head - $	1.00	1.20	1.30
Haul to mkt./head - $	1.30	1.40	1.50
Market/head - $	6.00	7.00	8.00

<u>SUPPLIES</u>

2 Fly tags - $	2.00
ID tags - (in above)	
Other supplies	1.00
Total - $	3.00

<u>MEDICAL</u>

IBR, P13, ETC. - $	1.00
2-3 worming - $	4.00
2 implants - $	1.80
general - $	1.80
Total - $	8.60

MACHINERY FOR 100 HEAD
A vehicle will be used to check the cattle and get the supplies. Mileage is estimated to be 150 miles, and the operating cost per mile is estimated to $.20 since much of the time will be in lower gears. This makes a cost of $30.

Steers purchased in the fall and sold in the fall (100 head)-

The budgets are based on the following assumptions.

Cattle have medium frames.

Weights and Prices

Fall Weight	Price	Gain	Fall Weight	Price
350	$70.00	350	700	$60.85
450	$68.00	350	800	$67.60
550	$66.00	350	900	$58.35

These prices are the average of the past five years.

DEATH LOSS
Death loss is 4% for 350lb. calves, 4.5% for 450lb. calves and 3.0% for 550lb. calves.

Calves are purchased around October 15 and sold around April 15 so they are on the farm about 360 days.

FEED REQUIREMENTS PER HEAD

Steer starting wt. (lbs.)	350	450	550
Per day gain (lbs.)	.6	.6	.6
Ave. wt. on farm (lbs.)	400	500	600
Ave. TDN/day (lbs.)	5.3	6.3	7.2

October 15 to November 15, 31 days - pasture
AUM
(AUM means animal unit months of pasture which = 300 pounds of TDN.)

November 15 to April 15, 150 days - hay.

Hay:

TDN = TDN / day * 150 days (lbs.)	795	945	1080
Hay = TDN / .48 = 1.1 (lbs.)	1820	2165	2475

April 15 to October 15 - 183 days and 200 lbs. of gain

TDN/day	8.2	9.2	10.2

Total TDN	1500	1685	1865
AUM	5.0	5.62	6.22
Total AUM with fall pasture	5.53	6.27	6.96

LABOR REQUIREMENTS FOR 100 HEAD		Oper. Hrs.	Hired Hrs.
Oct.	buy and deliver - 1 man	12	-
	medication - 3 men @ 5hrs.	5	10
	pasture checking @ 1 hr./day	15	-
Nov.	pasture checking, 1/2 mo.	10	-
	feeding and checking, 1/2 mo.	20	-
Dec.	feeding and checking	46	-
Jan.	medication - 3 men @ 5 hr.	5	10
	feeding and checking	46	
Feb.	feeding and checking	46	-
March	feeding and checking	23	-
April	feeding and checking	29	
	selling - 3 men @ 5 hrs.	5	10
May	Checking	15	
June	Checking	15	
	Medication - 3 men @ 5hrs.	5	10
July	Checking	15	
Aug.	Checking	15	
	Medication - 3 men @ 5 hrs.	5	10
Sept.	Checking	15	
Oct.	Checking	7	
	Marketing - 3 men @ 4 hrs.	4	8
	Total	381	58

HAULING AND MARKETING

Wt.	350	450	550
Haul to farm/head - $	1.00	1.20	1.30
Haul to mkt./head - $	1.10	1.30	1.50
Market/head - $	11.00	12.00	13.00

SUPPLIES

3 Fly tags - $	3.00
ID tags - (in above)	
Other supplies	4.00
Total - $	7.00

MEDICAL

IBR, P13, ETC. - $	1.00	1.00	1.00
3-4 worming - $	5.50	6.00	6.50
3 implants - $	5.40	5.40	5.40
general - $	4.00	4.00	4.00
lice treatment	.50	.50	.50
Total - $	16.40	16.90	17.40

MACHINERY FOR 100 HEAD

A vehicle will be used to check the cattle and get the supplies. Mileage is estimated to be 250 miles, and operating cost per mile is to be estimated to be $.20

Hay 148 days @ 1.2 hrs./day =175 hrs.

Operating costs
Hay: 175hrs. * $4.50 = $788 + $50 = $838

Fixed costs
Hay: 175hrs. * $3.50 + $50 = $662

Table A-2d. Roanoke mean cash data for #1 Hereford x Angus steers.

Year	Weight	Price	Basis
---------------Fall sales			
		--------$/cwt--------	
80	447.00	85.38	9.48
80	736.50	69.24	-5.82
81	453.67	70.00	3.71
81	738.58	62.13	-6.26
82	457.17	67.79	.65
82	748.38	63.67	-2.51
83	451.00	64.54	3.28
83	741.33	56.38	-3.11
84	459.50	67.50	1.09
84	739.33	60.96	-4.97
85	492.00	54.00	-11.35
85	758.00	56.00	-2.90
-------------Spring sales			
80	546.00	77.63	12.93
80	648.50	77.25	3.05
81	553.00	76.50	5.90
81	647.67	68.25	-2.35
82	550.50	69.75	3.34
82	645.75	63.56	-2.28
83	549.33	76.67	6.69
83	647.33	66.92	-3.06
84	552.00	69.83	1.21
84	645.00	66.17	-2.14
85	553.00	76.38	8.03
85	650.25	66.31	-2.84

APPENDIX III

DEMONSTRATION OF THE CALCULATION OF THE RETURNS USING ESTIMATED AND ACTUAL CATTLE COSTS.

<u>Example of return using estimated cattle cost</u>.

First spring-to-fall pricing action.

Pricing date for cattle purchase is 4/07/80.

At Action date when cattle are priced cost of cattle estimate is used in calculating a profit opportunity.

Cattle are priced on this date.

Cost of Cattle estimate =
futures price on pricing date + basis estimate.

Purchase weight = 600lb.
Sale weight = 800lb.
Futures price for nearby april on pricing date = 68.90
Purchase basis estimate = 8.34.
Purchase basis actual = 12.93.
Estimated cost of cattle = 68.90 + 8.34 = 77.24.
Estimated cost of cattle in terms of sale weight = (77.24*6)/8 = 57.93.
Actual cost of cattle in terms of sale weight = (77.63*6)/8 = 58.22
non-cattle costs = $5.88/cwt

Sale price of cattle = 69.24.
Basis estimate on pricing date = 1.38.
Actual Basis on sale date =-5.82.
Cash Return = Sale price - (cattle cost + non-cattle cost)
= 69.24 - 58.22 - 5.88 = 5.14
Hedge Return = Futures + Basis - Costs
Hedge Return = 69.00 - 5.82 - 58.22 - 5.88 = -.93
Difference between returns = -6.05

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EXPLORING THE USE OF TECHNICAL INDICATORS AS

PRICING GUIDES IN FEEDER CATTLE PRODUCTION CRITERIA

by

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(ABSTRACT)

The objective of this study was to examine the use of technical indicators, in an econometric context, as guides in making pricing decisions relative to feeder cattle production. Technical indicators were developed for both the short and long term. Short term indicators were designed to capture divergence/convergence between the Relative Strength Index and the futures price stream to form the Price Linked to Divergence index. A long term indicator using an average difference in price over a longer period was developed to form the Price Linked to Trend index. These indicators were used in the econometric models which in conjunction with cash production costs formed a hold/price/sell decision framework.

Analysis was conducted on fall-to-spring, spring-to-fall, and fall-to-fall production programs. Results for the three production programs in both the in and out-of-sample environments showed that on average a futures price in the top half of the futures price range was captured. This resulted in average improvement in returns through hedging for every program.