# ECONOMIC EVALUATION OF ALTERNATIVE HEDGING STRATEGIES FOR THE CATTLE FEEDER

By

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ECONOMIC EVALUATION OF ALTERNATIVE HEDGING

STRATEGIES FOR THE CATTLE FEEDER

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## PREFACE

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# CHAPTER I

# INTRODUCTION

## Current Situation

The fed cattle industry has been characterized by rapid expansion in recent years. Over the past five years, total fed cattle marketings have increased by almost 275 percent. In these five years fed cattle marketings have increased 34 percent annually in the Oklahoma-Texas area.[1] The fed cattle industry is important to the economies of these and surrounding states.

As both numbers and size of feedlots expand, the element of risk becomes extremely important. Many cattle feeders operate on small margins (in some cases negative margins) and a small fluctuation in fed cattle prices has a large effect on both level and variability of returns. Price fluctuations, as such, have been quite prevalent in the last five years. For example, considering weekly prices for Choice 900-1,100 pound steers at the Clovis market and twenty-week feeding periods beginning weekly, there have been 123 feeding periods during which the price of fat cattle dropped over the 1965-1970 period. Sixty-three times, the price dropped more than one dollar per cwt. In 1969, the price level dropped from $34.62 per cwt. the second week in June to $27.25 per cwt. the third week in October, for a price drop in excess of $7 per cwt. during one twenty-week feeding period. Therefore, the cattle feeder must be conscious of the risk associated with a falling market during any given feeding period. It should be noted that these price drops have occurred during a period considered by many as an "up" cattle market.

In conjunction with the fed cattle industry's growing importance in the economy and its high cash price variability, the live cattle futures market was introduced on the Chicago Mercantile Exchange in 1964. The purpose of this endeavor was to allow the cattle feeder to transfer his cash price risk to someone else. By hedging his operation the cattle feeder could greatly reduce the risk associated with unfavorable cash price fluctuations. However, as evidenced from surveys taken by Tapp[2] and Dunn,[3] little hedging is done in Oklahoma.

## The Problem

It has been observed that very few feeders are hedging but the reasons for such lack of hedging are largely unknown. It is probable that lack of understanding of how hedging can be used and how hedging can become an integral part of the feeder's decision model has contributed to the limited use and/or misuse of the futures market. The Tapp and Dunn surveys indicate many feeders do not understand the mechanics of a hedging operation, nor do they fully understand the economic purpose of hedging. Feeders are also largely unaware of the various hedging strategies which could be incorporated into the management of their operations. Much of this lack of understanding can apparently be attributed to a shortage of relevant information about hedging procedure. Information is needed not only to illustrate what potential hedging strategies are available, but also to facilitate an understanding of how they can be used.

## Review of Literature

Formal research into the live cattle futures market, which is little more than five years old, is rather sparse. Much of the work has been descriptive in nature, simply informing readers of the existence of the live cattle futures market. However, some of the most relevant material will be discussed.

Dunn's surveys revealed that 26 of 39 feeders who answered questions concerning use of the futures market noted they would not hedge cattle. Several reasons why they would not hedge were given. Many operators have never used the futures market and felt they didn't know enough about its operation. Others felt that hedging eliminated the chance of large profits and they would rather assume all the risk in exchange for a chance at larger profits. Several other feeders felt that since they bought and sold cattle on the same market, they had a built-in hedge. Other reasons given were that there was no real advantage to hedging cattle, the hedge had never worked to the operator's satisfaction, and some had lost before on hedging and were "soured" on the futures market.[4]

Edwards indicates the live cattle futures market can enable the cattle feeder to substantially eliminate his traditional headache of adverse price changes. It enables him to transfer the speculative element of his operation, thus allowing him more time and energy for management of the feeding operation which will enhance more rapid growth and specialization.[5]

Elder has attempted to develop a theoretical hedging decision model for cattle feeders. He reviews the problems of risk and uncertainty faced by cattle feeders and discusses the basic concept of hedging through futures markets. However, in its present form, the model is not directly applicable to cattle feeders. Elder states that more work is necessary to obtain parameters and distributions for hedging models.[6]

Gum and Wildermuth conclude that the feeder's decision model, ideally, should include expectations relating to price trends in product and input cash markets. When expectations are included in a feeder's decision model, a choice can be made between the expected profit and price risk associated with a position of hedged cattle versus utilization of the cash market. They suggest that further research to provide a theoretical and empirical basis for the integration of the hedging decision into the feeder's total decision-making process would prove fruitful.[7]

Skadberg and Futrell argue that the live cattle futures markets do not have a legitimate role to play in livestock marketing. Their major premise is that the cash-futures price basis is unclear and price quality variations between contract specifications and what is actually produced are large enough to introduce large error into the hedge. They further argue that cattle feeders are not willing to reduce risk at the expense of foregoing possible windfall gains.[8]

Plaxico states that with credit and finance being such a large part in the production agriculture of today, financial institutions could exert considerable influence on cattle feeders' decisions concerning hedging. On the other hand, Plaxico foresees the long run outlook for futures trading as being dependent upon its acceptance by producers. Will producers favor the shifting of the risk of price changes or will they prefer to bear windfall losses and reap windfall gains?[9]

Producers cannot rationally answer such questions without knowledge concerning mean returns and variability of returns from hedged and unhedged positions. Little research has been conducted relative to the economic evaluation of alternative hedging strategies for the cattle feeder. There is a void in information available to feeders as to the economic implications of applying various hedging strategies to their operations, as well as a lack of understanding of available information describing the hedging process. Such information is needed to guide cattle feeders towards an effective decision criterion for their particular organizational structure and environment.

## Objectives

The overall objective of this study is to provide information focusing on how the cattle feeder would have fared, using various hedging strategies as managerial tools, since the introduction of the live cattle futures in 1964. More specifically, the objectives of this study are as follows:

1. To determine how the various alternative hedging strategies can be used as managerial tools;
2. To compare the relative effectiveness of selected hedging strategies under alternative sets of conditions:
    a. Size of operation;
    b. Relative efficiency of operation;
    c. Level of operating capacity; and
3. To aid the cattle feeder in the development of a decision framework which will facilitate the correct choice of hedging

strategies given certain combinations of environmental conditions or level of selected economic variables.

## Procedure

It is not feasible that the objectives of this study can be accomplished under one catch-all procedure. Therefore, the completion of the overall project will mean developing a specific procedure for each of the objectives.

Objective one will be fulfilled by focusing on the various alternative hedging strategies that are available to the cattle feeder. More specifically, the alternative managerial strategies to be discussed and analyzed are as follows: (1) unhedged feeding operation, (2) completely hedged operation, (3) seasonal hedging operation, (4) hedging if expected lock-in is less than the mean net return, (5) hedging if expected lock-in is greater than or equal to the mean net return, (6) hedging if expected net revenue is less than the mean net return and expected lock-in is greater than zero, and (7) a seasonal hedging operation with correction for unexpected price changes.

Each strategy will be discussed with emphasis upon the basic dimensions of its application. Hopefully, these discussions will guide the cattle feeder towards a fundamental understanding of each hedging strategy as well as provide him with the know-how needed to adapt each strategy to his operation. Attention will also be focused on the "why" of each hedging strategy. It is necessary that the cattle feeder know why it would be beneficial to employ any or all of the various strategies to a cattle feeding operation.

Procedure for objective two will entail the comparison of the alternative hedging strategies in terms of mean net returns and variability of returns. The base for evaluation of the strategies will consist of typical feeding periods of 140 days during the period from January, 1965 through December, 1970. Choice feeder steers weighing 650 pounds will be placed on feed at the beginning of each feeding period at a cost taken from weekly average prices for 550-750 pound Choice feeder steers at the Oklahoma City market. The finished cattle will be sold at weekly average prices for 900-1,100 pound Choice slaughter steers at the Clovis or Amarillo (1970 and later) markets. The cost per pound of gain for each period will be adjusted as a function of changes in milo prices over the period.

Feeding costs will also be adjusted for different combinations of operating characteristics: various levels of operating capacity; various sizes of operation; and alternate rates of gain per day. The basic feeding operation and the alternative hedging strategies will be evaluated assuming several different combinations of operating characteristics in each feeding period, thus demonstrating the relative effectiveness of selected hedging strategies under alternative sets of conditions.

Objective three must be accomplished within the established framework developed in objectives one and two. The understanding and know-how demonstrated in objective one in conjunction with the relative effectiveness of the strategies as shown in objective two will substantially aid cattle feeders in the formulation of decision criteria. The cattle feeder, after determining the current operational conditions and/or predicted developments with which he will be confronted, will be able to choose the strategy which he should follow. No one strategy will be best for all operations and only general guides as which strategies are "best" will be presented.

FOOTNOTES

[1]Merle Buss, "Hedging--A Management Tool in Cattle Feeding" (Proceedings, Oklahoma Cattle Feeders' Seminar, Stillwater, Oklahoma, February 5, 1971), p. 1-k.

[2]Ralph L. Tapp, "Economic Implications of Variable Weighing and Grading Practices in the Sale of Slaughter Beef" (unpub. M.S. Thesis, Oklahoma State University, 1968).

[3]Terry Lee Dunn, "Economic Implications of Interlevel Goal Conflict and Operational Inconsistency in the Beef Marketing System: The Packer-Feeder Subsector" (unpub. M.S. Thesis, Oklahoma State University, 1970), p. 46.

[4]Ibid.

[5]Roy V. Edwards, "Cattle Feeding and the Futures Market," Oklahoma Current Farm Economics, XXXX (June, 1967), pp. 42-48.

[6]William A. Elder, "Risk, Uncertainty and Futures Trading, Implications for Hedging Decisions of Beef Cattle Feeders," Staff Paper, University of Minnesota (August, 1969), pp. 33-47.

[7]Russell Gum and John Wildermuth, "Hedging on the Live Cattle Futures Contract," Agriculture Economic Research, XXII (October, 1970), pp. 104-106.

[8]Marvin J. Skadberg and Gene A. Futrell, "An Economic Appraisal of Futures Trading in Livestock," Journal of Farm Economics, XXXXVIII (December, 1966), pp. 1485-1489.

[9]James S. Plaxico, "Live Animal Futures Markets," Oklahoma Current Farm Economics, XXXX (June, 1967), pp. 42-48.

## CHAPTER II

## A CONCEPTUAL FRAMEWORK FOR HEDGING DECISIONS

Futures trading has been extensively employed on a wide variety of commodities for many years. However, it was not until 1964 that live cattle futures trading was introduced on the Chicago Mercantile Exchange. Its late arrival could be attributed to much disagreement by experts as to the validity of futures trade in a commodity such as live cattle. Most of the controversy sparked by these arguments is in conjunction with the use of futures by cattle feeders. Will trade in live cattle futures and the related opportunity to hedge reduce price risk for feeders by an amount substantial enough to warrant their use?

Those supporting trade in live cattle futures felt that the introduction of trade would help to reduce price risk for feeders, moderate production cycles, stabilize prices, and make capital easier to obtain.[1]

Skeptics have argued that live cattle futures do not meet the traditional requirements for futures trade. It is generally suggested that for successful futures trading a commodity must be storable, be adaptable to standardized grading, have a seasonal pattern of production and storage, and be produced by a large number of producers and used by a large number of users. Agreement by experts that live cattle futures do break traditional requirements in these areas is widespread. The major areas of disjunction, it is argued, are those of grading, production-storage patterns and basis.[2] However, there is no widespread agreement as to the impact of those departures upon the usefulness of live cattle futures for hedging purposes.

Many of those in opposition feel the nature of the commodity and the failure to meet traditional requirements will substantially hamper the cattle feeder attempting to hedge. Proponents argue that the cattle feeder can, through adjustments and allowances, successfully hedge slaughter cattle. It is usually conceded, however, that the cattle feeder must possess a thorough knowledge of futures trading and the skill to select those hedging strategies which will succeed in reducing price risk without excessive costs. It is the purpose of this chapter to provide a conceptual framework which will facilitate development of the skill needed to build an effective hedging strategy.

## Hedging Framework

The live cattle futures market is by no means free from complications. An awareness as well as an understanding of the pros and cons of live cattle futures trade is essential to the cattle feeder in building an effective hedging framework. Discussion related to important attributes of the market and hedging activity follows.

### Grading

It has been argued that there is a wide range in quality of cattle within the USDA Choice grade which limits the amount of price protection attained by hedging. It is also argued that there is a wide price range within the Choice grade because of the wide range of quality and weights of cattle within the grade and/or because of supply fluctuations.[3]

Live beef cattle futures contracts must conform to several specifications in addition to consisting of Choice grade live steers. For instance, all cattle must be healthy enough to withstand shipment by rail or truck. Whether health requirements are met shall be determined by the grader. Excessively fat cattle are not eligible for delivery. A par delivery unit of 40,000 pounds must consist of steers weighing between 1,050 and 1,150 pounds with an estimated yield requirement of 61 percent or of steers weighing between 1,151 and 1,250 pounds with an estimated yield requirement of 62 percent. Also, no individual steer shall weigh more than 100 pounds over or under the average weight of the steers in the delivery unit.[4] Such contract specifications do narrow the range of quality and weight of cattle within the Choice grade, thus narrowing the price range as well. A schedule of discounts or premiums is provided for cattle which do not match the specifications.

## Production-Storage Patterns

It is generally known that live cattle do not follow the tradition of other commodities in their production and storage patterns. Most futures contract commodities are produced at a given time during the year and stored throughout the year with prices increasing accordingly. Prices rise within the storage year in an amount comparable to accumulated storage costs. However, beef does not follow this seasonal pattern of production. It is, therefore, difficult to estimate prices for beef cattle because supplies are less predictable. Some argue that this uncertainty of prices will make hedging unduly difficult and subject to widely variable outcomes.[5] It is just this price fluctuation inherent to the beef cattle industry which makes the need for hedging acute, however. If the risk or uncertainty associated with hedging is substantially less than the risk or uncertainty evolving in the cash markets, then hedging is justified.

## Basis

Basis refers to the difference between cash prices and the futures quote at any particular point in time. As a futures contract reaches maturity its quoted price should approach the cash price of live cattle on that day.

The current quote of a distant futures contract is the best consensus, given available information and interpretation by traders, of what the cash price will be at the future date. The consensus futures quote will change during the life of the contract if information and/or interpretation of information changes. As the contract reaches maturity, analysis of market information should continually push the consensus quote towards the actual live cattle price on the maturity date.

In addition to continual evaluation of market information, there are several economic forces which push for convergence. The most striking of these forces is that of delivery. Delivery of cattle, or even the threat of delivery, at the maturity date of a futures contract is of vital importance in the workings of the hedging process.

Generally speaking, delivery of cattle will occur only if the cattle feeder can profit more through delivering cattle than he can by marketing his cattle. Ordinarily, he would market his cattle and offset the futures he sold at the beginning of the feeding period with an equal and opposite buy order. However, if the cash price of cattle is substantially below the futures quote as the maturity date of the contract approaches, a potential delivery situation is present.

To illustrate, suppose a cattle feeder located in Oklahoma determines he can deliver his cattle to the delivery point for a total cost of $1.25 per cwt. If he later faces a situation in which the cash price on or near the maturity date of his futures contract is below the futures quote by more than $1.25 per cwt., he might consider delivering his cattle under the contract. Such delivery could increase the returns to his fed cattle operation.

When actual delivery takes place it will become a vital force pushing for convergence of the cash price and the futures quote during the month of maturity. Delivery of cattle will lessen the supply of cattle marketed in the local cash market, thus driving the cash price upward as shown in Figure 1. Before delivery, supply of cattle (SS) and demand for cattle (DD) indicate a price of $P_o$. After delivery is made the supply of cattle will drop to SS' which will result in a price of $P_1$. This will continue until cash price is driven up to approach the futures quote of $P_q$ as shown in the figure.

In addition, speculators may purchase cattle at the cash market price, sell a futures contract, and deliver the cattle to fulfill the contract. This will increase the demand for cattle in the local cash market, thus resulting in an increased cash market price as shown in Figure 2. Demand will continue to shift upward until the cash price is approaching the future quote.

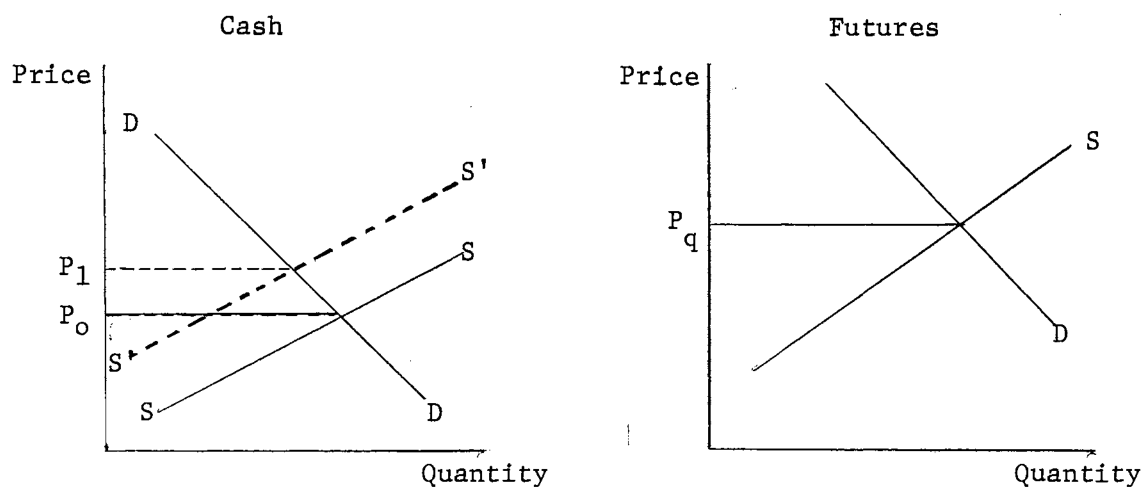


Figure 1. An Illustration of the Impact of Delivery Under a Futures Contract by Hedgers

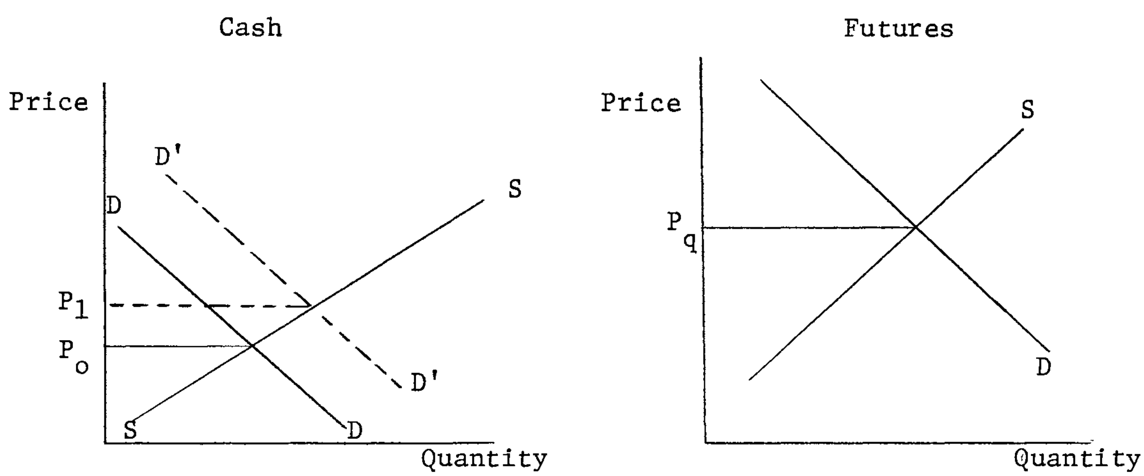


Figure 2. An Illustration of the Impact of Delivery Under a Futures Contract by Speculators

Both of the above forces (delivery by the hedger and speculator) work together to insure the basis is eliminated or approaches zero. Convergence of the cash price and the futures quote is "guaranteed" on the maturity date of the contract.

It is a well known fact, nevertheless, that the forces of delivery are not infallible. Complete convergence is very seldom accomplished. Theoretically, the futures market would be expected to close above the cash market by an amount equal to the cost of delivering under the contract. Such costs are bid into the price of the futures contract.

Several estimates place the costs of delivering cattle on the Chicago market at $.50 per cwt. which includes yardage fees, commission fees, feed costs, grading charges, and often order buying fees.[6] Thus, the futures quote should be $.50 per cwt. higher than the cash price as the futures contract matures. However, the futures quote has not consistently closed above the cash price by such an amount. The extent of non-convergence as well as its predictability over time are of immediate concern to the cattle feeder interested in hedging.

The extent of the basis over the years 1965-1970 is shown in Figure 3. Each point in the figure represents the mean weekly difference in the Chicago cash price for 900-1,100 pound Choice steers and the closing Chicago futures quote (Chicago futures minus Chicago cash) from 1965-1970. The mean difference over the entire period is -.0475 per cwt. with a standard deviation of .7237. The range of individual (not weekly average) differences is $3.10 per cwt. with a minimum of -$1.48 per cwt. and a maximum of $1.62 per cwt.

An apparent seasonal pattern in Figure 3 reveals that Chicago cash prices tend to be above Chicago futures quotes in the early months of

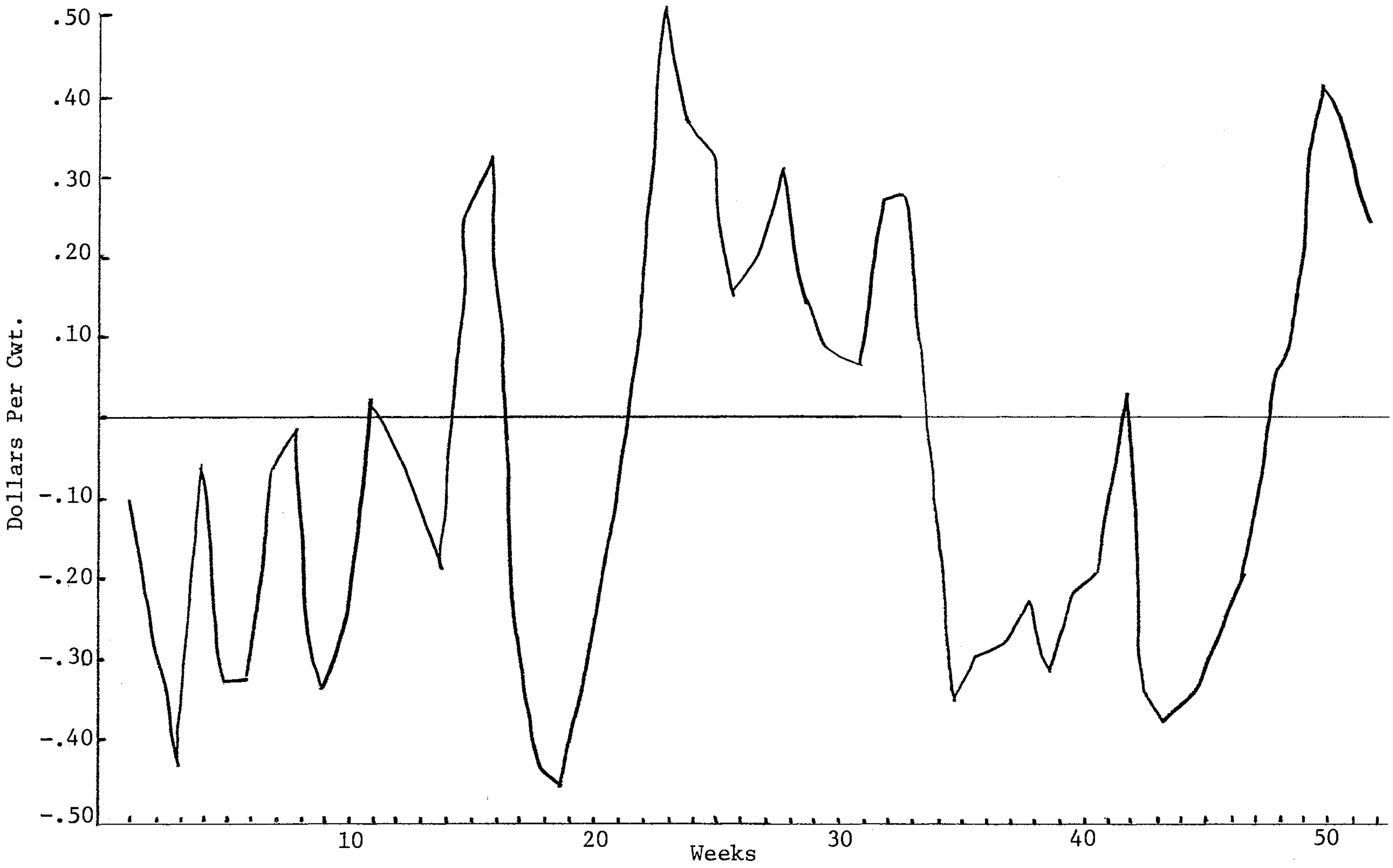


Figure 3. Mean Weekly Differences (Chicago Futures Minus Chicago Cash) for Choice 900-1100 Lb. Steers, 1965-1970

the year as well as in the latter months of the year. Also, futures quotes tend to be higher than cash prices throughout the summer months and in December.

Such information is needed in establishing and managing an effective hedge. In particular, awareness of the seasonal pattern to the basis can be useful. Suppose the cattle feeder chooses to hedge cattle coming out in February. If he then estimates the futures quote will be $.30 per cwt. higher than the Chicago cash price, he can anticipate receiving $.30 per cwt. less returns than he would have received if complete convergence had occurred. Obviously, the greater the accuracy with which the cattle feeder can estimate the basis, the more effective his hedging framework will be.

## Hedging Mechanics

If the futures market is to provide a sensible means of cash price protection to the cattle feeder, there must be a direct relationship between the cash price and the futures quote. The previous explanation and discussion of basis has attempted to mold a foundation for assuming such a relationship. Although complete convergence very seldom occurs, adequate forces pushing for convergence will come into play if the price spread becomes excessive.

The decision to hedge or not hedge depends on the feeder's ability and willingness to carry risk. If the cattle feeder has neither the ability nor the willingness to carry risk, he may use the futures market to protect himself from unfavorable or potentially disastrous cash price movements. In payment for this protection, he must forego any windfall gains which might have resulted from favorable price movements.

Thus, the hedging of fed cattle is not a strategy of profit maximization, but rather a strategy of risk reduction or profit stabilization. Risk will be decreased because, at the beginning of each feeding period, hedging procedures will allow the cattle feeder to estimate his profit or loss over the entire period. Such an estimate is referred to generally as his lock-in margin or, more specifically, as his lock-in profit or his lock-in loss.

In order to estimate his lock-in margin the feeder must determine the breakeven price on his finished steers. His breakeven price will consist of the initial cost of the feeder steers, the cost of feeding the cattle, interest, veterinary expenses, and all other expenses incurred while cattle are in his possession. The total of all cattle expenses will denote to the feeder the price he must obtain to breakeven on his feeding operation. The breakeven price can be incorporated into the cattle feeder's operation as shown by the following illustration.

Suppose the cattle feeder buys 36 head of feeder cattle in early April and plans to sell the fed cattle in August. Considering all costs of operation the feeder estimates his breakeven price will be $27 per cwt. when the cattle are ready for market in August. Further, assume the August futures contract is trading for $30 per cwt. in early April. The feeder has decided to hedge so he will take an equal and opposite position on the futures market in relation to the cash market. The 36 steers he purchased will weigh approximately 1,100 pounds each or 40,000 pounds in total when ready for market in August. To hedge, he will then offset his purchase by selling one 40,000 pound futures contract at $30 per cwt. which will allow him to lock-in an estimated

$3 per cwt. less commission costs of hedging. The commission costs amount to $36 per contract or about .09 per cwt. The August contract will remain outstanding until the conclusion of the feeding period in August, at which time he will sell his cattle at the market price (whether the price fluctuation during the period be favorable or unfavorable) and buy back his August futures contract at its quoted price. This will allow the feeder to obtain his estimated lock-in profit regardless of the cash price movement during the feeding period, as shown in Table I.

In (a) of the table the feeder experienced an unfavorable cash price move, while in (b) he faced a favorable price movement during the period. In both cases he maintained his estimated lock-in profit (LIP) of $2.91 per cwt. He has eliminated the risk of unfavorable cash price movements and traded the possibility of large windfall gains for a guaranteed lock-in margin.

The above illustration is a bit oversimplified. The basis for oversimplification is the phrase "guaranteed lock-in margin". Obviously, the feeders lock-in margin will not be "guaranteed" if the cash and future prices do not converge. As previously discussed and shown in Figure 3, a continuous basis is present because complete convergence does not take place. Therefore, every time a feeder places a hedge he must face the possibility that the cash price and the futures quote will not be the same or will not converge. This concept is known as the feeder's "basis risk".

Basis risk can be estimated and/or anticipated through study of past basis levels and behavior as shown in Figure 3. If the feeder makes the appropriate or even partial adjustment for basis before

TABLE I

AN ILLUSTRATION OF THE OUTCOME OF HEDGED FEEDING OPERATINGS
UNDER VARYING MARKET CONDITIONS

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April 1:

Buy 650 lb. steers and estimate a breakeven price (B.E.) of \$27/cwt.

Sell August futures contract at \$30/cwt.

Estimate Lock-In Profit of \$30-\$27 = \$3/cwt.
Less Commission = \$.09/cwt.
L.I.P. = \$2.91/cwt.

(a)
August 20:

Sell 1,100 lb. fed steers at \$25/cwt.

Buy August futures contract at \$25/cwt.

Net gain above B.E. is \$25-\$27 = -\$2/cwt.

Net gain on futures transactions is \$30-\$25 = \$5/cwt.

Net Profit of Operation = \$5-\$2 = \$3/cwt.
Less Commission = \$.09/cwt.
N.P. = \$2.91/cwt.

(b)
August 20:

Sell 1,100 lb. fed steers at \$35/cwt.

Buy August futures contract at \$35/cwt.

Net gain above B.E. is \$35-\$27 = \$8/cwt.

Net gain on futures transactions is \$30-\$35 = -\$5/cwt.

Net Profit of Operation = \$8-\$5 = \$3/cwt.
Less Commission = \$.09/cwt.
N.P. = \$2.91/cwt.

estimating his lock-in margin, then his basis risk will be decreased and his estimated lock-in margin will be much more reliable.

One obvious conclusion that can be drawn is that basis risk must be less than cash price risk to warrant hedging. If the basis risk when hedging is greater than price risk, the feeder who hedges would protect himself from unpredictable and often unfavorable cash price movements only to find himself facing even more unpredictable and often unfavorable basis movements. Statistics show, however, that basis has had a range of $3.10 per cwt. with a maximum of $1.62 per cwt. and a minimum of -$1.48 per cwt., while Chicago cash prices for comparable cattle had a range of $10.70 per cwt. with a minimum of $23.72 per cwt. and a maximum of $34.42 per cwt. during the 1965-1970 period. This would suggest that basis risk has been much less than cash price risk over the past six years.

### Geographical Adjustments

As previously discussed, convergence of the feeder's cash price and the futures quote on or near the maturity date of the futures contract is essential to the workings of the hedging process. If convergence is not present, the feeder must make the appropriate adjustments before he can, with much confidence, estimate his lock-in margin. A further complication encountered when estimating a lock-in margin is a geographical adjustment which refers to an adjustment the feeder must make, with regard to the location of his cattle feeding operation, relative to Chicago or the par delivery market. For instance, a feeder in the Oklahoma area would receive a cash price for his fed cattle in accordance with prices at the Clovis-Amarillo market at the conclusion of the feeding period. He will then buy back his futures contract at its market price in Chicago. If we assume consideration has been given to basis as previously discussed, then for convergence to be present the Chicago cash price must equal the Clovis-Amarillo cash price for comparable cattle plus the costs of delivery under the contract. If the equality does not hold, the sell and buy procedures undertaken by the feeder at the end of the period will not be equal and opposite actions. His estimated lock-in margin could, therefore, float in either direction depending on the differences in prices in the two market areas. If Chicago prices relative to Clovis-Amarillo prices are high, his realized margin would decrease relative to the lock-in margin. On the other hand, if Chicago prices are less than the market price for his cattle, his realized margin would increase.

The chance that the Chicago cash price and the Clovis-Amarillo price will not remain in constant relationship (rise or fall together) can be termed the feeder's geographical basis risk. To substantially reduce risk a definite relationship between the markets needs to be established.

The relationship between the markets, or the prevailing price in each market, fluctuates in accordance with supply and demand conditions for live beef cattle in each area. The demand for cattle depends on such factors as tastes and preferences, population growth, prices of substitute products, consumer income, advertising, etc. The supply of cattle marketed depends upon such variables as number of cattle on feed, availability of feed, weather conditions, etc. Many of these factors affecting supply and demand are difficult to predict, especially supply factors such as weather conditions and availability of feed.

Varying weather conditions and availability of feed, for example, may be quite prevalent in each market area and decrease the probability of a constant price relationship between markets.

The price relationship between markets will not be allowed to fluctuate immensely, however, because the economic relationships of supply and demand between markets will curtail very large market price differences. For example, if prices in Chicago are higher than Clovis-Amarillo prices by an amount larger than the cost of shipping cattle from that area to Chicago, shipment of cattle to Chicago from the Clovis-Amarillo region will increase the supply of cattle marketed in Chicago, thus lowering prices. In addition, speculators may buy cattle on the Clovis market and ship them to the Chicago market, thus increasing the demand for cattle in Clovis and driving prices up. The actions by both feeders and speculators will work together to insure that prices in any one market are not continually higher than another market by more than transportation costs of the cattle to that market. These forces follow the same general explanation as those forces previously discussed in regard to basis and the threat of delivery.

Figure 4 depicts the weekly difference in Chicago cash prices and Clovis-Amarillo prices for 900-1,100 pound Choice steers over the 1965-1970 period. The mean over the entire six year period is \$.95 per cwt. with a standard deviation of \$.39 per cwt. In other words, the Chicago cash price is an average \$.95 per cwt. above the Clovis-Amarillo price over the period 1965-1970. Many would maintain that \$.95 per cwt. represents a reasonable approximation of the transportation costs for shipping cattle from the Clovis-Amarillo area to Chicago.

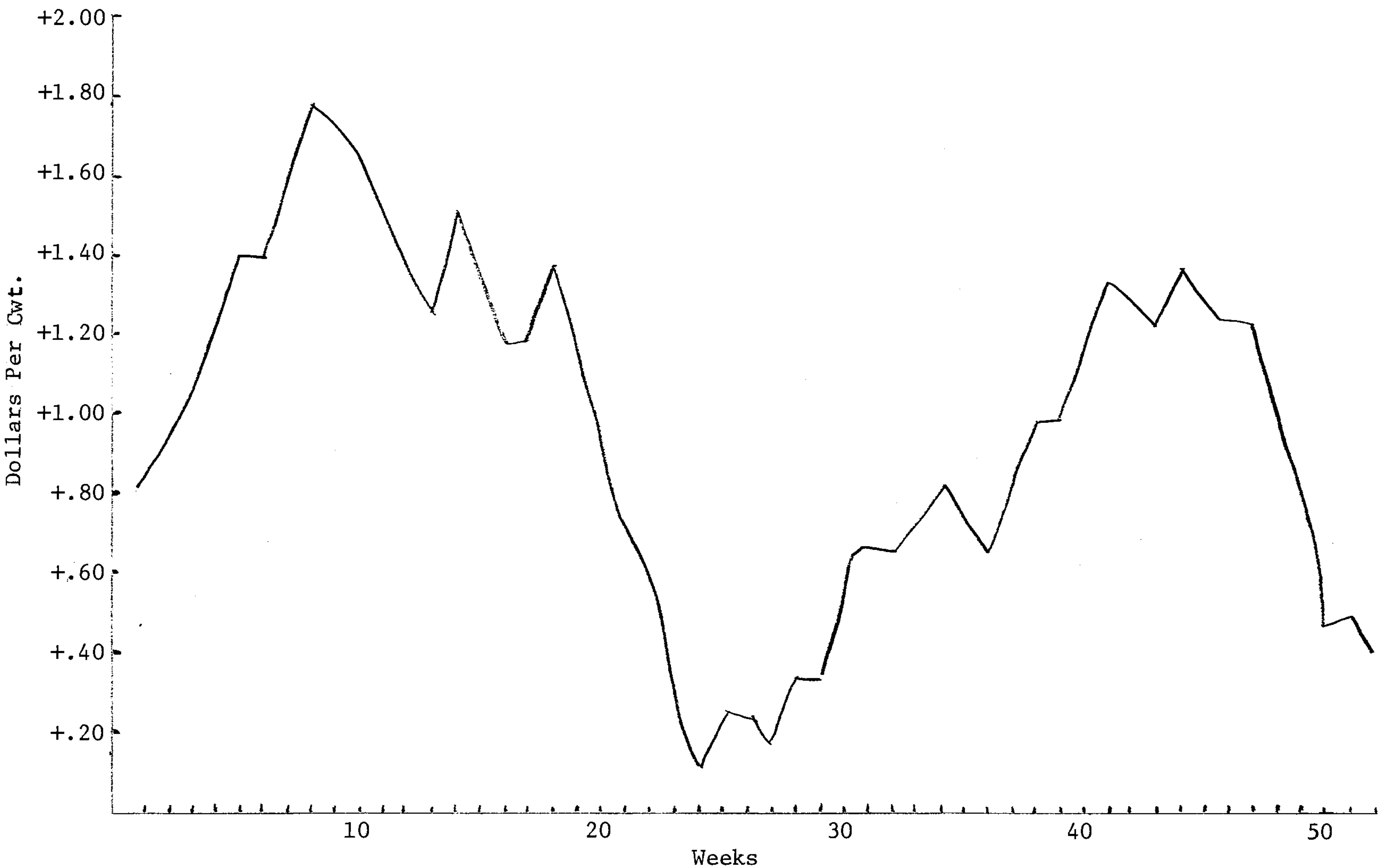


Figure 4. Mean Weekly Differences (Chicago Cash Minus Clovis-Amarillo Cash) for Choice 900-1100 Lb. Steers, 1965-1970

The figure reveals that Chicago prices, relative to Amarillo prices, are above the mean in the early months of the year as well as in the latter portion of the year. Differences are below the mean during the summer months and mid-winter months of January and December. The range of individual (not weekly average) differences is $2.72 per cwt. with a maximum of $2.32 and a minimum of -$.40 per cwt.

Again, to warrant hedging, the risk associated with geographical location must be less than the risk associated with the feeder's market prices. Obviously, a range of $2.72 per cwt. associated with geographical location suggests much less risk than a range in Clovis-Amarillo prices of $13.12 per cwt. over the 1965-1970 period.

## Selective Hedging

Thus far, the nucleus of the discussion has attacked the problem of developing a hedging framework for the cattle feeder. But, the question remains as to when the feeder should incorporate hedging into his feeding operation. Should the feeder hedge all cattle on feed over every feeding period, or should he hedge all cattle for only a portion of the feeding periods, and if so, when? It seems the most logical answer to this question would be for the feeder to hedge selectively. Hedging selectively refers to hedging in accordance with future expectations or some selected indicator of how the hedged position will compare with the unhedged position in terms of net returns.

If the feeder does not employ selective hedging but rather decides to hedge all cattle on feed in every period, then he will be hedging in many instances when cash price movements are favorable during the feeding period. When hedged during a period of favorable cash price movements, the hedge will eliminate the potential financial gains resulting from the price increases just as it eliminates the losses from unfavorable cash price movements. Therefore, the optimum hedging strategy would involve hedging only in those times when unfavorable cash movements occurred. In other words, he would "select" those time periods to hedge in which the price moved in a downward direction over the feeding period. But as discussed previously, prices cannot be accurately predicted, resulting in considerable price risk associated with feeding cattle. However, there are several sources of information which can be utilized to estimate fed cattle price movements, sources such as:

1. Supply of fed cattle;
2. Demand for fed cattle;
3. Trends in fed cattle prices;
4. Seasonal variation in fed cattle prices;
5. Cycles in fed cattle prices; and
6. General tendencies of the economy.

Clearly, the most enlightening of the above information sources are those of supply and demand. If supply and demand can be determined precisely for a future time period, prices can be predicted with great accuracy. However, since there are so many forces affecting supply and demand, their precise prediction would be highly unlikely. We must, therefore, turn our attention to the information available from the other sources.

Trends in fed cattle prices may be estimated through observation. A trend simply refers to the general direction of the market. If the feeder continually observes and analyzes fed cattle prices he will be well aware of the general direction of the market. If recent prices for fed cattle have moved in an upward direction, then a trend as such is present.

Seasonal variation in fed cattle prices may also be determined from observation of market prices or from several outside sources. Numerous studies have been completed with emphasis on seasonal variation in fed cattle prices.[7] Seasonal variation refers to variations in cattle prices and their correlation with the time of the year. The cattle feeder may, for example, determine that fed cattle prices are typically lower in the early winter months as compared to the remainder of the year.

Cycles in fed cattle prices refer to a regularly recurring succession of fed cattle prices. Cycles will indicate to the cattle feeder those years in which cattle prices are expected to peak and the years prices are expected to form a trough. However, the determination and analysis of cycles in cattle prices are very difficult. As yet no beef cattle cycle, free from inconsistencies, has been determined.

In addition, movements of fed cattle prices may also maintain a relationship with the general state of the economy. A feeder with an interest in economics and the dedication to pursue economic and political movements may find it reasonable to correlate fed cattle prices with the general economic trends.

The above is a brief outline of a few of the guidelines the cattle feeder could use to estimate fed cattle prices. In addition, the feeder should employ any other sources of information relevant to the prediction of fed cattle price movements, because the effectiveness with which he is able to estimate price movements will greatly affect the outcome of his selective hedging strategy. In other words, the more times the cattle feeder anticipates unfavorable cash price movements, and hedges against such, the greater his returns will be.

In addition to price outlook indicators, there are several other criteria for selective hedging. One such criterion reverts to the feeder's financial requirements. Financial requirements and the availability of credit are becoming increasingly important in the fed cattle industry. It is highly probable that a larger percentage of credit and financial institutions will require hedging to reduce their clients', as well as their own, vulnerability towards a highly variable and often disrespectful cash market. For instance, national surveys revealed that 68 percent of the banks responding said feeders who hedge are a better risk.[8] A cattle feeder that hedges his feeding operation reduces his risk substantially because he has protected himself against sharp price moves in either direction. Regardless of the price move during the feeding period, the feeder will receive his estimated lock-in margin.

Lending agencies protect themselves from the risk of a loan by either lending less than the value of the borrower's assets or by charging a higher interest rate. Therefore, the more the feeder can do to reduce the risk associated with his loan, the better the terms of the loan are likely to be. Obviously, any cattle feeder who has hedged his operation will be considered a better risk than those feeders who are at the mercy of the highly volatile cash market.

Another criterion for selective hedging is termed stop-loss hedging. The purpose of this hedge is to stop additional or continuing losses to the feeding operation. If fed cattle prices continue to fall during the course of the feeding period until they reach a point in which the cattle feeder can stand no more losses, he may wish to place a hedge to protect his business from unbearable losses. Of course, if and when this point is reached will depend on the feeder's ability and willingness to accept risk.

The stop-loss criterion may override the selective hedging procedure based on the price outlook. Even though the feeder may expect a favorable price outlook in fed cattle prices, he may not be willing to accept the risk associated with his price prediction. If the financial position of his operation is such that a downward price move would prove disastrous, the feeder may wish to hedge to stop any potential losses.

The cattle feeder may also choose to hedge selectively on the basis of future business decisions. Future business decisions may be made further in advance if the risk on present operations is reduced. The feeder's estimated lock-in margin from a hedged position will allow the feeder to anticipate a specific return on his present investments, thus estimating the future financial position of his operation. Without hedging, however, the feeder may be forced to wait until the end of a feeding period to analyze his financial position, thus delaying important financial business decisions.

In summary, the feeder, under a strategy of selective hedging, will choose those periods to hedge as indicated by his particular feeding situation. He may choose to hedge in response to price outlook, financial requirements, financial position, planning decisions, and/or any other hedging indicators he deems reliable.

## FOOTNOTES

[1]J. Marvin Skadberg and Gene A. Futrell, "An Economic Appraisal of Futures Trading in Livestock," Journal of Farm Economics, XLVIII (December, 1966), pp. 1485-1489.

[2]Ibid.

[3]Ibid.

[4]U.S. Department of Agriculture, Chicago Mercantile Exchange Yearbook, 1969-1970 (Chicago, Illinois: Market News Department, 1970), pp. 196-200.

[5]Skadberg, pp. 1485-1489.

[6]John B. Riley, Wayne D. Purcell and J. Richard Crow, "Hedging Cattle Feeding Activities Under the New Chicago Mercantile System," Current Farm Economics. XLIV (October, 1971), p. 7.

[7]Paul Hummer and Ronald Campbell, "Seasonal Relationships of Beef Cattle Prices in Oklahoma" (Forthcoming publication, Oklahoma State University).

[8]"Feeder Cattle Loan Rates Higher," Feedlot, September, 1969, pp. 20-21.

# CHAPTER III

## EVALUATION OF ALTERNATIVE HEDGING STRATEGIES

Discussion in Chapter II concentrated upon the development of an effective hedging framework for the cattle feeder. However, no discussion was presented which analyzed alternative hedging strategies, nor is there publicly available research results which evaluate the performance of such strategies for a particular commodity over time.

The objective of this chapter is to analyze the performance of alternative hedging strategies, over time, for cattle feeding operations. All strategies will be evaluated on the basis of mean and variance of net returns for feeding operations of various sizes, utilization levels, and rates of gain for the period 1965-1970. Strategies will be evaluated individually and comparisons between strategies will be made.

### Data Requirements

For purposes of evaluation of the alternative hedging strategies, the assumptions and data employed must be clarified. As will be apparent, the data used and the models which were employed will be applicable to the High Plains of Texas, New Mexico, Kansas, southeastern Colorado, and Oklahoma.

First, it was assumed that 650-pound Choice feeder steers are placed on feed at the beginning of each feeding period. In order to obtain a large number of observations a new feeding period was begun each week. Feeder steer prices were taken from weekly Oklahoma City prices for 550-750 pound Choice steers.[1] All steers were fed for a period of 140 days and sold at a weight consistent with the 140 days and a specified rate of gain per head per day. The selling price for finished steers was taken from weekly Clovis-Amarillo prices for 900-1,100 pound Choice steers.[2]

The above assumptions were employed in building a basic feeding model for analysis of all strategies. Regardless of the strategies employed during any particular feeding period, the initial cost of feeder steers, the number of days on feed, and the prices received for finished steers remained constant. Therefore, any variation in mean and variance of net returns, for various strategies, results directly from modification of the strategies employed rather than from differences in the basic feeding operation.

The cost of gain for the 140 days was a function of the price of grain sorghum or milo during the feeding period. Reported prices for milo in the "triangle area" of the Texas Panhandle were available after October, 1967.[3] Prior to that time, no such price series was reported.

To fill the data gap prior to October, 1967 a price series was estimated as a function of No. 2 yellow milo prices as reported for Fort Worth.[4] The mean difference between the Panhandle and Fort Worth weekly price series was calculated for 1967, 1968, 1969, and 1970. This mean difference ($.52 per cwt.) was subtracted from the Fort Worth series for 1965-1967 to generate an estimated series for the Texas Panhandle over that period.

To test the adequacy of the estimated series, estimates were calculated for the 1967-70 period. This estimated series was then compared to the actual Panhandle series. A hypothesis which stated the two series were equal was subjected to statistical test and was not rejected. As a result, the estimated series was judged to be acceptable and was used.

Total feeding cost was calculated in the following manner: Daily feed intake for daily gains of 2.3, 2.8, and 3.3 pounds per day were interpolated from Table 4 in a study by Wagoner.[5] The rate of gain was assumed constant over the entire feeding period. It is realized that the assumption of constant gains does some injustice to the actual growth curve, but comparison and testing with actual growth curves as developed by Wagoner indicated no significant difference in total cost.

Assuming concentrates constitute 85 percent of the daily feed intake, 14.8, 16.8, and 18.9 pounds of concentrates were required per day for rates of gain of 2.3, 2.8, and 3.3 pounds per head per day respectively. These feed requirements, in conjunction with a base grain sorghum price of $1.85 per cwt.,[6] provided the basis for determining feeding cost with respect to rate of gain. Further calculations revealed that the cost of gain for 2.8 pounds per day rather than 3.3 pounds per day was an additional $.50 per cwt. and, in addition, the cost of gain for 2.3 pounds per day rather than 2.8 pounds per day required an additional cost of $.81 per cwt. with milo at $1.85 per cwt. Feed costs were then allowed to vary at each rate of gain with respect to weekly grain sorghum prices as expressed by the following relationship:

$$\sum_{t=t-19}^{t} \frac{(M_t - 1.85)\ \text{Gain}^k}{.05}$$

where

$\text{Gain}^k$ = the cost of gain as a function of the rate of gain, and

$M_t$ = milo price for the $t^{th}$ week in dollars per cwt.

At rates of gain of 2.3, 2.8, and 3.3 pounds per day, feed costs vary by \$.35 per cwt., \$.29 per cwt., and \$.24 per cwt. respectively for each \$.05 per cwt. change in weekly milo prices. In other words, if milo prices move upward by \$.05 per cwt., the feed cost at a gain of 2.3 pound gains per day will increase by \$.35 per cwt. Variations, as such, were interpolated from Table 20 in a cost study by Dietrich.[7]

Additional variables affecting costs per pound of gain, in addition to rate of gain, are lot size and utilization rate. After much preliminary investigation, the basis for estimation of total costs are equations (8) and (14) in Dietrich's cost study.[8] Equation (8) shows the relationship between total fixed costs per pound of gain, feedlot size and utilization level, while equation (14) shows the relationship between total feeding costs and feedlot size.

Analysis of both equations and comparisons with other studies[9,10] revealed that total costs per pound of gain for a feeding operation at full capacity and a 2.8 pound of gain per head per day were \$.2350, \$.2410, \$.2469, \$.2513, \$.2556, and \$.2650 for feedlots of 20,000, 10,000, 7,500, 5,000, 2,500, and 1,000 head respectively. The total cost in each case consists of both fixed and variable costs. The variable cost will change for each size feedlot in accordance with rates of gain and milo prices as discussed previously. Fixed costs will change as utilization rates are altered for each size feedlot. As utilization rates fluctuate, variable costs will fluctuate accordingly; however, fixed cost requirements must continue to be met.

Table II depicts the cattle feeder's total costs as a function of the utilization level, lot size, and the rate of gain per head per day if a milo price of $1.85 per cwt. is assumed. These costs are used for all operational conditions under each strategy. For example, a lot of 10,000 head at 75 percent utilization and a 2.8 pound of gain per day will incur a cost per pound of gain of $.2442, regardless of the strategy employed. Total feeding costs will vary, as previously discussed, over each feeding period as a function of weekly grain sorghum prices.

TABLE II

FEEDLOT OPERATORS TOTAL COST PER POUND OF GAIN
AT A MILO COST OF $1.85/cwt.

| Feedlot Size | Rate of Gain Per Head (lbs./day) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2.3 | | | 2.8 | | | 3.3 | | |
| | 100% | 75% | 50% | 100% | 75% | 50% | 100% | 75% | 50% |
| (hd) | ($ Per Head) | | | ($ Per Head) | | | ($ Per Head) | | |
| 1,000 | .2731 | .2771 | .2829 | .2650 | .2690 | .2748 | .2600 | .2640 | .2698 |
| 2,500 | .2637 | .2677 | .2720 | .2556 | .2596 | .2639 | .2506 | .2546 | .2589 |
| 5,000 | .2594 | .2628 | .2673 | .2513 | .2547 | .2592 | .2463 | .2497 | .2542 |
| 7,500 | .2550 | .2587 | .2627 | .2469 | .2506 | .2546 | .2419 | .2456 | .2496 |
| 10,000 | .2491 | .2523 | .2567 | .2410 | .2442 | .2486 | .2360 | .2392 | .2436 |
| 20,000 | .2431 | .2462 | .2503 | .2350 | .2381 | .2422 | .2300 | .2331 | .2372 |

## The Model

The following notation of variables was employed:

$M_t$ = Amarillo milo price in week t;

$OKP_t$ = Oklahoma City 650-pound Choice steer prices in week t;

$CLO_t$ = Clovis 900-1,100-pound Choice steer price in week t;

$FP_t$ = Futures prices at Monday's close;

$CAPUT^{ij}$ = Variable representing cost of gain as a function of lot size i and utilization rate j;

$GAIN^k$ = Variable representing cost of gain as a function of rate of gain k;

GLOC = Geographical location component of the Chicago-Clovis basis;

TIME = Time component of the Chicago-Clovis basis;

$EWT^k$ = Weight of finished animal for rate of gain k; and

$PJCLO_t$ = Projected Clovis price.

The net revenue function for lot size i, utilization rate j, and feeding rate k is then defined as :

$$NR_t = (EWT^k)\ CLO_t - 6.5\ (OKP_{t-19}) - 20\ (CAPUT^{ij}) - \sum_{t=t-19}^{t} \frac{(M_t - 1.85)\ GAIN^k}{.05} . \qquad (3\text{-}1)$$

## Alternative Strategies

The alternative strategies available to the cattle feeder are infinite. However, there are several that appear to be more closely tied to reality. These will be discussed as to their development, explanation, and evaluation.

Strategy I - Unhedged Feeding Operation

The unhedged feeding operation provides the base from which all other strategies are developed. It consists of the feeding operation discussed previously in which 650-pound Choice steers are fed for 140 days and sold at a weight consistent with their assumed rate of gain. All hedging strategies will be compared to this operation to evaluate their performances over the 1965-1970 period.

The net revenue per head for an unhedged operation is defined in Equation (3-1).

Table III depicts the mean and variance of net returns for an unhedged feeding operation. The table reveals, as expected, increasing mean returns as lot size, utilization rate, and rate of gain per day increase. Also exhibited in the table are increasing variance in net returns as rate of gains are increased. However, variance for a specified rate of gain over all mean returns remains nearly stable.

The basic premise of Table III is that it represents the mean and variance of net returns that the typical feeder, in the High Plains area, would have received for feeding operations of various sizes, utilization levels, and rates of gain in the period 1965-1970. It is realized that not all feeders are "typical feeders". Therefore, their total feeding costs, their prices paid and/or received, etc. may result in mean and variances other than these shown in Table III.

Strategy II - Completely Hedged Operation

This strategy assumes that every animal placed on feed is fully hedged. When cattle are placed on feed, each week, the feeder sells the appropriate number of futures contracts to fully hedge all cattle

TABLE III

MEAN AND VARIANCE OF NET RETURNS FOR AN UNHEDGED FEEDING OPERATION

| | | Rate of Gain Per Head Lbs./Day | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2.3 | | 2.8 | | 3.3 | |
| Feedlot Size | Utilization Rate | Mean ($U_R$) ($ Per Head) | Variance ($\sigma^2_R$) ($ Per Head) | Mean ($U_R$) ($ Per Head) | Variance ($\sigma^2_R$) ($ Per Head) | Mean ($U_R$) ($ Per Head) | Variance ($\sigma^2_R$) ($ Per Head) |
| 1,000 | | -3.6585 | 416.7087 | -0.8869 | 448.0955 | 1.5840 | 484.1462 |
| 2,500 | | -0.8115 | 415.8889 | 2.5742 | 448.4734 | 5.6632 | 486.0574 |
| 5,000 | 100% | 0.4850 | 415.8604 | 4.1575 | 449.1636 | 7.5292 | 487.6467 |
| 7,500 | | 1.8158 | 416.0574 | 5.7775 | 450.2024 | 9.4386 | 489.7397 |
| 10,000 | | 3.6003 | 416.6816 | 7.9500 | 452.1282 | 11.9990 | 493.2859 |
| 20,000 | | 5.4150 | 417.7393 | 10.1592 | 454.7131 | 14.6022 | 497.7705 |
| 1,000 | | -4.8684 | 417.3767 | -2.3597 | 448.4058 | -0.1518 | 483.9856 |
| 2,500 | | -2.0253 | 416.1096 | 1.1014 | 448.1245 | 3.9274 | 484.9805 |
| 5,000 | 75% | -0.5433 | 415.8635 | 2.9056 | 448.5913 | 6.0538 | 486.3523 |
| 7,500 | | 0.6967 | 415.8755 | 4.4153 | 449.3052 | 7.8330 | 487.9482 |
| 10,000 | | 2.6324 | 416.2917 | 6.7717 | 451.0098 | 10.6103 | 491.2561 |
| 20,000 | | 4.4774 | 417.1396 | 9.0178 | 453.2993 | 13.2572 | 495.3447 |
| 1,000 | | -6.6226 | 418.6777 | -4.4952 | 449.3508 | -2.6687 | 484.4438 |
| 2,500 | | -3.3258 | 416.5588 | 0.4818 | 448.0605 | 2.0614 | 484.2593 |
| 5,000 | 50% | -1.9043 | 416.0776 | 1.2487 | 448.1467 | 4.1010 | 485.0706 |
| 7,500 | | -0.5131 | 415.8608 | 2.9424 | 448.6052 | 6.0972 | 486.3860 |
| 10,000 | | 1.3016 | 415.9531 | 5.1517 | 449.7615 | 8.7009 | 488.8745 |
| 20,000 | | 3.2373 | 416.5215 | 7.5081 | 451.6895 | 11.4782 | 492.4951 |

Number of Observations = 295

over the entire feeding period. When fed cattle are sold, in 140 days, an equal and opposite buy order will be placed on all futures contracts outstanding. Both selling and purchasing prices for futures contracts, each week, are taken from the Monday closing prices for live cattle futures on the Chicago Mercantile Exchange.[11] The Monday closing prices were chosen because observation revealed that they seemed to represent the prices for each week as well or better than the price for any other single day. However, the decision was arbitrary and grounds for debate are undoubtedly present.

The futures contract sold at the beginning of the period will be for the nearest trading month proceeding the week in which the fed cattle will be sold. In other words, all cattle coming out prior to when the February 1966 contract leaves the exchange (February 20 or very close) and after the December 1965 contract left the exchange (December 20 or very close), will be hedged under the February contract. All cattle coming out after the February contract leaves the exchange will be hedged under the April contract and so forth for all contract months.

Equation (3-1) which defined the income of the basic feeding operation is also the basis for the hedged operation. In addition, the expression for the income from the futures activity is:

$$HNET_t = (FP_t - FP_{t-19})\ EWT^k - 1.04.$$

The \$1.04 is the charge for commission costs per head for a hedged operation. Not included in the equation are interest costs on margin money. It is realized that if an established position moves against the feeder, additional capital would be required to maintain the margin requirements. Interest charges, however, will not be included in the analysis of any of the hedging strategies.

The feeder's net returns, when fully hedged, will be the sum of the net returns from his feeding operation and his hedged position. The expression for his total net returns is:

$$NRH_t = NR_t + HNET_t$$

Table IV depicts the feeder's mean and variance of net returns for strategy II. It is noted that mean returns in the table are quite low and often negative. Variance, although considerably less than in an unhedged position, exhibited much the same pattern of change across varying operational conditions as did the variance for the basic feeding operation.

Strategy III - Seasonal Hedging Operation

Seasonal hedging will allow the cattle feeder to gamble on windfall gains during that portion of the year in which prices are expected to be "up". Seasonal hedging refers to hedging in accordance with seasonal price movements in fed cattle prices. The feeder will select only those periods to hedge in which fed cattle prices are expected to be unfavorable when compared to the remainder of the year. Data in recent years has shown a downward trend in fed cattle prices in the fall months of the year. Therefore, the feeder would hedge all cattle coming out in the fall to protect himself from expected low prices. Under strategy III all cattle coming out in the months of September-December will be fully hedged. Income for fully hedged cattle will be obtained in a similar manner as was income under strategy II. All

TABLE IV

MEAN AND VARIANCE OF NET RETURNS FOR A COMPLETELY HEDGED FEEDING OPERATION

| | | Rate of Gain Per Head Lbs./Day | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2.3 | | 2.8 | | 3.3 | |
| Feedlot Size | Utilization Rate | Mean ($U_R$) | Variance ($\sigma^2_R$) | Mean ($U_R$) | Variance ($\sigma^2_R$) | Mean ($U_R$) | Variance ($\sigma^2_R$) |
| | | ($ Per Head) | ($ Per Head) | ($ Per Head) | ($ Per Head) | ($ Per Head) | ($ Per Head) |
| 1,000 | | -9.7247 | 135.2825 | -7.3196 | 138.2062 | -5.2153 | 145.4935 |
| 2,500 | | -6.8817 | 132.2310 | -3.8586 | 135.7041 | -1.1362 | 143.8178 |
| 5,000 | 100% | -5.5812 | 131.1824 | -2.2754 | 135.0767 | 0.7298 | 143.7684 |
| 7,500 | | -4.2505 | 130.3364 | -0.6554 | 134.7691 | 2.6392 | 144.1843 |
| 10,000 | | -2.4660 | 129.5615 | 1.5171 | 134.8902 | 5.1995 | 145.4817 |
| 20,000 | | -0.6514 | 129.1957 | 3.7263 | 135.6389 | 7.8032 | 147.6701 |
| 1,000 | | -10.9346 | 136.8974 | -8.7924 | 139.7403 | -6.9510 | 146.8595 |
| 2,500 | | -8.0915 | 133.4015 | -5.3314 | 136.5793 | -2.8720 | 144.2676 |
| 5,000 | 75% | -6.6095 | 131.9932 | -3.5273 | 135.5458 | -0.7457 | 143.7697 |
| 7,500 | | -5.3695 | 131.0325 | -2.0176 | 135.0052 | 1.0335 | 143.8033 |
| 10,000 | | -3.4339 | 129.9306 | 0.3388 | 134.7495 | 3.8108 | 144.6730 |
| 20,000 | | -1.5890 | 129.3313 | 2.5849 | 135.1734 | 6.4580 | 146.4296 |
| 1,000 | | -12.6888 | 139.5721 | -10.9280 | 142.4609 | -9.4680 | 149.5298 |
| 2,500 | | -9.3921 | 134.8710 | -6.9146 | 134.8337 | -4.7379 | 145.1862 |
| 5,000 | 50% | -7.9705 | 133.2760 | -5.1841 | 136.4792 | -2.6984 | 144.2053 |
| 7,500 | | -6.5793 | 131.9677 | -3.4904 | 135.5298 | -0.7023 | 143.7659 |
| 10,000 | | -4.7646 | 130.6361 | -1.2812 | 134.8477 | 1.9015 | 143.9680 |
| 20,000 | | -2.8290 | 129.6858 | 1.0752 | 134.8170 | 4.6788 | 145.1496 |

Number of Observations = 295

cattle during the remainder of the year will not be hedged and net income is again expressed by Equation (3-1).

Table V depicts the mean and variance for the seasonal hedging strategy.

### Strategy IV - Hedging if Expected LI ≤ Mean Net Returns

This hedging strategy might apply to those feeders who would like to gamble on possible windfall gains, if they seem probable, but who would like to lock-in a profit if smaller than average gains are expected. The expected LI was calculated by subtracting from the appropriate Chicago futures price, after allowances were made for geographical and time basis adjustments, the cost of producing the finished animal. A futures position was established if the mean net returns ($U_R$) of the unhedged operation were greater than the expected lock-in margin. In equation form the feeder would hedge if

$$ELI_{t-19} < U_R$$

where

$$ELI_{t-19} = FP_{t-19} - \text{Basis} - \text{Costs}$$

and

Basis = Geographical Location Basis (GLOC) + Time Basis (TIME):

$$\text{Costs} = 6.5\ (OKP_{t-19}) - 20\ (CAPUT^{ij}) - \sum_{t=t-19}^{t} \frac{(M_t - 1.85)\ \text{Gain}^k}{.05}$$

The "geographical location adjustment" represents the mean difference in Chicago and Clovis weekly prices for each trading month over

TABLE V

MEAN AND VARIANCE OF NET RETURNS FOR A SEASONAL HEDGING OPERATION

| Feedlot Size | Utilization Rate | Rate of Gain Per Head Lbs./Day 2.3 Mean ($U_R$) | 2.3 Variance ($\sigma^2_R$) | 2.8 Mean ($U_R$) | 2.8 Variance ($\sigma^2_R$) | 3.3 Mean ($U_R$) | 3.3 Variance ($\sigma^2_R$) |
|---|---|---|---|---|---|---|---|
| | | ($ Per Head) | ($ Per Head) | ($ Per Head) | ($ Per Head) | ($ Per Head) | ($ Per Head) |
| 1,000 | | -2.9311 | 370.2351 | -0.0822 | 400.2014 | 2.4659 | 435.3262 |
| 2,500 | | -0.0882 | 369.6809 | 3.3788 | 400.9382 | 6.5451 | 437.7021 |
| 5,000 | 100% | 1.2124 | 369.7747 | 4.9621 | 401.7937 | 8.4111 | 439.5042 |
| 7,500 | | 2.5431 | 370.0981 | 6.5821 | 403.0010 | 10.3205 | 441.8147 |
| 10,000 | | 4.3276 | 370.8911 | 8.7546 | 405.1528 | 12.8807 | 445.6543 |
| 20,000 | | 6.1423 | 372.1174 | 10.9638 | 407.9663 | 15.4841 | 450.4370 |
| 1,000 | | -4.1410 | 370.7893 | -1.5550 | 400.3572 | 0.7301 | 434.9670 |
| 2,500 | | -1.2979 | 369.7886 | 1.9060 | 400.4370 | 4.8093 | 436.4277 |
| 5,000 | 75% | 0.1840 | 369.6824 | 3.7102 | 401.0906 | 6.9356 | 438.0413 |
| 7,500 | | 1.4241 | 369.8105 | 5.2199 | 401.9624 | 8.7149 | 439.8406 |
| 10,000 | | 3.3598 | 370.4092 | 7.5763 | 403.9114 | 11.4922 | 443.4644 |
| 20,000 | | 5.2047 | 371.4304 | 9.8224 | 406.4360 | 14.1390 | 447.8550 |
| 1,000 | | -5.8952 | 371.9260 | -3.6906 | 401.0811 | -1.7868 | 435.1387 |
| 2,500 | | -2.5984 | 370.1157 | 0.3228 | 400.2080 | 2.9433 | 435.4927 |
| 5,000 | 50% | -1.1769 | 369.7688 | 2.0533 | 400.4744 | 4.9828 | 436.5381 |
| 7,500 | | 0.2143 | 369.6826 | 3.7471 | 401.1084 | 6.9790 | 438.0803 |
| 10,000 | | 2.0290 | 369.9448 | 5.9563 | 402.4937 | 9.5828 | 440.8665 |
| 20,000 | | 3.9647 | 370.6965 | 8.3128 | 404.6680 | 12.3601 | 444.8015 |

Number of Observations = 295

the 1965-1970 period. In other words, a mean adjustment factor was calculated for each trading month from mean weekly differences. The "time basis adjustment" represents the mean difference in Chicago futures and Chicago cash weekly prices for each trading month over the six-year period. Thus, the mean time adjustments and the mean geographical adjustments are summed for each trading month (February, April, June, August, October, and December) to determine the adjustment factor for each futures contract. For example, all feeding periods ending in weeks in which the February contract was used for hedging applied the mean February adjustment factor to compute the expected lock-in. It is realized, however, that the variation in geographical and time adjustments is quite large. Use of a mean monthly adjustment factor will not give a very accurate estimate of what the actual basis will be. However, as discussed previously, the possibility of eliminating geographical and time basis risk is very remote. Basis risk is one of the major problems encountered when hedging.

Costs were estimated by extending current grain costs over the entire feeding period.

Table VI exhibits the mean and variance of net returns with respect to strategy IV.

Strategy V - Hedge if Expected LI ≥ Mean Net Returns

This strategy might appeal to a feeder who wished to lock in returns that are expected to be greater than his average returns, while he also gambles that his predictions in other feeding periods of expected LI < mean net returns are wrong. The feeder will fully hedge his feeding operation in those periods in which his expected LI is

TABLE VI

MEAN AND VARIANCE OF NET RETURNS FOR A STRATEGY OF HEDGING IF EXPECTED LOCK-IN < MEAN NET RETURNS

| Feedlot Size | Utilization Rate | Rate of Gain Per Head Lbs./Day: 2.3 Mean ($U_R$) ($ Per Head) | 2.3 Variance ($\sigma^2_R$) ($ Per Head) | 2.8 Mean ($U_R$) ($ Per Head) | 2.8 Variance ($\sigma^2_R$) ($ Per Head) | 3.3 Mean ($U_R$) ($ Per Head) | 3.3 Variance ($\sigma^2_R$) ($ Per Head) |
|---|---|---|---|---|---|---|---|
| 1,000 | | -9.7680 | 291.0332 | -7.4933 | 320.1731 | -6.0582 | 337.3606 |
| 2,500 | | -6.6186 | 293.5427 | -3.7353 | 322.1389 | -1.5876 | 341.6277 |
| 5,000 | 100% | -5.2340 | 293.5435 | -1.9115 | 324.0876 | 0.5489 | 343.9434 |
| 7,500 | | -3.8173 | 293.5437 | -0.1868 | 324.0886 | 2.8226 | 348.8098 |
| 10,000 | | -1.9175 | 293.5432 | 2.1013 | 324.6797 | 5.5485 | 348.8093 |
| 20,000 | | 0.0144 | 293.5410 | 4.4533 | 324.6785 | 8.4715 | 355.5869 |
| 1,000 | | -11.0750 | 291.2493 | -9.0613 | 320.1738 | -7.9062 | 337.3586 |
| 2,500 | | -7.9066 | 293.5427 | -5.2685 | 320.0159 | -3.4710 | 338.4060 |
| 5,000 | 75% | -6.3288 | 293.5427 | -3.3453 | 322.4900 | -1.1718 | 341.6255 |
| 7,500 | | -5.0087 | 293.5437 | -1.6370 | 324.0876 | 0.8723 | 343.9431 |
| 10,000 | | -2.9479 | 293.5430 | 0.8717 | 324.0881 | 4.0700 | 348.8091 |
| 20,000 | | -0.9838 | 293.5425 | 3.2381 | 324.6807 | 6.8882 | 348.8074 |
| 1,000 | | -13.0255 | 291.7136 | -11.6124 | 311.9119 | -10.7077 | 332.4185 |
| 2,500 | | -9.4138 | 291.0313 | -7.0621 | 320.1736 | -5.5500 | 337.3599 |
| 5,000 | 50% | -7.7778 | 293.5430 | -5.1116 | 321.0154 | -3.2862 | 338.4058 |
| 7,500 | | -6.2966 | 293.5425 | -3.3060 | 322.4895 | -1.1256 | 341.6260 |
| 10,000 | | -4.3647 | 293.5417 | -0.8530 | 324.0879 | 2.0159 | 349.0984 |
| 20,000 | | -2.3039 | 293.5432 | 1.6309 | 324.6794 | 4.9940 | 348.8083 |

Number of Observations = 295

greater than his mean net returns and will not hedge if his expected lock-in is less than his mean net return.

The decision rule is to hedge if

$$ELI_t \geq U_R.$$

Under strategy V predictions of expected lock-in, use of mean monthly adjustments for basis, choices of futures prices and contracts, grain costs, and net income, all follow the same procedure and explanation presented for strategy IV.

Table VII shows the mean and variance of net returns for a hedge if expected LI $\geq$ mean net returns.

Strategy VI - Hedge if Expected Net Revenue $\leq$ Mean Net Returns and Expected LI $\geq$ 0

The cattle feeder employing this strategy is in a position to gamble for large windfall returns if expected net revenue appears favorable. If, however, expected net revenue is not favorable but the expectation of obtaining a positive lock-in is present the feeder will hedge his operation. Therefore, if returns are expected to be unfavorable the feeder can hedge against an even more unfavorable price movement. But, if price--and therefore returns--are expected to be favorable, he can gamble under an unhedged position that an even more favorable situation will prevail.

The decision rule specifies a hedge if

$$ENR < U_R \text{ and } ELI_{t-19} > 0,$$

where

TABLE VII

MEAN AND VARIANCE OF NET RETURNS IF EXPECTED LOCK-IN $\geq$ MEAN NET RETURNS

| | | Rate of Gain Per Head Lbs./Day | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2.3 | | 2.8 | | 3.3 | |
| Feedlot Size | Utilization Rate | Mean ($U_R$) ($ Per Head) | Variance ($\sigma^2_R$) ($ Per Head) | Mean ($U_R$) ($ Per Head) | Variance ($\sigma^2_R$) ($ Per Head) | Mean ($U_R$) ($ Per Head) | Variance ($\sigma^2_R$) ($ Per Head) |
| 1,000 | | -4.4802 | 296.0750 | -1.2435 | 304.1921 | 2.1922 | 323.0837 |
| 2,500 | | -1.5761 | 294.8318 | 2.3678 | 303.1316 | 6.4071 | 320.8945 |
| 5,000 | 100% | -0.1915 | 294.8311 | 3.9152 | 302.8328 | 8.2438 | 320.9294 |
| 7,500 | | 1.2253 | 294.8291 | 5.6399 | 302.8308 | 10.0357 | 319.6541 |
| 10,000 | | 3.1251 | 294.8281 | 7.9776 | 301.9480 | 12.7615 | 319.6538 |
| 20,000 | | 5.0570 | 294.8269 | 10.3296 | 301.9480 | 15.3819 | 315.0200 |
| 1,000 | | -5.7492 | 295.6555 | -2.8115 | 304.1938 | 0.3442 | 323.0840 |
| 2,500 | | -2.8640 | 294.8311 | 0.7651 | 304.6802 | 4.5946 | 323.5461 |
| 5,000 | 75% | -1.2863 | 294.8313 | 2.6834 | 303.2322 | 6.8229 | 320.8943 |
| 7,500 | | 0.0339 | 294.8306 | 4.1897 | 302.8320 | 8.5672 | 320.9290 |
| 10,000 | | 2.0947 | 294.8281 | 6.6984 | 302.8328 | 11.2831 | 319.6538 |
| 20,000 | | 4.0588 | 294.8269 | 9.1144 | 301.9487 | 14.1008 | 319.6655 |
| 1,000 | | -7.5339 | 294.2886 | -4.8076 | 308.8276 | -2.2134 | 325.9775 |
| 2,500 | | -4.1260 | 296.0750 | -0.8124 | 304.1984 | 2.7004 | 323.0840 |
| 5,000 | 50% | -2.7352 | 294.8308 | 0.9219 | 304.6797 | 4.7794 | 323.5457 |
| 7,500 | | -1.2541 | 294.8313 | 2.7226 | 303.2329 | 6.8691 | 320.8940 |
| 10,000 | | 0.6779 | 294.8289 | 4.9737 | 302.8323 | 9.2716 | 319.0571 |
| 20,000 | | 2.7386 | 294.8286 | 7.5072 | 301.9509 | 12.2071 | 319.6541 |

Number of Observations = 295

$$ENR = (PJCLO_t)\ (EWT^k) - Costs.$$

The projected Clovis price was calculated by using a seasonal price index.[12] The Clovis price at the beginning of the feeding period was multiplied by the appropriate index number to get the estimated price for fed cattle at the end of each feeding period. Again, the remaining calculations and data requirements are as described in strategy IV.

Depicted in Table VIII are mean and variance of returns for strategy VI.

### Strategy VII - Seasonal Hedging Operation Adjusted for Price Declines During the Remainder of the Year

Typically, fed cattle prices have tended to move downward in the fall months of the year. The cattle feeder protected himself from unfavorable price expectations in the fall by employing strategy III--the seasonal hedge. However, no protection was afforded the feeder from unfavorable price movements during the remainder of the year. Strategy VII allows the feeder to correct his unhedged position in the spring if typical price patterns are altered. It provides for the hedging of all cattle coming out in the September-December months with additional hedging during the remainder of the year if a price decrease greater than one dollar over a four week interval occurs. Therefore, cattle coming out in the months of January-August are not hedged unless prices decrease by more than one dollar over a four week interval. The correlation of hedging decisions and a greater than one-dollar price change over a four week interval was chosen after preliminary investigation of Clovis-Amarillo price patterns indicated that this criterion

TABLE VIII

MEAN AND VARIANCE OF NET RETURNS IF EXPECTED NET REVENUE < MEAN NET RETURNS AND EXPECTED LOCK-IN > 0

| Feedlot Size | Utilization Rate | Rate of Gain Per Head Lbs./Day | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2.3 | | 2.8 | | 3.3 | |
| | | Mean ($U_R$) | Variance ($\sigma^2_R$) | Mean ($U_R$) | Variance ($\sigma^2_R$) | Mean ($U_R$) | Variance ($\sigma^2_R$) |
| | | ($ Per Head) | ($ Per Head) | ($ Per Head) | ($ Per Head) | ($ Per Head) | ($ Per Head) |
| 1,000 | | -2.5917 | 348.5166 | -0.9206 | 359.1301 | 1.4087 | 390.0862 |
| 2,500 | | -0.4888 | 336.8569 | 2.7017 | 364.8293 | 4.9100 | 349.3787 |
| 5,000 | 100% | 0.6639 | 334.9395 | 4.1885 | 367.2632 | 6.4295 | 351.7041 |
| 7,500 | | 1.8705 | 333.7935 | 5.2495 | 329.0364 | 8.0999 | 352.1394 |
| 10,000 | | 3.7105 | 335.8398 | 7.1315 | 330.8364 | 10.8092 | 366.4680 |
| 20,000 | | 4.8341 | 301.9485 | 9.1684 | 332.2280 | 13.5810 | 366.4727 |
| 1,000 | | -3.8850 | 350.9053 | -1.8901 | 365.4702 | 0.2848 | 396.4736 |
| 2,500 | | -1.6596 | 335.1997 | 1.0256 | 357.2842 | 3.9133 | 389.5432 |
| 5,000 | 75% | -0.1529 | 335.1733 | 2.8582 | 367.1348 | 5.2579 | 350.0115 |
| 7,500 | | 0.8914 | 334.9158 | 4.4630 | 367.2610 | 6.6948 | 351.9458 |
| 10,000 | | 2.7357 | 33.8413 | 6.0096 | 329.2273 | 9.1991 | 352.9146 |
| 20,000 | | 4.5274 | 335.9304 | 7.9532 | 331.3647 | 12.1489 | 366.4670 |
| 1,000 | | -5.7881 | 363.2446 | -3.1622 | 390.0505 | -1.8340 | 398.4036 |
| 2,500 | | -2.2375 | 348.5178 | -0.4487 | 361.5051 | 1.9169 | 390.0872 |
| 5,000 | 50% | -1.5270 | 335.1697 | 1.1825 | 357.2834 | 4.0189 | 390.4709 |
| 7,500 | | -0.1781 | 335.9006 | 2.9099 | 366.8494 | 5.3041 | 350.0110 |
| 10,000 | | 1.4048 | 333.0408 | 4.8604 | 347.0049 | 7.5334 | 352.3579 |
| 20,000 | | 3.3980 | 335.0603 | 6.7291 | 329.8757 | 10.2548 | 366.4688 |

Number of Observations = 295

would avoid most temporary abberrations while identifying the major fluctuations.

Again, assumptions and data requirements for strategy VII are explained and noted under previous strategies.

Table IX contains mean and variance of net returns for strategy VII.

TABLE IX

MEAN AND VARIANCE OF NET RETURNS FOR A STRATEGY OF SEASONAL HEDGING WITH ADDITIONAL HEDGING DURING THE REMAINDER OF THE YEAR IF PRICE DROPS MORE THAN $1.00 OVER A FOUR WEEK INTERVAL

| | | Rate of Gain Per Head Lbs./Day | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2.3 | | 2.8 | | 3.3 | |
| Feedlot Size | Utilization Rate | Mean ($U_R$) | Variance ($\sigma^2_R$) | Mean ($U_R$) | Variance ($\sigma^2_R$) | Mean ($U_R$) | Variance ($\sigma^2_R$) |
| | | ($ Per Head) | ($ Per Head) | ($ Per Head) | ($ Per Head) | ($ Per Head) | ($ Per Head) |
| 1,000 | | -3.1285 | 404.6787 | -0.0860 | 438.3926 | 2.6374 | 476.6553 |
| 2,500 | | -0.1120 | 404.6443 | 3.5863 | 438.4365 | 6.9654 | 476.7969 |
| 5,000 | 100% | 1.2678 | 404.6501 | 5.2660 | 438.4851 | 8.9453 | 476.9038 |
| 7,500 | | 2.6798 | 404.6702 | 6.9850 | 438.5591 | 10.9711 | 477.0410 |
| 10,000 | | 4.5731 | 404.7163 | 9.2900 | 438.6855 | 13.6876 | 477.2710 |
| 20,000 | | 6.4986 | 404.7898 | 11.6341 | 438.8506 | 16.4498 | 477.5649 |
| 1,000 | | -4.4121 | 404.7122 | -1.6487 | 438.4021 | 0.7956 | 476.6343 |
| 2,500 | | -1.3956 | 404.6521 | 2.0236 | 438.4055 | 5.1237 | 476.7200 |
| 5,000 | 75% | 0.1768 | 404.6450 | 3.9378 | 438.4434 | 7.3798 | 476.8176 |
| 7,500 | | 1.4925 | 404.6528 | 5.5396 | 438.4971 | 9.2676 | 476.9236 |
| 10,000 | | 3.5463 | 404.6887 | 8.0398 | 438.6113 | 12.2144 | 477.1389 |
| 20,000 | | 5.5038 | 404.7493 | 10.4230 | 438.7627 | 15.0226 | 477.4072 |
| 1,000 | | -6.2733 | 404.7803 | -3.9146 | 438.4438 | -1.8748 | 476.6436 |
| 2,500 | | -2.7755 | 404.6721 | 0.3437 | 438.3933 | 3.1438 | 476.6667 |
| 5,000 | 50% | -1.2673 | 404.6509 | 2.1799 | 438.4092 | 5.3078 | 476.7285 |
| 7,500 | | 0.2089 | 404.6453 | 3.9769 | 438.4465 | 7.4259 | 476.8201 |
| 10,000 | | 2.1343 | 404.6599 | 6.3209 | 438.5276 | 10.1885 | 476.9851 |
| 20,000 | | 4.1881 | 404.7053 | 8.8211 | 438.6567 | 13.1352 | 477.2163 |

Number of Observations = 295

FOOTNOTES

[1]U.S. Department of Agriculture, Oklahoma City Feeder Cattle Prices for 550-750 lb. Choice Steers (Oklahoma City, Oklahoma: Agricultural Market Service, Livestock Division).

[2]U.S. Department of Agriculture, Clovis-Amarillo Fed Cattle Prices for 900-1100 lb. Choice Steers (Amarillo, Texas: Market News Office).

[3]U.S. Department of Agriculture, Texas Livestock Market News (Austin, Texas: Texas Department of Agriculture).

[4]U.S. Department of Agriculture, Weekly Grain Market News (Independence, Missouri: Consumer and Marketing Service).

[5]Donald Wagner, "The Effect of In-Weight on the Costs and Efficiencies of Gain" (Proceedings, Oklahoma Cattle Feeders Seminar, Stillwater, Oklahoma, February 5, 1971), pp. F-13-19.

[6]The average milo price for the 1965-1970 period was $1.85 per cwt. This average was used as a "base price" and the cost of gain adjusted as the price moved up or down relative to the $1.85.

[7]Raymond A. Dietrich, Costs and Economies of Size in Texas-Oklahoma Cattle Feedlot Operations, Technical Bulletin B-1083, Texas A & M University, Texas Agricultural Experiment Station (May, 1969), p. 19.

[8]The equations are as follows:

$$\log Y_1 = -1.118793 - .218175 \log X_1 - .597284 \log X_2 \quad (8)$$

$$\log Y_8 = -.499194 - .030374 \log X_1 \quad (14)$$

where: $Y_1$ = total annual fixed costs per pound of gain in dollars;

$X_1$ = feedlot size or one-time capacity;

$X_2$ = feedlot utilization rate; and

$Y_8$ = total feeding costs per pound of gain in dollars.

For further explanation see Dietrich, pp. 35-36.

[9]William Brant, "Management Decisions as Affected by Lot Size and Volume" (Proceedings, Oklahoma Cattle Feeders Seminar, Stillwater, Oklahoma, February 5, 1971), pp. M-1-7.

[10]Wagner, pp. F-1-24.

[11]U.S. Department of Agriculture, Chicago Mercantile Exchange Yearbooks, 1965-1970 (Chicago, Illinois: Market News Department, 1965-1970).

[12]Paul Hummer and Ronald Campbell, "Seasonal Relationships of Beef Cattle Prices in Oklahoma" (Forthcoming publication, Oklahoma State University).

# CHAPTER IV

# COMPARISON OF ALTERNATIVE STRATEGIES

Chapter III presented the expected mean and variance of net returns from alternative hedging strategies for representative High Plains cattle feeding operations. No discussion was presented that compared the hedging strategies to the basic cattle feeding operation. It is the purpose of this chapter to compare all strategies with respect to mean and variance of net returns. No attempt to inform the feeder of an optimum strategy will be made. Rather, the discussion will endeavor to aid the cattle feeder in selecting a strategy which he feels best fits his operation.

## Strategy Comparisons

As previously discussed, the unhedged feeding operation provides the base against which all other strategies are compared. Therefore, all strategies will be compared to the basic feeding operation to evaluate their performances over the 1965-70 period. Comparisons will be made with respect to the mean and variance of net returns for all operational conditions under each strategy. The mean and variance of net returns for all strategies at lot sizes of 1,000, 2,500, 5,000, 7,500, 10,000, and 20,000 head capacity are shown in Tables X, XI, XII, XIII, XIV, and XV respectively.

TABLE X

MEAN AND VARIANCE OF NET RETURNS FOR ALL STRATEGIES AT A FEEDLOT SIZE OF 1,000 HEAD

| | | Rate of Gain Per Head Lbs./Day | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2.3 | | 2.8 | | 3.3 | |
| Strategy | Utilization Rate | Mean ($U_R$) ($ Per Head) | Variance ($\sigma^2_R$) ($ Per Head) | Mean ($U_R$) ($ Per Head) | Variance ($\sigma^2_R$) ($ Per Head) | Mean ($U_R$) ($ Per Head) | Variance ($\sigma^2_R$) ($ Per Head) |
| I | | -3.6585 | 416.7087 | -0.8869 | 448.0955 | 1.5840 | 484.1462 |
| II | | -9.7247 | 135.2825 | -7.3196 | 138.2062 | -5.2153 | 145.4935 |
| III | | -2.9311 | 370.2351 | -0.0822 | 400.2014 | 2.4659 | 435.3262 |
| IV | 100% | -9.7680 | 291.0332 | -7.4933 | 320.1731 | -6.0582 | 337.3606 |
| V | | -4.4802 | 296.0750 | -1.2435 | 304.1921 | 2.1922 | 323.0837 |
| VI | | -2.5917 | 348.5166 | -0.9206 | 359.1301 | 1.4087 | 390.0862 |
| VII | | -3.1285 | 404.6787 | -0.0860 | 438.3926 | 2.6374 | 476.6553 |
| I | | -4.8684 | 417.3767 | -2.3597 | 448.4058 | -0.1518 | 483.9856 |
| II | | -10.9346 | 136.8974 | -8.7924 | 139.7403 | -6.9510 | 146.8595 |
| III | | -4.1410 | 370.7893 | -1.5550 | 400.3572 | 0.7301 | 434.9670 |
| IV | 75% | -11.0750 | 291.2493 | -9.0613 | 320.1738 | -7.9062 | 337.3586 |
| V | | -5.7492 | 295.6555 | -2.8115 | 304.1938 | 0.3442 | 323.0840 |
| VI | | -3.8850 | 350.9053 | -1.8901 | 365.4702 | 0.2848 | 396.4736 |
| VII | | -4.4121 | 404.7122 | -1.6487 | 438.4021 | 0.7956 | 476.6343 |
| I | | -6.6226 | 418.6777 | -4.4952 | 449.3508 | -2.6687 | 484.4438 |
| II | | -12.6888 | 139.5721 | -10.9280 | 142.4609 | -9.4680 | 149.5298 |
| III | | -5.8952 | 371.9260 | -3.6906 | 401.0811 | -1.7868 | 435.1387 |
| IV | 50% | -13.0255 | 291.7136 | -11.6124 | 311.9119 | -10.7077 | 332.4185 |
| V | | -7.5339 | 294.2886 | -4.8076 | 308.8276 | -2.2134 | 325.9775 |
| VI | | -5.7881 | 363.2446 | -3.1622 | 390.0505 | -1.8340 | 398.4036 |
| VII | | -6.2733 | 404.7803 | -3.9146 | 438.4438 | -1.8748 | 476.6436 |

TABLE XI

MEAN AND VARIANCE OF NET RETURNS FOR ALL STRATEGIES AT A FEEDLOT SIZE OF 2,500 HEAD

| Strategy | Utilization Rate | Rate of Gain Per Head Lbs./Day 2.3 Mean ($U_R$) ($ Per Head) | 2.3 Variance ($\sigma^2_R$) ($ Per Head) | 2.8 Mean ($U_R$) ($ Per Head) | 2.8 Variance ($\sigma^2_R$) ($ Per Head) | 3.3 Mean ($U_R$) ($ Per Head) | 3.3 Variance ($\sigma^2_R$) ($ Per Head) |
|---|---|---|---|---|---|---|---|
| I | | -0.8115 | 415.8889 | 2.5742 | 448.4734 | 5.6632 | 486.0574 |
| II | | -6.8817 | 132.2310 | -3.8586 | 135.7041 | -1.1362 | 143.8178 |
| III | | -0.0882 | 369.6809 | 3.3788 | 400.9382 | 6.5451 | 437.7021 |
| IV | 100% | -6.6186 | 293.5427 | -3.7353 | 322.1389 | -1.5876 | 341.6277 |
| V | | -1.5761 | 294.8318 | 2.3678 | 303.1316 | 6.4071 | 320.8945 |
| VI | | -0.4888 | 336.8569 | 2.7017 | 364.8293 | 4.9100 | 349.3787 |
| VII | | -0.1120 | 404.6443 | 3.5863 | 438.4365 | 6.9654 | 476.7969 |
| I | | -2.0253 | 416.1096 | 1.1014 | 448.1245 | 3.9274 | 484.9805 |
| II | | -8.0915 | 133.4015 | -5.3314 | 136.5793 | -2.8720 | 144.2676 |
| III | | -1.2979 | 369.7886 | 1.9060 | 400.4370 | 4.8093 | 436.4277 |
| IV | 75% | -7.9066 | 293.5427 | -5.2685 | 320.0159 | -3.4710 | 338.4060 |
| V | | -2.8640 | 294.8311 | 0.7651 | 304.6802 | 4.5946 | 323.5461 |
| VI | | -1.6596 | 335.1997 | 1.0256 | 357.2842 | 3.9133 | 389.5432 |
| VII | | -1.3956 | 404.6521 | 2.0236 | 438.4055 | 5.1237 | 476.7200 |
| I | | -3.3258 | 416.5588 | 0.4818 | 448.0605 | 2.0614 | 484.2593 |
| II | | -9.3921 | 134.8710 | -6.9146 | 134.8337 | -4.7379 | 145.1862 |
| III | | -2.5984 | 370.1157 | 0.3228 | 400.2080 | 2.9433 | 435.4927 |
| IV | 50% | -9.4138 | 291.0313 | -7.0621 | 320.1736 | -5.5500 | 337.3599 |
| V | | -4.1260 | 296.0750 | -0.8124 | 304.1984 | 2.7004 | 323.0840 |
| VI | | -2.2375 | 348.5178 | -0.4487 | 361.5051 | 1.9169 | 390.0872 |
| VII | | -2.7755 | 404.6721 | 0.3437 | 438.3933 | 3.1438 | 476.6667 |

TABLE XII

MEAN AND VARIANCE OF NET RETURNS FOR ALL STRATEGIES AT A FEEDLOT SIZE OF 5,000 HEAD

| | | Rate of Gain Per Head Lbs./Day | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2.3 | | 2.8 | | 3.3 | |
| Strategy | Utilization Rate | Mean ($U_R$) | Variance ($\sigma^2_R$) | Mean ($U_R$) | Variance ($\sigma^2_R$) | Mean ($U_R$) | Variance ($\sigma^2_R$) |
| | | ($ Per Head) | ($ Per Head) | ($ Per Head) | ($ Per Head) | ($ Per Head) | ($ Per Head) |
| I | | 0.4850 | 415.8604 | 4.1575 | 449.1636 | 7.5292 | 487.6467 |
| II | | -5.5812 | 131.1824 | -2.2754 | 135.0767 | 0.7298 | 143.7684 |
| III | | 1.2124 | 369.7747 | 4.9621 | 401.7937 | 8.4111 | 439.5042 |
| IV | 100% | -5.2340 | 293.5435 | -1.9115 | 324.0876 | 0.5489 | 343.9434 |
| V | | -0.1915 | 294.8311 | 3.9152 | 302.8328 | 8.2438 | 320.9294 |
| VI | | 0.6639 | 334.9395 | 4.1885 | 367.2632 | 6.4295 | 351.7041 |
| VII | | 1.2678 | 404.6501 | 5.2660 | 438.4851 | 8.9453 | 476.9038 |
| I | | -0.5433 | 415.8635 | 2.9056 | 448.5913 | 6.0538 | 486.3525 |
| II | | -6.6095 | 131.9932 | -3.5273 | 135.5458 | -0.7457 | 143.7697 |
| III | | 0.1840 | 369.6824 | 3.7102 | 401.0906 | 6.9356 | 438.0413 |
| IV | 75% | -6.3288 | 293.5427 | -3.3453 | 322.4900 | -1.1718 | 341.6255 |
| V | | -1.2863 | 294.8313 | 2.6834 | 303.2322 | 6.8229 | 320.8943 |
| VI | | -0.1529 | 335.1733 | 2.8582 | 367.1348 | 5.2579 | 350.0115 |
| VII | | 0.1768 | 404.6450 | 3.9378 | 438.4434 | 7.3798 | 476.8176 |
| I | | -1.9043 | 416.0776 | 1.2487 | 448.1467 | 4.1010 | 485.0706 |
| II | | -7.9705 | 133.2760 | -5.1841 | 136.4792 | -2.6984 | 144.2053 |
| III | | -1.1769 | 369.7688 | 2.0533 | 400.4744 | 4.9828 | 436.5381 |
| IV | 50% | -7.7778 | 293.5430 | -5.1116 | 321.0154 | -3.2862 | 338.4058 |
| V | | -2.7352 | 294.8308 | 0.9219 | 304.6797 | 4.7794 | 323.5457 |
| VI | | -1.5270 | 355.1697 | 1.1825 | 357.2834 | 4.0189 | 390.4709 |
| VII | | -1.2673 | 404.6509 | 2.1799 | 438.4092 | 5.3078 | 476.7285 |

TABLE XIII

MEAN AND VARIANCE OF NET RETURNS FOR ALL STRATEGIES AT A FEEDLOT SIZE OF 7,500 HEAD

| | | Rate of Gain Per Head Lbs./Day | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2.3 | | 2.8 | | 3.3 | |
| Strategy | Utilization Rate | Mean ($U_R$) | Variance ($\sigma^2_R$) | Mean ($U_R$) | Variance ($\sigma^2_R$) | Mean ($U_R$) | Variance ($\sigma^2_R$) |
| | | ($ Per Head) | ($ Per Head) | ($ Per Head) | ($ Per Head) | ($ Per Head) | ($ Per Head) |
| I | | 1.8158 | 416.0574 | 5.7775 | 450.2024 | 9.4386 | 489.7397 |
| II | | -4.2505 | 130.3364 | -0.6554 | 134.7691 | 2.6392 | 144.1843 |
| III | | 2.5431 | 370.0981 | 6.5821 | 403.0010 | 10.3205 | 441.8147 |
| IV | 100% | -3.8173 | 293.5437 | -0.1868 | 324.0886 | 2.8226 | 348.8098 |
| V | | 1.2253 | 294.8291 | 5.6399 | 302.8308 | 10.0357 | 319.6541 |
| VI | | 1.8705 | 333.7935 | 5.2495 | 329.0364 | 8.0999 | 352.1394 |
| VII | | 2.6798 | 404.6702 | 6.9850 | 438.5591 | 10.9711 | 477.0410 |
| I | | 0.6967 | 415.8755 | 4.4153 | 449.3052 | 7.8330 | 487.9482 |
| II | | -5.3695 | 131.0325 | -2.0176 | 135.0052 | 1.0335 | 143.8033 |
| III | | 1.4241 | 369.8105 | 5.2199 | 401.9624 | 8.7149 | 439.8406 |
| IV | 75% | -5.0087 | 293.5437 | -1.6370 | 324.0876 | 0.8723 | 343.9431 |
| V | | 0.0339 | 294.8306 | 4.1897 | 302.8320 | 8.5672 | 320.9290 |
| VI | | 0.8914 | 334.9158 | 4.4630 | 367.2610 | 6.6948 | 351.9458 |
| VII | | 1.4925 | 404.6528 | 5.5396 | 438.4971 | 9.2676 | 476.9236 |
| I | | -0.5131 | 415.8608 | 2.9424 | 448.6052 | 6.0972 | 486.3860 |
| II | | -6.5793 | 131.9677 | -3.4904 | 135.5298 | -0.7023 | 143.7659 |
| III | | 0.2143 | 369.6826 | 3.7471 | 401.1084 | 6.9790 | 438.0803 |
| IV | 50% | -6.2966 | 293.5425 | -3.3060 | 322.4895 | -1.1256 | 341.6260 |
| V | | -1.2541 | 294.8313 | 2.7226 | 303.2329 | 6.8691 | 320.8940 |
| VI | | -0.1781 | 335.9006 | 2.9099 | 366.8494 | 5.3041 | 350.0110 |
| VII | | 0.2089 | 404.6453 | 3.9769 | 438.4465 | 7.4259 | 476.8201 |

TABLE XIV

MEAN AND VARIANCE OF NET RETURNS FOR ALL STRATEGIES AT A FEEDLOT SIZE OF 10,000 HEAD

| Strategy | Utilization Rate | Rate of Gain Per Head Lbs./Day: 2.3 Mean ($U_R$) ($ Per Head) | 2.3 Variance ($\sigma^2_R$) ($ Per Head) | 2.8 Mean ($U_R$) ($ Per Head) | 2.8 Variance ($\sigma^2_R$) ($ Per Head) | 3.3 Mean ($U_R$) ($ Per Head) | 3.3 Variance ($\sigma^2_R$) ($ Per Head) |
|---|---|---|---|---|---|---|---|
| I | | 3.6003 | 416.6816 | 7.9500 | 452.1282 | 11.9990 | 493.2859 |
| II | | -2.4660 | 129.5615 | 1.5171 | 134.8902 | 5.1995 | 145.4817 |
| III | | 4.3276 | 370.8911 | 8.7546 | 405.1528 | 12.8807 | 445.6543 |
| IV | 100% | -1.9175 | 293.5432 | 2.1013 | 324.6797 | 5.5485 | 348.8093 |
| V | | 3.1251 | 294.8281 | 7.9776 | 301.9480 | 12.7615 | 319.6538 |
| VI | | 3.7105 | 335.8398 | 7.1315 | 330.8364 | 10.8092 | 366.4680 |
| VII | | 4.5731 | 404.7163 | 9.2900 | 438.6855 | 13.6876 | 477.2710 |
| I | | 2.6324 | 416.2917 | 6.7717 | 451.0098 | 10.6103 | 491.2561 |
| II | | -3.4339 | 129.9306 | 0.3388 | 134.7495 | 3.8108 | 144.6730 |
| III | | 3.3598 | 370.4092 | 7.5763 | 403.9114 | 11.4922 | 443.4644 |
| IV | 75% | -2.9479 | 293.5430 | 0.8717 | 324.0881 | 4.0700 | 348.8091 |
| V | | 2.0947 | 294.8281 | 6.6984 | 302.8328 | 11.2831 | 319.6538 |
| VI | | 2.7357 | 333.8413 | 6.0096 | 329.2273 | 9.1991 | 352.9146 |
| VII | | 3.5463 | 404.6887 | 8.0398 | 438.6113 | 12.2144 | 477.1389 |
| I | | 1.3016 | 415.9531 | 5.1517 | 449.7615 | 8.7009 | 488.8745 |
| II | | -4.7646 | 130.6361 | -1.2812 | 134.8477 | 1.9015 | 143.9680 |
| III | | 2.0290 | 369.9448 | 5.9563 | 402.4937 | 9.5828 | 440.8665 |
| IV | 50% | -4.3647 | 293.5417 | -0.8530 | 324.0879 | 2.0159 | 349.0984 |
| V | | 0.6779 | 294.8289 | 4.9737 | 302.8323 | 9.2716 | 319.0571 |
| VI | | 1.4048 | 333.0408 | 4.8604 | 347.0049 | 7.5334 | 352.3579 |
| VII | | 2.1343 | 404.6599 | 6.3209 | 438.5276 | 10.1885 | 476.9851 |

TABLE XV

MEAN AND VARIANCE OF NET RETURNS FOR ALL STRATEGIES AT A FEEDLOT SIZE OF 20,000 HEAD

| Strategy | Utilization Rate | Rate of Gain Per Head Lbs./Day | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2.3 | | 2.8 | | 3.3 | |
| | | Mean ($U_R$) | Variance ($\sigma^2_R$) | Mean ($U_R$) | Variance ($\sigma^2_R$) | Mean ($U_R$) | Variance ($\sigma^2_R$) |
| | | ($ Per Head) | ($ Per Head) | ($ Per Head) | ($ Per Head) | ($ Per Head) | ($ Per Head) |
| I | | 5.4150 | 417.7393 | 10.1592 | 454.7131 | 14.6022 | 497.7705 |
| II | | -0.6514 | 129.1957 | 3.7263 | 135.6389 | 7.8032 | 147.6701 |
| III | | 6.1423 | 372.1174 | 10.9638 | 407.9663 | 15.4841 | 450.4370 |
| IV | 100% | 0.0144 | 293.5410 | 4.4533 | 324.6785 | 8.4715 | 355.5869 |
| V | | 5.0570 | 294.8269 | 10.3296 | 301.9480 | 15.3819 | 315.0200 |
| VI | | 4.8341 | 301.9485 | 9.1684 | 332.2280 | 13.5810 | 366.4727 |
| VII | | 6.4986 | 404.7898 | 11.6341 | 438.8506 | 16.4498 | 477.5649 |
| I | | 4.4774 | 417.1396 | 9.0178 | 453.2993 | 13.2572 | 495.3447 |
| II | | -1.5890 | 129.3313 | 2.5849 | 135.1734 | 6.4580 | 146.4296 |
| III | | 5.2047 | 371.4304 | 9.8224 | 406.4360 | 14.1390 | 447.8550 |
| IV | 75% | -0.9838 | 293.5425 | 3.2381 | 324.6807 | 6.8882 | 348.8074 |
| V | | 4.0588 | 294.8269 | 9.1144 | 301.9487 | 14.1008 | 319.6655 |
| VI | | 4.5274 | 335.9304 | 7.9532 | 331.3647 | 12.1489 | 366.4670 |
| VII | | 5.5038 | 404.7493 | 10.4230 | 438.7627 | 15.0226 | 477.4072 |
| I | | 3.2373 | 416.5215 | 7.5081 | 451.6895 | 11.4782 | 492.4951 |
| II | | -2.8290 | 129.6858 | 1.0752 | 134.8170 | 4.6788 | 145.1496 |
| III | | 3.9647 | 370.6965 | 8.3128 | 404.6680 | 12.3601 | 444.8015 |
| IV | 50% | -2.3039 | 293.5432 | 1.6309 | 324.6794 | 4.9940 | 348.8083 |
| V | | 2.7386 | 294.8286 | 7.5072 | 301.9509 | 12.2071 | 319.6541 |
| VI | | 3.3980 | 335.0603 | 6.7291 | 329.8757 | 10.2548 | 366.4688 |
| VII | | 4.1881 | 404.7053 | 8.8211 | 438.6567 | 13.1352 | 477.2163 |

Comparisons of the performance of strategy I, the basic feeding operation, and strategy II, the completely hedged feeding operation, reveal that the completely hedged operation yielded mean net returns decisively inferior to those obtained under strategy I. However, the variances of net returns under strategy II were quite low when compared to those expected for the basic feeding operation.

The large reduction in variance, associated with strategy II, results because hedging reduces the feeder's risk associated with price fluctuations over the feeding period. Regardless of whether price fluctuations are favorable or unfavorable during the feeding period, the feeder has protected himself against such fluctuations. His net returns will remain much more stable than for the basic feeding operation--i.e., variance of net returns will be less when hedged.

Therefore, when completely hedged, the feeder will be better off when price movements during the period are in a downward direction. Conversely, he may be worse off when prices move in an upward direction. In the latter case the feeder has deprived himself of potential windfall gains resulting from price appreciation during the feeding period.

The 1965-1970 period was a time in which fed cattle prices moved in a generally upward direction. As a result, the complete hedging strategy hedged many times when price movements during the feeding period were favorable. Increasing prices over the period is the primary reason that the feeder's mean net returns are decisively lower for the hedged operation when compared to the basic feeding operation.

How strategies I and II compare in the future will depend upon the movement of fed cattle prices. If fed cattle prices move upward throughout the period, the feeder should obtain higher mean net returns if he does not choose to hedge. In contrast, if prices move downward during the period, a strategy employing hedging all the time should yield higher mean net returns than those received in the basic feeding operation.

Therefore, the outcome of comparisons of mean net returns for strategies I and II will depend directly upon price movements during the feeding periods. But, the variance of mean net returns will be less for a strategy of hedging regardless of the price movements associated with the feeding period.

Strategy III, the seasonal hedging operation, exhibits mean net returns slightly higher than those attained for the unhedged feeding operation. The variance of net returns is slightly lower than those for the basic feeding operation. Seasonal hedging is, therefore, superior to the basic feeding operation with respect to both mean and variance of net returns.

In addition, strategy III yields mean net returns substantially higher than those obtained for the fully hedged operation. Variance, however, is also much higher for strategy III than for the fully hedged strategy because prices fluctuated during the unhedged portion of the year. The strategy does eliminate the basic shortcoming of the complete hedging strategy. No hedge is placed on cattle to be sold during January through August, the period during which the price is rising on a seasonal basis. Consequently, the disadvantage associated with hedging during periods of seasonal increases in price are offset. Instead, the cattle to be sold during the period September-December--a period of seasonally declining prices--are hedged.

The net result is a simple strategy which both increases the mean return and reduces variability when compared to the basic feeding strategy. Clearly, the seasonal hedging strategy--strategy III--offers real possibilities to the feeder who could employ this strategy.

Strategy IV, hedge if the expected lock-in is less than the mean, resulted in a reduction in both mean and variance of net returns when compared to the basic feeding operation. Thus, if strategy IV were employed by a previously unhedged feeder, he would be trading a substantial reduction in mean net returns for a reduction in variance of net returns.

One of the difficulties associated with strategy IV is that the expected lock-in margin is very difficult to predict. Basis movements during the feeding period, as well as feed costs etc., may alter the expected lock-in margin. Therefore, the feeder may make a hedging decision based on an expected lock-in margin which proves inaccurate at the end of the feeding period.

Strategy V, hedging when the expected lock-in is equal to or greater than mean net returns, results in mean returns very close to those obtained under the basic feeding operation. The variance, however, was substantially lower than under strategy I. In addition, the variance was lower than any strategy thus far discussed with the exception of the fully hedged strategy II. Again, as in strategy IV, the presence of basis risk hampers the accurate prediction of the expected lock-in margin.

Strategies IV and V are exactly opposite decision criteria. Under strategy IV, the feeder hedges when expected returns are less than mean net returns. Under strategy V, he hedges if expected returns are higher than the mean net returns. When strategy IV indicates a hedging situation, strategy V does not signify a hedge and vice versa.

Strategy V outperforms strategy IV with respect to both mean and variance of net returns. It is of interest to explore why hedging when expected lock-in is greater than mean net returns is superior to hedging when expected lock-in is less than mean net returns.

As stated previously, the current quote of a distant futures contract is the best consensus, given available information and interpretation by traders, of what the cash price will be at that future date. Regardless of whether the consensus quote is an overestimate or an underestimate of the cash price, it will adjust during the life of the contract as information and/or interpretation of information changes. Continuing adjustments will move the consensus quote towards the actual live cattle price as the maturity date of the contract approaches. It is this convergence phenomenon that aids in explaining why strategy V outperforms strategy IV.

Suppose the consensus futures quote underestimates the actual fed cattle price that will prevail at the end of the feeding period. Strategy IV, a strategy which indicates a hedge if lock-in is less than mean net returns, would very likely indicate a hedge since lock-in is calculated using the futures quote. If instead, the consensus futures quote had overestimated the cash price for finished steers, a hedge is less likely under strategy IV because expected lock-in would be higher. Strategy V would be more likely to indicate a hedge under these conditions since it calls for a hedge if lock-in is greater than mean net returns.

It is obvious that a feeder would obtain greater returns from hedging when futures quotes overestimate cash prices as opposed to an underestimation. When the futures quotes adjust downward the hedger buys the futures back at a price below the earlier selling price, making the overall net from the hedged operation more favorable.

If, however, the feeder hedges when futures quotes underestimate cash prices, as might be the case under strategy IV, he will be forced to repurchase his contracts later at higher prices. In this case, the futures quote will move upward towards convergence over the feeding period.

Analysis of both strategies over the 1965-1970 period revealed that the movement of futures quotes over each feeding period was, in fact, the primary reason strategy V outperformed strategy IV. In several cases strategy IV indicated a hedge and then witnessed futures quotes adjusting upward over the entire feeding period. Cases of this nature were most prevalent during the substantial rise of fed cattle prices in 1968 and early 1969. For example, the futures quote for the feeding period ending on June 6, 1969 was $26.55 per cwt. at the time the cattle were placed and hedging considered.[1] Strategy IV called for a hedge because expected lock-in was less than mean net returns. However, as fed cattle prices moved upward over the entire period, the futures quote adjusted accordingly. The futures quote at the end of the feeding period (June 6, 1969) was $34.57 per cwt.[2] As a result, a cattle feeder with a 10,000 head lot, a 2.8 pound of gain per day, and a utilization rate of 75 percent,[3] incurred a loss of $81.48 per head on his futures transactions. The net loss to his feeding operation was $1.88 per head. Strategy V did not indicate a hedge and the feeder obtained a net profit to his feeding operation of $79.60 per head. Strategy V allowed the feeder to benefit from favorable cash price movements over the feeding period--i.e., the feeder was not hurt by futures quotes adjusting upward throughout the feeding period.

In contrast to the upward fed cattle price trend in early 1969, prices of fed cattle moved sharply downward in the later part of 1969. In this case futures quotes did not reflect the sharpness of the downturn and overestimated cash prices. Strategy V, therefore, called for a hedge on cattle coming out in the fall because high futures prices indicated a lock-in greater than mean net returns. Conversely, strategy IV did not indicate a hedge. Strategy V again proved to be the most effective strategy because the feeder completed his hedge by repurchasing his contracts after futures quotes had adjusted downward. For example, strategy V called for a hedge in the period ending October 24, 1969. The appropriate futures quote at the beginning of the feeding period was $31.35 per cwt. Following the price downturn during the period the futures quote was $28.45 per cwt.[4] The feeder obtained a profit of $26.05 per head on his futures trade or a net loss of $5.06 per head to his hedged feeding operation. Feeders under strategy IV did not hedge and experienced losses of $31.11 per head to their feeding operations. Again, a 10,000 head feedlot, 2.8 pounds of gain per day, and 75 percent utilization rate was assumed.

The above examples have demonstrated that strategy V may be superior to strategy IV when futures quotes underestimate as well as overestimate cash prices. However, this is not to say exceptions were not present. There were cases in which strategy IV was superior to strategy V, but these cases were not nearly as prevalent as those discussed above. Therefore, strategy V was a better strategy than IV over the entire period with respect to both mean and variance of net returns.

Strategy VI, hedge if expected net revenue is less than mean net returns and expected lock-in is greater than zero, resulted in a mean and variance less than those in strategy I. Again a trade-off in mean returns for variance must occur if the feeder chooses strategy VI over the basic feeding operation.

One of the difficulties in using strategy VI is in the prediction of expected net revenue. The use of seasonal price indexes to predict the price of fed cattle will often result in underestimates of the price changes. A seasonal price index simply correlates typical fluctuations in prices with the time of the year. It represents the average price change in one period when compared to another base period. Since price indexes represent the average price movements, they may often indicate the direction of price movements while underestimating the magnitude of the movement. As a result, fed cattle were often hedged when price movements during the period were quite favorable or were not hedged when price movements were unfavorable.

As discussed earlier, for strategies IV and V, the problem of basis risk also hampered the correct prediction of expected lock-in profit.

Strategy VII, a seasonal hedging operation with corrections for price changes, yielded a lower variance and a higher mean return than strategy I. This strategy combined strategy III, with a correction mechanism which allowed the feeder to eliminate many of the "bad" positions he accepted under strategy III. In addition to the seasonal hedging provision in strategy III, this strategy allowed the cattle feeder to place a hedge if fed cattle prices moved downward by more than $1.00 per cwt. over a four week period during any of the rest of the year. This allowed the cattle feeder to escape those periods, from January-August, in which large losses occurred because of high magnitude price decreases.

The variance of mean net returns for strategy VII, although higher than strategies II, III, IV, V, and VI, was lower than strategy I. Therefore, strategy VII was superior to strategy I with respect to both mean and variance of net returns.

Strategy VII is the only hedging strategy able to respond to fed cattle cash price movements. The adjustment or correction factor associated with a $1.00 per cwt. cash price movement over a four week period gives this strategy the flexibility needed to avoid large losses associated with rapid price movements. The mean net returns of other strategies were often cut sharply by extensive price movements over a period such as 1968 and 1969. The avoidance of only a few periods in which large losses occurred has yielded a higher mean net return for strategy VII than for any other strategy.

## Conclusions

Comparisons of mean and variance of net returns have been made for all strategies under all combinations of operational conditions. The basic feeding operation was employed as a standard of comparison for each of the other strategies. While no particular strategy is recommended, the analysis does allow identification of those strategies that are inferior or superior when compared to the basic feeding operation. Identification of such strategies is presented in Figure 5. Figure 5

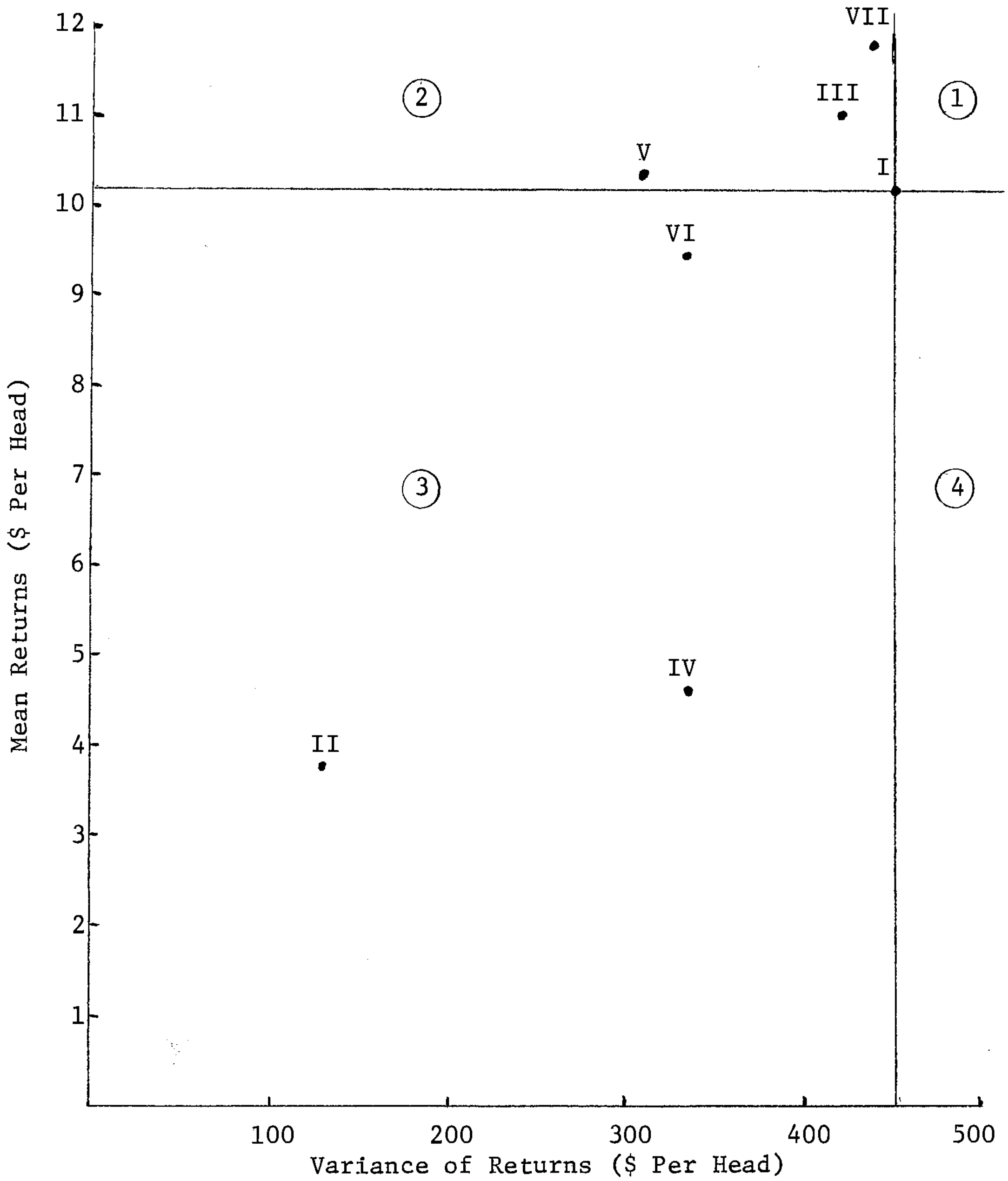


Figure 5. Relationship Between Mean and Variance of Net Returns for Alternative Hedging Strategies

depicts the mean and variance of each of the hedging strategies assuming a 20,000 head lot, 100 percent utilization, and 2.8 pounds gain per day. The mean net return is shown on the vertical axis with the horizontal axis representing the variance of mean net returns. Shown in the figure are four quadrants with an origin at I, the mean-variance coordinates for strategy I, the basic feeding operation. The mean and variance of strategies II thru VII are shown by their respective points in the figure.

Examination of Figure 5 reveals that any strategy falling in quadrant two is superior to strategy I--showing both a higher mean and lower variance of net returns. Any strategy in quadrant four is clearly inferior to strategy I--showing both lower mean and higher variance of net returns.

The merits of any strategy falling in quadrants one or three is dependent upon the feeder's preference pattern between level and variability of returns. All strategies falling in quadrant three have both lower mean returns and lower variance of mean net returns than strategy I. Any strategy in quadrant one has both higher mean and variance of net returns than the basic feeding operation. Thus, strategies in quadrants one or three involve "trade offs" between mean and variance of net returns.

No strategies, however, are found in quadrants one or four in Figure 5. This results because hedging, under all strategies, reduces the variance level below that of strategy I.

Figure 5 also affords an opportunity to compare the other strategies involving hedging with the strategy which fully hedged every lot of cattle--strategy II. The results show clearly that hedging all cattle fed results in a very large reduction in mean net returns per head. Of course, there is a comparable reduction in the variance of net returns. The question is whether the feeder would be willing to sacrifice mean net returns for the increased stability.

As noted before, there is no single strategy which is "best" for all feeders. There are, however, strategies which may well offset one of the primary reasons feeders do not hedge--the reduction in level of net returns the feeder feels he must endure to secure the stability in returns hedging can provide. Several of the strategies discussed in this chapter, strategies such as III and VII which employ the rule of selective hedging, reduced variability with no cost in the form of reduced mean returns.

It should be noted, in closing this discussion, that the results of all strategies were obtained from a continuous feeding operation. A feeder should not expect to employ the strategies discussed on a hit and miss basis and obtain results similar to those herein discussed.

FOOTNOTES

[1]U.S. Department of Agriculture, Chicago Mercantile Exchange Yearbook, 1969-1970 (Chicago, Illinois: Market News Department, 1970), p. 209.

[2]Ibid., p. 208.

[3]A feedlot of 10,000 head, 2.8 pounds gain per day, and 75 percent utilization was chosen at random for example purposes only.

[4]U.S.D.A., Mercantile Yearbook, pp. 218-219.

# CHAPTER V

# SUMMARY, CONCLUSIONS AND IMPLICATIONS

Surveys by Tapp[1] and Dunn[2] revealed that little hedging is done in Oklahoma. The most common reason for such is lack of understanding of the mechanics of a hedging operation in conjunction with a failure to understand the economic purpose of hedging.

The working hypothesis underlying this study is as follows: There exists a lack of understanding of how hedging can be used effectively as a managerial tool and this lack of understanding contributes to the limited use and/or misuse of the live cattle futures market. Thus, the overall objective was (1) to demonstrate, under alternative combinations of operating characteristics, how various alternative hedging strategies can be used as managerial tools, and (2) to evaluate the performance of each strategy over time.

## Basic Assumptions

A basic feeding operation was developed to "typify" a cattle feeding operation located in the High Plains of Texas, Oklahoma, New Mexico and Kansas. The operation consisted of twenty-week feeding periods and, in order to obtain a large number of observations, a new feeding period was begun each week over the entire evaluation period. The six years from 1965-1970 were chosen as the evaluation period since live cattle futures were not introduced until late 1964. It should be noted that this period can be referred to, generally, as an "up" market for prices of fed cattle and influence from such is exerted upon the results of the strategies.

Choice feeder steers weighing 650 pounds were placed on feed, fed for twenty weeks, and sold. A representative feedlot situation with various rates of gain, lot sizes, and utilization rates was constructed. Feeding costs were adjusted with each different combination of operating characteristics. Weekly prices from published series were used for the feeder cattle and slaughter cattle. The operation was evaluated assuming several different combinations of operating characteristics in each feeding period. Mean and variance of net returns were chosen as evaluation criteria for the basic feeding operation.

The basic unhedged feeding operating provided the standard for analysis of all strategies. Regardless of the strategy employed, the initial cost of feeder steers, the number of days on feed, and the price received for finished steers remained the same for the twenty-week period. Therefore, any variation in the mean and variance of net returns, for various hedging strategies, results directly from modification of the strategies employed rather than from differences in the basic feeding operation.

Selection of each hedging strategy was equivalent to hypothesizing that such a strategy would be a realistic managerial tool for consideration in the feeder's operational framework. A summary of the results will be discussed with emphasis upon the conclusions emerging from the analysis and the implications of such conclusions.

## Results of Alternative Hedging Strategies

While no attempt is made to recommend an optimum strategy, the analysis does identify those strategies that are inferior or superior and some notion of the strategies that are efficient is obtained.

In comparison to the unhedged operation, no hedging strategies are identified as clearly inferior. Some hedging strategies did yield lower mean net returns, but none yielded a greater variance than that of the unhedged operation. In all cases involving hedging the stability of net returns was improved when compared to the unhedged operation. It can be concluded, therefore, that hedging reduced the risk associated with fed cattle cash price fluctuations over the 1965-1970 period.

Not all strategies involving hedging were superior to the unhedged operation. However, some strategies proved to be neither inferior nor superior when compared to the basic feeding operation. The merits of strategies which reduce the variance of net returns but also reduce mean net returns depend upon the feeder's preference pattern between mean and variance of net returns. A "trade-off" between mean net returns and variance of net returns must be made.

When compared to the unhedged operation, the strategy of hedging all cattle resulted in a reduction in variance of net returns of about two-thirds, but at a cost of approximately the same reduction in mean net returns. The substantial reduction in mean returns results because the feeder often finds himself in a hedged position when cattle prices are increasing over the feeding period. This implies that feeders hedging all the time will not receive or will "lock-out" any chance of windfall gains resulting from increasing cattle prices.

An alternative strategy which called for a hedge if expected lock-in was less than mean net returns from the unhedged operation did not perform well. This strategy yielded a reduction in mean net returns nearly twice the reduction obtained in variance. The trip mechanism triggered a hedge many times when futures quotes moved upward over the feeding period, resulting in substantial losses on futures transactions.

Still another strategy was designed to hedge if expected net revenue was less than the mean net returns and expected lock-in was greater than zero. Variance was reduced almost 30 percent while mean returns were reduced only ten percent. The difficulty with this strategy is that the use of seasonal indexes to estimate future cattle prices and expected net revenue usually indicated the direction of price change, but often underestimated the magnitude of the change. If a strategy of this nature is to be employed, further study to develop a more sophisticated price forecasting model is necessary to reveal not only the direction of price movements but their magnitude as well.

Incorporation of additional market information and feedback led to the development of hedging strategies that yielded reduced variability of net returns and increased mean net returns when compared to the unhedged operation. A seasonal hedging strategy which hedged all cattle sold during September-December and none the rest of the year resulted in a reduction of almost ten percent in variance while yielding a ten percent increase in mean returns. This strategy was clearly superior to the feeding strategy which did no hedging.

Another strategy which called for a hedge if expected lock-in was greater than or equal to mean net returns also decreased the variance and increased the mean net returns. Difficulties did arise, however, as it proved hard to accurately estimate an expected lock-in because of continual variation in basis. If further research were undertaken to develop tactics to combat basis risk, perhaps this strategy would have even greater operational significance.

A strategy which involved the seasonal hedge with a correction for price changes also performed quite well. The "no hedge" decision in the January-August period was changed or "corrected" if cash price fell by more than $1.00 per cwt. during any four-week period the cattle were on feed. The result was a slight improvement in both mean and variance of net returns when compared to the basic feeding operation. Results from this strategy suggest that an effort to incorporate a more complex price forecasting model into a given hedging strategy would prove worthwhile both in stability and level of net returns.

## Conclusions and Implications

This study has demonstrated that hedging strategies can become a useful part of the cattle feeder's decision framework. The most obvious implication is that cattle feeders who maintained a completely unhedged operation over the 1965-1970 period received mean and variance of net returns inferior to those that could have been obtained if selected hedging strategies had been employed. This implies that, even in a period in which cattle prices trended upward, hedging can be an efficient management tool for cattle feeding operations.

Results further revealed that under all combinations of environmental characteristics and selected economic variables, hedging always increased the stability of net returns; i.e., reduced the cattle feeder's cash price risk. However, no longer must the cattle feeder who employs hedging anticipate a "cut" in mean returns in payment for the reduction in variance. Hedging strategies, based upon several selective hedging criteria, have been presented that will reduce variance of net returns while also yielding increased mean net returns. When compared to the basic unhedged feeding operation, hedging strategies presented in this study have reduced variance by as much as one-third while also producing increased mean returns.

Cattle feeders of the 1970's may well be under increased pressure from credit institutions, tight financial positions, and narrowed profit margins to seek means of reducing the variance of net returns.[3] Thus, cattle feeders may be willing to trade mean net returns for reduced variance levels. If so, they may employ the completely hedged operation which, when compared to the unhedged operation, reduced variance by nearly two-thirds. Most, however, may be reluctant to pay the price of a nearly equivalent percentage reduction in level of mean returns to get reduced variance in net returns. In that case, selective hedging strategies presented in this study, which produced reductions in variance of returns substantially larger than the reduction in level of mean returns, will prove increasingly attractive. The feeder's preference patterns, as influenced by the economic variables associated with his feeding operation, will dictate which route he chooses to take.

Each of the hedging strategies presented in this study possess a uniqueness common to all. Every strategy analyzed retains the virtue of simplicity. Any of the strategies discussed can be employed by any cattle feeder who possesses the desire to develop a basic knowledge of the futures market. An extensive knowledge of model formulation and the ability to manipulate complex mathematics, although a virtue if possessed, is certainly not a necessity. Therefore, the assumption that many cattle feeders do not have the education or background needed to profitably use the futures market is quite invalid.

The success, in conjunction with the simplicity of the hedging strategies presented in this project, imply that further research to develop more reliable strategies would prove worthwhile. For instance, additional research is needed to develop a model which will accurately predict basis movements; i.e., expected lock-in. A successful basis prediction model would eliminate much of the basis risk associated with hedging activities.

Further research is also needed to incorporate a more reliable price forecasting model into a hedging strategy. Each strategy presented, including the strategy with the price correction mechanism, hedged during feeding periods in which cash price movements would have been favorable. A more accurate price forecasting model would allow the feeder to more often hedge in accordance with unfavorable cash price movements.

In addition, more study into the workings of the futures market would undoubtedly prove profitable. Futures contracts were bought and sold, in every feeding period, at the appropriate closing price on Monday. Models indicating the general tendencies of the futures market should allow the feeder to buy and sell his futures contracts at a more opportune time within the trading week.

Research is continually needed to incorporate further hedging equations, techniques, and models into a management tool useful to the cattle feeder. Continual explanation, education, and "down to earth" information must be made available to the cattle feeder as progress in hedging procedure continues. Improved hedging techniques will prove to be of no avail if they result in lack of understanding by those who are expected to employ them.

FOOTNOTES

[1]Ralph L. Tapp, "Economic Implications of Variable Weighing and Grading Practices in the Sale of Slaughter Beef" (unpub. M.S. Thesis, Oklahoma State University, 1968).

[2]Terry Lee Dunn, "Economic Implications of Interlevel Goal Conflict and Operational Inconsistency in the Beef Marketing System: The Packer-Feeder Subsector" (unpub. M.S. Thesis, Oklahoma State University, 1970), p. 46.

[3]"Feeder Cattle Loan Rates Higher," Feedlot, September, 1969, pp. 20-21.

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