MULTIPLE HEDGING STRATEGIES FOR

MARKETING SLAUGHTER HOGS

By

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PREFACE

The brief two years I have spent at Oklahoma State University have been rewarding educationally as well as personally. Some special people have offered me unending support during my development as an Agricultural Economist and a person. I choose this time to acknowledge some of those people.

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TABLE OF CONTENTS

Chapter | Page

LIST OF TABLES

Table		Page

Table | Page

LIST OF FIGURES

CHAPTER I

INTRODUCTION

The world is full of risks. Driving a car, walking across a street and swimming are common activities which involve risks. In any risk worth taking the benefits received from participation in the selected activity will outweigh the costs of non-participation.

Hog producers confront many risks daily including production and marketing risks. Production risks facing hog producers refer to factors which affect the efficiency or quality of the product produced (Ikerd, 1978). Marketing risks, on the other hand, refer to factors which influence input prices farmers pay or product prices farmers receive. Since hog producers tend to be more skilled in handling production risks and production risks tend to be more manageable, marketing risks will be the focus of this study.

The Problem

What evidence is there that hog production entails large marketing risks? First, hog production decisions must be planned months in advance of reaping the benefits of incurring the losses from the sale of market weight hogs. Market conditions, beyond the control of an individual hog producer, may change dramatically, yet the producer based production intentions upon prior price expectations. Hog producers can make minor adjustments on the production side, but major price changes can overshadow minor production adjustments. Highly variable slaughter hog prices and input prices are two factors which can increase marketing risk. Since 1974 hog cash prices have fluctuated dramatically as illustrated in Figure 1. In 1980, monthly cash prices ranged from a low of $28.86/cwt to $48.30/cwt. Another demonstration of fluctuating hog prices is shown in Figure 2. This figure contains the weekly high and low price range of the nearest futures contract for live hogs over time. In 1979, futures prices ranged from $55.00/cwt to below $35.00/cwt. In 1980, futures prices demonstrated an even wider range from $27.00/cwt to $52.00/cwt.

To demonstrate the combined effects of highly variable input and hog slaughter prices, monthly net margins of hog producers are graphed over time in Figure 3.[1] In 1979, monthly net margins dropped from $4.63/cwt to a negative $14.18/cwt then increased to a negative $2.45/cwt. In 1980, monthly net margins declined from a negative $1.94/cwt to negative $18.63/cwt then increased to $8.65/cwt and finally retreated to a negative $4.09/cwt.

Spiraling costs of production are additional factors which can increase marketing risks. The USDA (1981) calculated the average total cost of producing hogs to be $55.17/cwt for all sizes and areas of farrow-to-finish enterprises in 1979. The USDA projection for 1981 was $71.95/cwt. The time lag required for increased costs of production to filter through the economic system leaves hog producers one step behind. This phenomenon creates financial difficulties for hog producers in the form of cash-flow problems, thus increasing the changes for financial failure.

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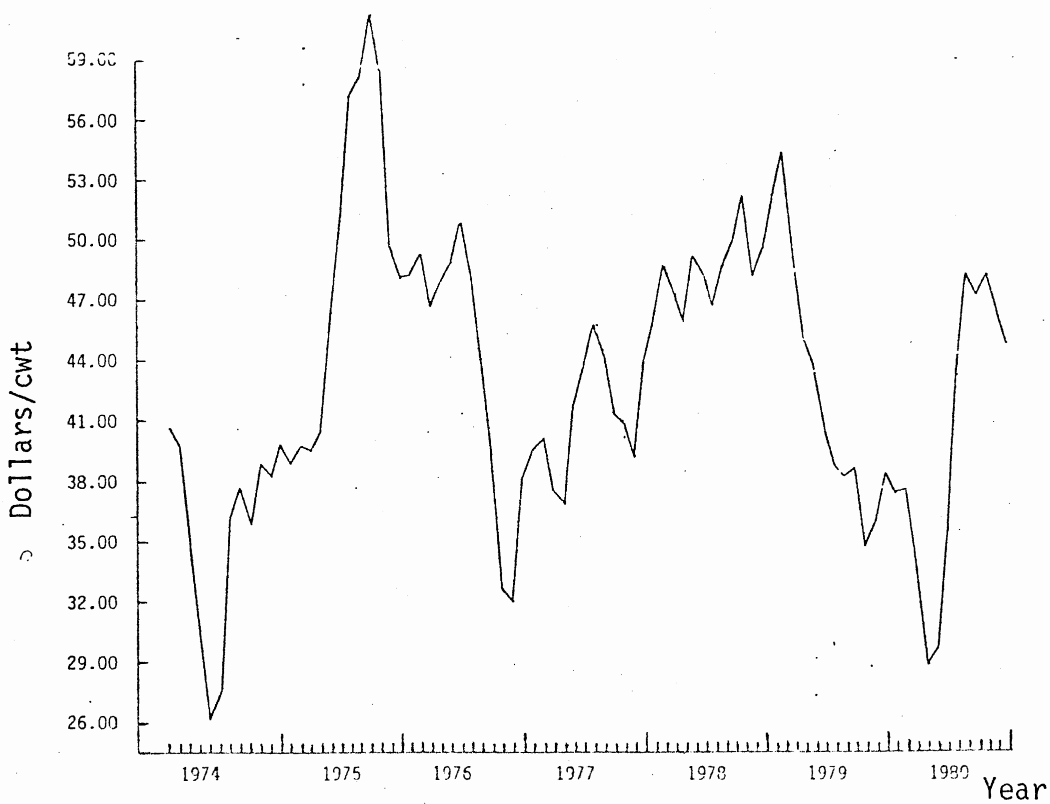
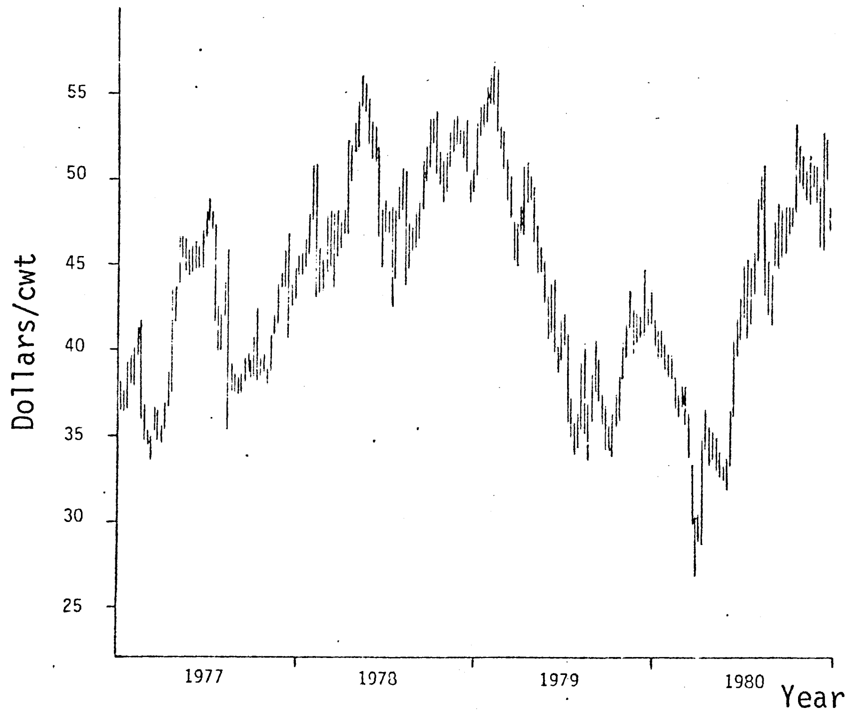
[1]The montly net margin was calculated by subtracting the selling price per cwt required to cover all costs of raising a 220 pound hog from the monthly average price per cwt for barrows and gilts sold in the seven markets, combined.



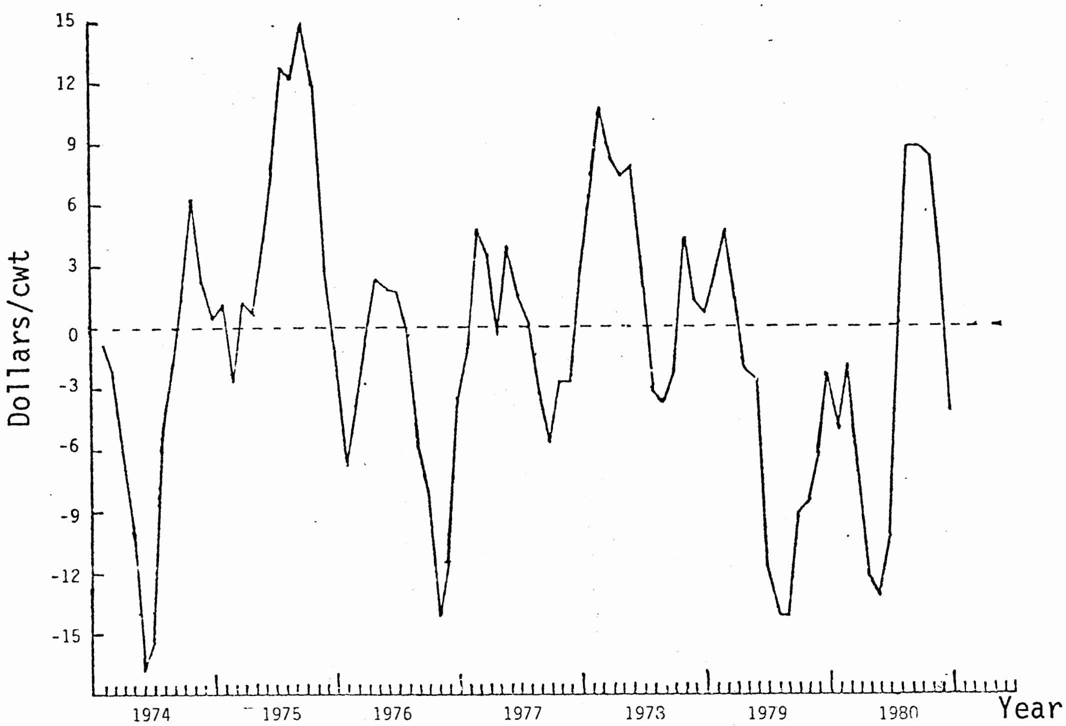
Source: USDA, Livestock and Meat Situation (February, 1974-1981)

Figure 1. Monthly Average Prices for Barrows and Gilts from Seven Markets Combined, 1974-1980



Source: Commodity Price Charts (January 1981)

Figure 2. Weekly High and Low Price Range of the Nearest Futures Contract for Live Hogs, 1977-1980



Source: USDA, Livestock and Meat Situation (February, 1974-1981)

Figure 3. Monthly Net Margins of U.S. Hog Producers, 1974-1980

High financial leverage also can increase marketing risks to hog producers. First, an important point to note is that economies of size prevail in the hog industry. Table I shows the total cost per cwt of selected farrow-to-finish enterprises for 1979. The total cost for a 40-sow farrow-to-finish enterprise was estimated at $71.30/cwt in 1979 whereas the total cost for a 5,000-head enterprise is estimated at $47.91/cwt for the same year. By substituting capital for labor and using both resources intensively, the cost per cwt declines as the enterprise size increases. Some discrepancies exist when moving from small to large enterprises, but in general, increasing size means reduced costs per cwt. With these economies of size comes higher financial leverage to buy the needed capital. Tweeten (1979) contends that large farms, on the average, operate with a lower ratio of equity to assets and a higher ratio of production costs to gross farm receipts than small farms. He concludes that, on the average, risk of financial collapse is greater on large farms than on small farms.

Given the above description of the hog industry, the evidence appears that hog producers face significant marketing risk. What can be done to help hog producers deal with marketing risks? Multiple hedging has been proposed as a viable marketing alternative to handle marketing risks (Ikerd and Franzmann, 1980). Multiple hedging is defined as lifting and placing a hedge anytime up to delivery of the finished product. This marketing technique can increase marketing flexibility, reduce price risk and increase profits compared to current marketing practice (Ikerd and Franzmann, 1980). Assuming that multiple hedging is a viable marketing alternative, the next question is "What tool should be used to signal placement and lifting of hedges?" Moving averages are one technical tool employed to signal the placement and

TABLE I

AVERAGE CASH AND TOTAL COSTS OF PRODUCING SLAUGHTER HOGS IN FARROW-TO-FINISH ENTERPRISES, ALL SIZES, SELECTED INPUT CATEGORIES, ALL REGIONS COMBINED, 1979

Annual Sales (head)	Total Cash Costs	Feed Costs	Labor	Other Direct Costs	Owner-ship Costs	Manage-ment	Land Taxes	Total Costs
	$/cwt							
All sizes	38.04	26.72	5.49	9.11	10.20	3.61	.04	55.17
40	41.39	27.38	10.69	12.22	16.29	4.66	.06	71.30
140	40.18	29.96	10.49	11.47	13.52	4.37	.07	66.88
300	37.19	26.59	6.71	9.09	10.11	3.68	.06	56.24
650	36.76	26.65	5.12	8.57	8.63	3.43	.05	52.45
1600	37.55	26.81	3.66	8.81	10.17	3.46	.02	52.93
5000	36.02	26.49	2.08	7.79	8.39	3.13	.03	47.91

Source: USDA (1981, pg. 18)

lifting of hedges. In this analysis, moving averages were used as the technical tool to implement hedges.

Objectives

The general objective of this thesis is to contribute to the knowledge and development of marketing strategies which can help hog producers manage price risks more effectively while maximizing profits.

Specific objectives include:

1. To determine if reoptimizing moving average parameters at specified intervals can increase total profits from futures trading.
2. To determine if reoptimization of moving averages will increase profits and reduce variability of profits in multiple hedging strategies.
3. To develop moving average parameters for use in multiple hedging strategies for slaughter hogs which are capable of increasing profits and reducing variability of profits when compared to a strategy of cash marketing of slaughter hogs.

To accomplish the first objective, moving average parameters are reoptimized at selected time intervals. The various reoptimization combinations are compared on the basis of total net profits and profits from short trades.

The second objective is accomplished simultaneously with the third objective by allowing each multiple hedging strategy to begin 9, 6, 3, or 2 months prior to marketing the slaughter hogs. Comparison is based on mean net return and coefficient of variation.

For the third objective, moving average parameters are selected for testing in a multiple hedging marketing framework. The selection is based on total net profits, net profits from short and long trades, percentage of profitable short and long trades and average net profit per trade. Next, the selected strategies are tested in the multiple hedging framework. Again, the results are compared on the basis of mean net return and coefficient of variation.

Literature Review

The thrust of this thesis lies in finding marketing strategies which maximize profits while reducing price risks faced by hog producers. Multiple hedging offers the possibility of accomplishing both goals. To accomplish these goals, timely placement and lifting of hedges is a major concern of the hog producer. Scarcity of empirical research in this area has prompted a partitioning of literature pertinent to this thesis into two parts: (1) the theory of hedging and (1) tools for timely execution of hedging transactions.

Theory of Hedging

Working (1977a) concluded that the primary function of hedging is to take advantage of variable changes between spot and futures prices. Working adds that risk reduction is a secondary consideration. In a later article Working (1977b) cited four reasons for hedging as follows: (1) hedging facilitates buying and selling conditions, (2) hedging gives greater freedom for business action, (3) hedging is a reliable basis for conducting storage of commodity surpluses, and (4) hedging reduces business risks. Working remained firm in his conviction that hedging's primary purpose is not risk reduction.

Johnson (1977) postulates price risk places an important role in determining the use of hedging. The following statement demonstrates his beliefs.

> The importance of the price 'insurance' factor in coffee hedging most clearly manifests itself in the fact that one group of traders, the roasters, who face little price risk in holding inventory almost never hedge, while another group, the importers, who do face large price risks make extensive use of the futures markets for hedging purposes (p. 212).

Ward and Fletcher (1971) developed a decision making model which shows: (1) alternative cash and futures market positions, (2) role of income, cost, risk and expectation in the decision process, (3) optimal cash and futures position, and (4) hedging and speculative positions in futures and cash markets. Speculation is explicitly defined as a futures position greater than the 100 percent hedging level or when the established futures position does not provide hedging possibilities in conjunction with the cash market position. They assumed a set of price expectations, a probability distribution for this set and a risk averse preference function. Ward and Fletcher point out that the model extends analysis of the relationship between market output decisions and futures positions beyond previous theoretical attempts, but other considerations are not discussed. Optimal timing of futures positions is ignored and costs are assumed fixed.

Peck (1977) employed optimal hedging strategies developed from a portfolio approach. She used the producer's viewpoint to explore economic implications of producer hedging. To do this, Peck looked at the mean squared error of the producer's forecasts. She concluded futures markets can be a useful tool for the producer attempting to control income variability. Peck also suggests additional research which could make her model dynamic by updating the price forecasts and by re-evaluating the hedging positions over time.

Oster (1979) believes the name of today's game in farming is risk management. Oster sites six reasons for his belief: (1) devaluation of the dollar, (2) demand for better diets, (3) variable weather, (4) higher price volatility, (5) economic interdependence around the world, and (6) higher financial risk. Oster contends the futures market can help farmers control price risk by shifting it to speculators. Oster proposes use of fundamental and technical analysis to facilitate decisions concerning the timing of hedging transactions.

Ikerd (1978) classifies risks confronting producers into two types: production risk and marketing risk. Production risks refer to factors which affect the efficiency of production or quality of product produced. He claims market risks are factors which influence input prices farmers pay or product prices farmers receive. Ikerd believes a producer must decide how much total risk and which type of risk he is willing to take in order to develop a consistent forward pricing strategy. The producer must decide whether he wants a higher price or a more certain price or a combination of the two. Ikerd suggests use of technical or fundamental analysis to help producers make more effective hedging decisions.

Tools for Timely Execution of Hedging Transactions

Holland, Purcell and Hague (1972) evaluated the performance of alternative hedging strategies for cattle feeding operations. They used the mean and variance of net returns as evaluative criteria. Alternative hedging strategies are based on seasonal tendencies, a lock-in margin and the mean net return of the unhedged operation. Results of this study indicate hedging strategies are present which decrease variability and increase the mean of net returns, which is not usually expected.

Wood (1972) conducted a similar study with hog prices. He used seasonal indices as a technique to hedge and employed the mean net return and variance as evaluative criteria. Mean net returns were significantly increased in three of the five selective hedging strategies, but the variances also increased. He concluded that hog producers would need to make the ultimate choice as to how much variation in net returns they are willing to accept. He suggested further study into short-run price prediction models as a tool for implementing hedging transactions.

Franzmann (1975) indicated that for producers of products, hedging is a possible option to reduce price risks. Deciding to hedge adds an additional problem of when to place and lift the hedge. He suggests the use of technical analysis as an objective tool to aid producers for optimal placement and lifting of hedges. As an example, he illustrates point-and-figure charting using the live cattle futures prices. Several formations and penetration of support and resistance lines were discussed.

Riffe (1978) examined the financial effects of hedging strategies designed to reduce severity of cash deficits. Hedges were placed and lifted based on signals from point-and-figure charts, a moving average combination, a price forecasting model, and a price forecasting model in conjunction with the point-and-figure charts and moving average combination. The frequency distribution, range, total accumulated debt balance, graphic distribution over time, mean and standard deviation of the 30-day cash balances were the evaluative criteria. Riffe concluded by stating:

> . . . the selective hedging strategies tested do not significantly reduce the number of deficit cash flow periods over time, but improve financial position by reducing the severity of the deficits and by redistributing them so that fewer deficit periods are observed consecutively (p. 91).

Link (1976) analyzed various hedging strategies for a feeder pig operation. He compared the strategies on the basis of mean net return and the variance of mean net return from January 1972 to July 1976. Various methods for implementing the hedges included a moving average, if the projected cash price was greater than the futures quote, and a moving average combination in conjunction with a price projection. Link reported that selective hedging greatly increased mean net return without substantially increasing the variance of net return. In conclusion, Link adds that hedging strategies are a viable technique which hog producers can use to increase returns or decrease variability of returns.

Brown (1977) compared hedging strategies over the period November 1972 to November 1976 for four production alternatives a feeder steer producer might employ. The hedging strategies were compared on the basis of mean net return and the standard deviation of mean net returns. A moving average of futures prices, price prediction equations, and a combination of the two were tools used to signal placement and lifting of hedges. Brown's results indicate that the moving average technique increased net returns by 100 percent and reduced the standard deviation from 53.21 to 35.71 when compared to a no-hedge strategy. He pointed out that a producer must assess his own risk-carrying ability prior to selecting the hedging strategy appropriate to his needs. The producer must choose between maximizing returns or reducing risks or a combination of these alternatives. Brown concluded that the results of the hedging strategies strongly suggest that the hedging options presented are more advantageous than a no-hedge strategy.

Lehenbauer (1978) completed a study on the use of optimal moving average and point-and-figure parameters for hedging feeder cattle. He used profit maximization as a primary goal and risk reduction as a secondary goal. Again, average net returns and the standard deviation of net returns were the basis for comparing the various hedging strategies. He concluded that selective hedging is preferred to not hedging based on the hedging strategies tested in his analysis.

Shields (1980) employed the Box Complex Procedure on live cattle, corn and feeder cattle futures prices from 1975 to 1979 to locate optimal moving average parameters. Next, he simulated a multiple hedging program for use by a continuous feedlot operation. Various combinations of marketing strategies were compared on the basis of mean, standard deviation and coefficient of variation. The return was calculated as a production margin between feeder cattle, corn costs and live cattle sales recorded. After examining the results, he concluded that multiple hedging of feeder cattle, corn and live cattle with optimal moving average parameters can potentially increase profits and reduce price risk for a continuous feedlot operation. He suggested further study with other commodities using the Box Complex Procedure to locate optimal moving average parameters.

CHAPTER II

CONCEPTS IN RISK MANAGEMENT AND SELECTION OF OPTIMAL MOVING AVERAGE PARAMETERS FOR FUTURES TRADING

The USDA (1980) reports that hog production has continued to shift toward larger, more efficient enterprises. Projections for 1978 indicate farms selling 1000 head or more annually account for 36 percent of total marketings compared to 7 percent in 1964. This trend is attributed to realized cost economies accruing to larger enterprises. In 1979, total costs per cwt for the largest hog enterprise were $7.26 per cwt less than the average cost per cwt for all sizes of farrow-to-finish operations. A major portion of the difference was due to non-cash inputs such as nonfeed direct costs and ownership costs. These input costs require heavy financial investment to achieve large cost economies. High financial leverage makes larger volume producers more susceptible to financial failure compared to small-volume hog producers with full equity and a diversified farming operation.

Means to more effectively handle risks confronting producers benefit not only hog producers, but can also benefit consumers of pork. Efficiency in the marketing system is gained through transferrence of risks from hog producers to speculators. Since hog producers are in business to market hogs and speculators are in business to assume risk, each group should be able to do their respective jobs more effectively.

Additional market efficiency translates into lower prices for pork consumers in the long run, ceteris paribus.

Marketing Alternatives and Risk Management

Available marketing alternatives include cash marketing, forward pricing, and multiple hedging. Cash marketing occurs when commodities are simply sold as they are delivered to market. Holding unhedged commodities confronts the producer with maximum price risk. Even though faced with marximum price risk a producer may still prefer to use the cash market. Cash markets are far simplier, more familiar and more trusted by producers as a means of determining fair market value (Ikerd, 1978). Also, when low cash prices are received by producers at the same time, there tends to be comfort in numbers. In other words, there is less psychological strain when other producers receive the same low price. Finally, selling in the cash market can also be as profitable as other marketing strategies.

A second marketing alternative is forward pricing. There are two reasons a producer may want to forward price a commodity. First, the producer may have reasons to believe the current futures price is higher than the expected cash price. Also, the producer may not be willing or able to risk the chance of receiving a lower price than the prevailing adjusted futures price. Ultimately, the producer must decide which reason is more important. The producer must examine variables such as personal factors, financial status, and production risks to make a wise decision (Oster, 1979). Personal factors include the feeling of security, freedom from debt, wealth accumulation, spouse's attitude, and the number of dependents. Net worth, liquidity, and financial leverage are items relating to financial status.

Production risks facing hog producers include drought, feed conversion rates, death rates and disease. By no means is this list exhaustive, but these items are examples of factors to be considered.

Two methods a producer may use to forward price are by forward contracting and by hedging. Forward contracting makes use of a cash contract for future delivery. Other terms of the contract are specified by the seller and the buyer. Hedging means taking an equal and opposite position in the cash and futures market. Table II depicts the arithmetic of a hedge and hold strategy for selling hogs and demonstrates the use of hedging. In essence, variation in the basis is substituted for price variation in the cash market. Since basis variation is more reliable, risk is less. Below is a discussion comparing the use of a cash contract with that of a futures contract to forward price.

TABLE II

AN EXAMPLE OF HEDGING HOGS UNDER A FAVORABLE CHANGE IN BASIS

Date	Cash Market	Futures Market	Basis
October 1	Expected price for Jan. 31 Delivery $39.27	Sells February futures for $40.77	$1.50
January 31	Sells hogs at local market for $38.19	Buys February futures for $39.57	$1.38
	Difference $1.08	Profit $1.20	Difference $.12
Results:	Cash price received	$38.19	
	Futures market profit	1.20	
	Net hedged price	$39.39	

Using a cash contract, a producer must be a skilled negotiator since price determination and terms of the contract are conducted on a one-on-one basis. Also, pricing flexibility is lost once the producer is committed to an agreement when forward contracting. Futures contracts can be bought or sold at any time. The price in a cash contract tends to be biased downward compared to futures market prices because the buyer assumes the basis risk (Ikerd, 1978).

Once the cash contract is agreed upon, the producer knows with certainty the price he will receive. There is no price risk. When hedging, price level risk is traded for basis risk and involves more risk than forward contracting. Trading futures contracts requires margin deposits and commission fees while cash contract transactions avoid these inconveniences. Cash contract sizes are negotiable to fit production expectations, but futures contracts sizes are fixed. Finally, since cash contracts are primarily handled locally, they are less complicated and easier to comprehend than futures contracts.

A final marketing technique available to the producer is multiple hedging and offers the most marketing flexibility (Ikerd and Franzmann, 1980). When employing multiple hedging, a hedge may be placed and lifted any time up to delivery of the finished product. Thus, as economic conditions and risk carrying abilities change the producer can change his price position. Futures positions are never in excess of expected output quantities and are only taken to offset cash market positions. These qualifications distinguish multiple hedging from speculation.

When a producer holds an unhedged product, he faces the maximum amount of price risk. By offsetting cash positions in the futures market for selected time periods throughout the production process, price risk is intuitively less. The main idea of multiple hedging is to protect the producer against a falling market when he is not willing or able to carry price risk and to take advantage of a rising cash market when he is willing or able to incur price risk. Ideally, the producer hopes to gain more in the futures market than he loses in the cash market during a falling market. Thus, profits can be enhanced while market risks are reduced compared to simply selling the commodity in the cash market.

Many of the disadvantages of multiple hedging are synonymous to the disadvantages of hedging. Futures contract transactions require margin deposits and commission fees. Also, a futures contract size is standardized, thus, the size may not match output of the producer. Finally, price risk is generally greater with multiple hedging than with forward pricing. Even with these inconveniences, in today's fast changing economy, flexibility is the key to financial survival for hog producers. Multiple hedging is a marketing technique which can provide marketing flexibility.

The above discussion considers marketing alternatives available to the hog producer. Several of these techniques can reduce marketing risk. Production flexibility is another employable technique to reduce marketing risk. Producers can adjust output according to future profit expectations. If profit expectations are pessimistic, production can be curtailed and alternatively, if profit expectations are optimistic production can be increased. Production flexibility is limited in its application since production must continue in order to cover fixed costs.

Concepts in Selecting Optimal Moving Average Parameters

Two approaches exist when attempting to determine appropriate timing for placement and lifting of hedges. One approach is fundamental analysis. Supply and demand factors affecting product price are examined, then a future price is estimated. For hog producers, demand factors include consumer income, prices of competitive commodities such as beef and chicken, age and religion. Supply factors include previous hog prices, management ability, and feed availability and cost. Attempting to project prices using fundamental analysis is not an easy task.

Another method to time placement and lifting of hedges is technical analysis. Commodity technical analysis is an investigation using prices, and in some analyses volume and open interest, which applies specific, well-defined rules or equations to the properties of commodity price movement (Kaufman, 1978). The technical analyst argues there are so many fundamental factors acting and reacting that an important determinant can be overlooked or for those considered, incorrectly weighted. Also, not all of the supply and demand elements are quantifiable.

> The marketplace reflects not only the differing value opinions of many orthodox (commodity) appraisers, but also all of the hopes and fears and guesses and moods, rational and irrational, of hundreds of potential buyers and sellers, as well as their needs and resources--in total, factors which defy analysis and for which no statistics are obtainable . . . (Teweles, Harlow, and Stone, 1977, p. 166).

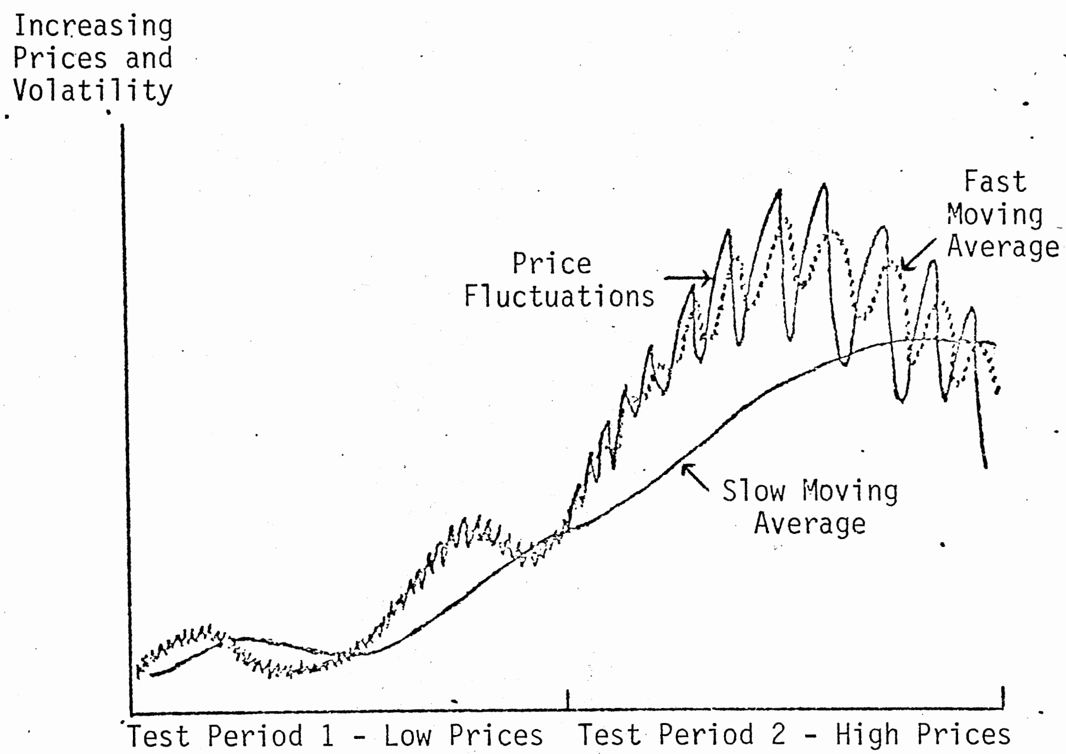
In using technical analysis, it is worth noting that a limited amount of data is needed: price, volume, and open interest.

Bar charts, moving averages, oscillators, and point and figure charts are among technical tool options available to futures traders. Moving averages are an objective technical tool which may provide the crucial characteristic of discipline to producers. Most producers are not experienced in futures trading. Temptations to speculate are everpresent. Using a technique void of hunches can be essential for beginning traders. Also, major price breaks are of utmost concern to producers. Moving averages can help producers avoid financial disaster when major price breaks occur in the market.

In this study moving averages were chosen as the technical tool to signal placement and lifting of hedges. The idea behind this trend following method is that once a price trend is established it is more likely to continue than to reverse. A moving average is a progressive average where the divisor remains constant, but at daily intervals a new price is added to the end of the series and simultaneously an item is dropped from the beginning. A buy signal is generated when the shorter moving average crosses the longer moving average from below. A sell signal occurs when the shorter moving average penetrates the longer moving average from above. There are two basic constituents to consider when choosing an appropriate moving average. First, the length of time used to compute the moving average. It is important to note a trade-off is involved. The shorter the length of time, the more responsive the moving average is to a change in trend. Greater sensitivity to trend comes at the expense of a greater number of commission fees and whipsaw losses. Whipsaw losses occur when trading signals cannot respond quickly enough to rapidly fluctuating prices. The results are trading signals at the wrong end of price movements. If a longer time period is used to compute the moving average the number of whipsaw losses is reduced, but signals of new trends are much later.

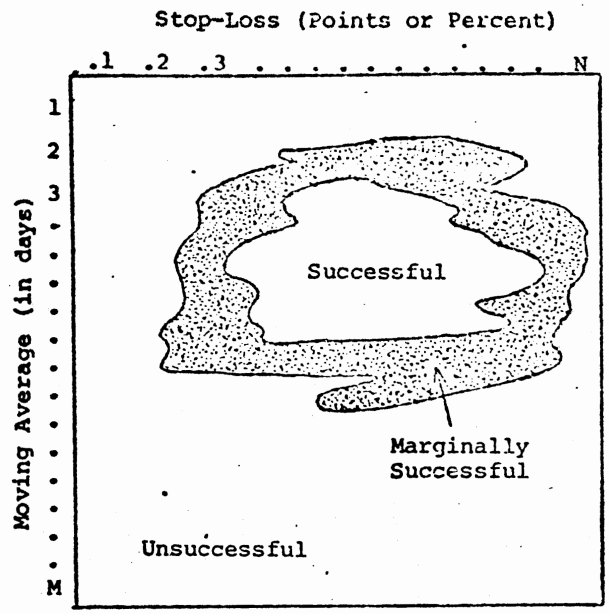
A second consideration is the amount of penetration required to signal a new trend. Penetration rules are used to reduce the number of whipsaw losses. Again, similar trade-offs exist. Too small a penetration rule does not effectively reduce whipsaw losses or the number of trades. Too large a penetration rule cuts profits short.

In choosing a trading system it is important to base those decisions on sound theory. Kaufman (1980) discusses theoretical considerations of choosing an optimal moving average strategy. He points out that, when mapping systems, most show areas of intense success surrounded by bands of declining success. Many systems indicate two sections of good performance. The two sections are coined a fast and slow sector. The slow sector is characterized by an infrequent number of trades. The fast sector is characterized by frequent trading. Having two areas of successful trading generally occurs in very volatile commodities where higher prices cause a stratification of the speed on a successful technique. When extreme price fluctuations exist, traders can profit from the short movements or the major trend. Figure 4 illustrates the concept of increasing price volatility and the uses of various moving averages. Figure 5 shows the test map of a medium speed moving average and the successful areas one might expect. The reason for employing a medium speed moving average is that a fast moving average cannot capture adequate profits on such short signals and a slow moving average is not responsive enough to price changes. Figure 6 illustrates the test map of higher prices and the relevant areas of success. In this case, a fast moving average is successfully employed on short



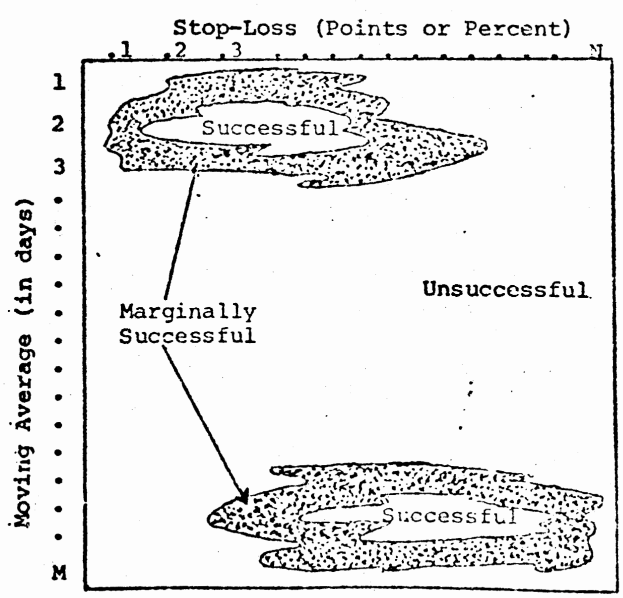
Source: Kaufman (1980, p. 147)

Figure 4. Price Movement



Source: Kaufman (1980, p. 148)

Figure 5. Test Map Results for Period 1--Low Prices



Source: Kaufman (1980, p. 148)

Figure 6. Test Map Results for Period 2--High Prices

fluctuations and a slow moving average works successfully on the longer run trends in prices. The fast moving average area of success is identified in the upper left corner of the test map and the corresponding area for the slow moving average is in the lower right hand corner. The vertical axis of the test map displays various lengths of moving averages. The horizontal axis shows various stop-loss (points or percent) options. Penetration rules could substitute for the stop-loss variable.

Kaufman (1980) points out that retesting of the price chart, Figure 4, at regular intervals, using data from the beginning of the price chart biases the results toward slower moving averages. In low prices, the fast moving averages generate losses while the slow moving averages show little profits as their signals are longer-term by nature. As prices move higher, profits from fast moving averages offset previous losses. The slower moving averages perform well in the higher prices. When combining the results, the slower moving averages tend to indicate a more successful performance. Kaufman also says a similar conclusion results when testing the price chart over many years using shorter time intervals.

There exists two categories of tests: static and dynamic. Static testing adheres to the idea that a single trading method which is successful in the past will continue to perform well in the future. Dynamic testing refers to changing either the system or the variables of the system over time. A test strategy is reapplied at well-defined intervals, then as a result new parameters are to be used. The objective of a dynamic test is to keep the parameters in the successful area of the test map. As market changes occur new parameters surface.

If a static test is used, then only one set of parameters is used for the entire test period.

Summary

This chapter includes a discussion of marketing alternatives, their relationship to risk management, and theoretical considerations in choosing optimal moving average parameters. Marketing alternatives discussed include cash marketing, forward contracting, hedging and multiple hedging. Advantages and disadvantages of each strategy are discussed along with each strategy's relation to price risk. Also considered in the discussion is production flexibility.

Since multiple hedging offers the most marketing flexibility in that it is the most viable alternative available to enhance profits and reduce price risks, a tool to appropriately time placement and lifting of hedges is deemed necessary. A brief discussion of fundamental as well as technical analysis is followed by a theoretical approach of choosing optimal moving average parameters. Static and dynamic testing are also considered in the discussion.

CHAPTER III

OPTIMIZATION OF MOVING AVERAGE PARAMETERS FOR LIVE HOG FUTURES PRICES

The beginning of the chapter is a description and illustration of the moving average technique. Next, the procedure used to obtain optimal moving average parameters is discussed. Also included in this chapter is a description of selected reoptimization combinations plus selected sets of moving average parameters used to trade a futures contract from October 1, 1977 through March 31, 1981. The various combinations and moving average parameters are presented with their results.

The Moving Average Technique

There are many types of moving averages. Exponential, linearly weighted, accumulated, and truncated moving averages are among the more common ones. Linearly weighted and truncated moving averages are the ones considered in this analysis. Truncated moving averages are commonly referred to as simple moving averages and are by far the most common price smoothing technique. The number of elements in the price series remains constant, but the interval of elements changes. To illustrate, suppose we have a set of prices, P, over the time period t: P_1, P_2, P_3, ..., P_t. Assume we want a moving average of length n. The moving average, M_t, calculated from this set is:

$$M_t = \frac{P_t + P_{t-1} + P_{t-2} + \ldots + P_{t-n+1}}{n}$$

To achieve the smoothing effect a new price, P_{t+1}, is added and the oldest price P_{t-n+1} is dropped from the set for each new time period.

The linearly weighted moving average is computed by assigning a weight factor to each price in the moving average. The oldest price in the series is assigned a weight of one, the next price a weight of two and continuing until the final price is given a weight of the moving average length. The divisor is equal to the sum of the weights.[1]

Buy and sell signals are generated by a "crossing over" action of two or more moving averages. To clarify signalling, a two moving average combination is illustrated in Figure 7 and discussed below. When the shorter length moving average penetrates the longer moving average from below, an uptrend in prices is indicated which is a signal to buy the commodity. A sell signal is indicated when the shorter moving average crosses the longer moving average from above.

Similar signals are generated from the crossing action of three moving averages (Figure 8). The shortest moving average confirms the signal from the crossing of the other two moving averages. A buy signal is confirmed when the shortest moving average is above a buy signal generated by the crossing of the medium and long moving averages.

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[1]Illustration of calculating a 3-day linearly weighted moving average. Let n be the day of the most recent closing price.

Day	Price		Weight		Product
n	49.27	x	3	=	147.81
n-1	48.75	x	2	=	97.50
n-2	50.00	x	1	=	50.00
			6		295.31

The 3-day weighted average is 295.31/6 = 49.22.

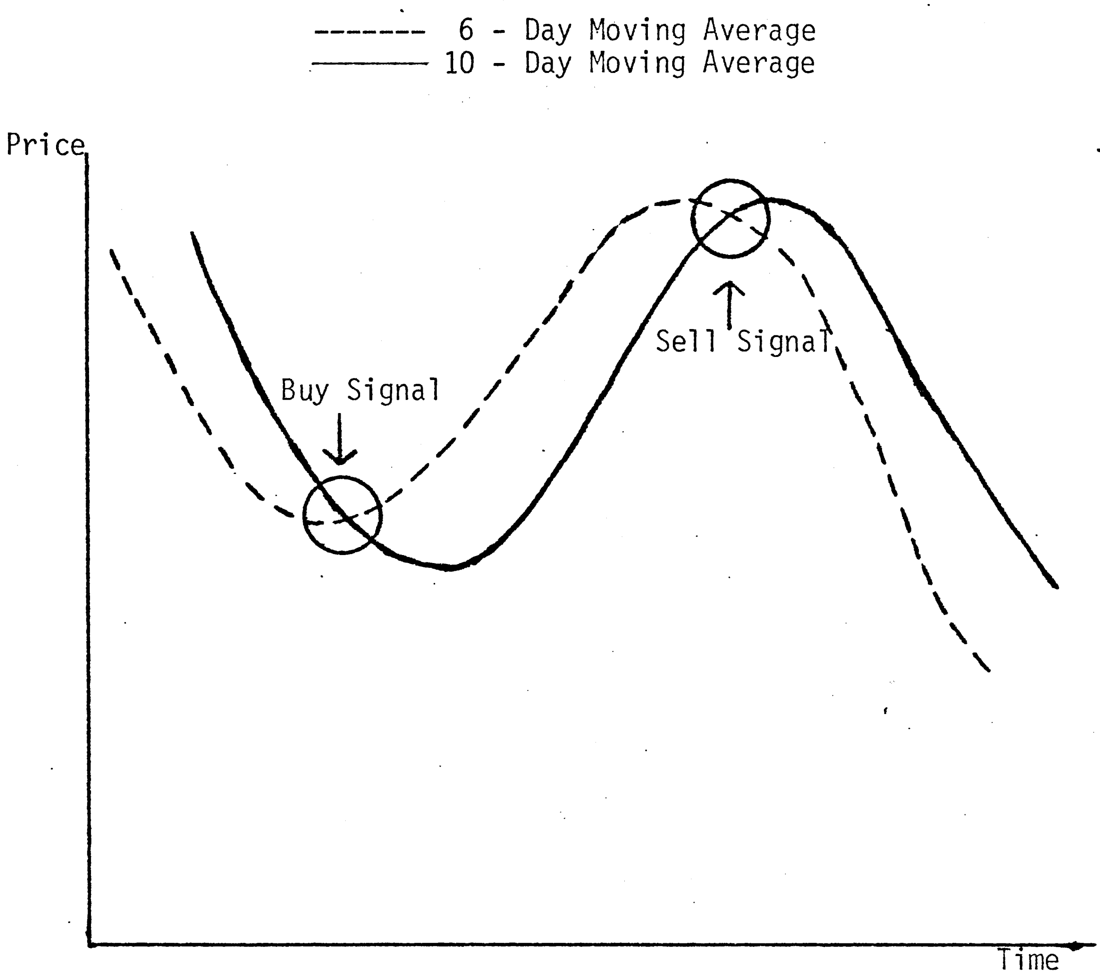

Figure 7. Buy and Sell Signals from a Two Moving Average Combination

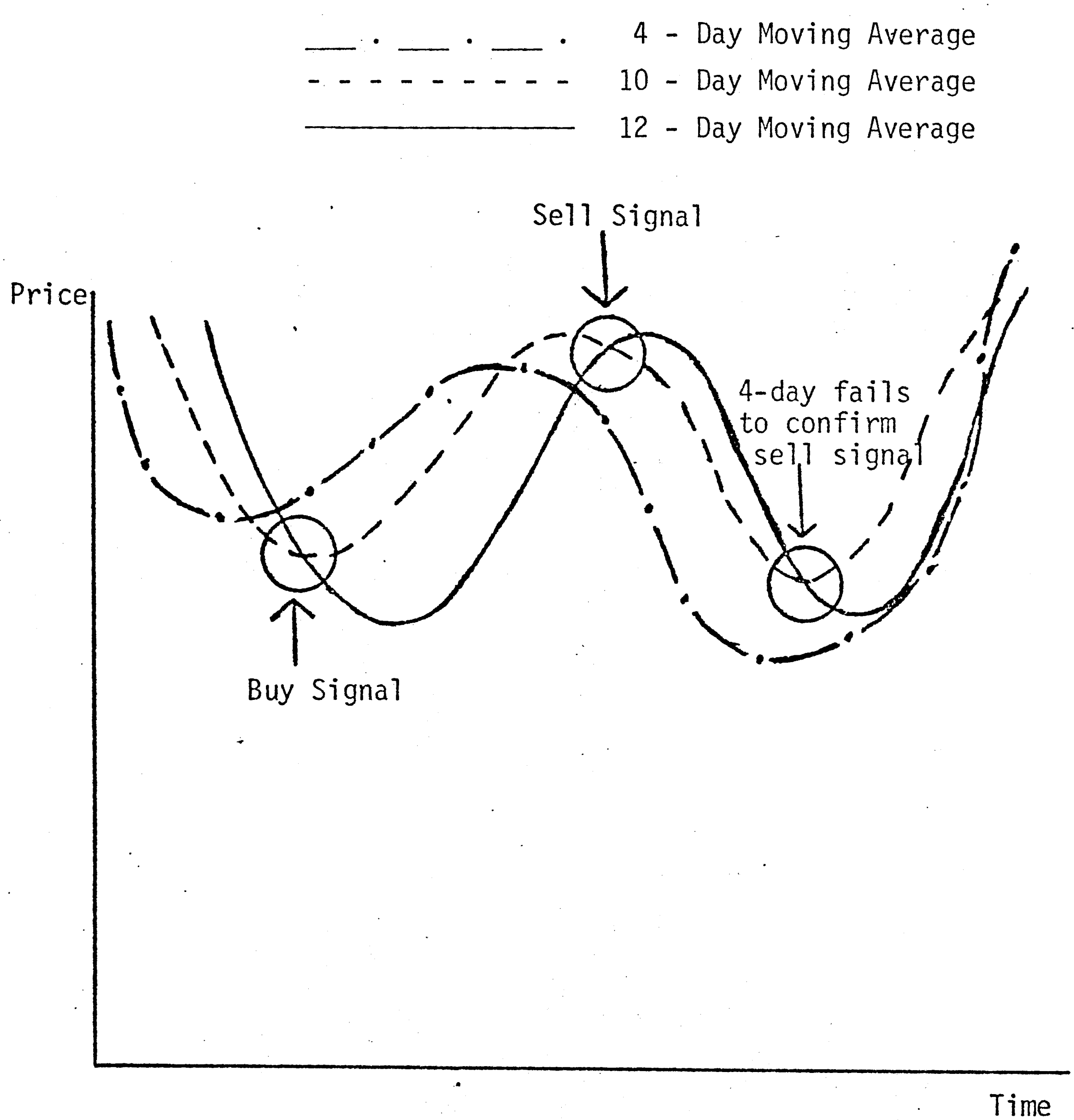

Figure 8. Crossing Action of Three Moving Averages

A sell signal is confirmed when the shortest moving average is below a sell signal generated by the medium and long moving averages.

The third moving average helps eliminate false signals which produce whipsaw losses and excess number of trades. A penetration rule or stop-loss option can be added to provide more complex trading signals. As discussed in Chapter II, a trade-off occurs between shorter, more responsive and longer, slower reacting moving average combinations. The slow moving averages hold positions over long time spans allowing opportunity for greater profits as well as losses. A faster set of moving average parameters trades more frequently to capture short term profits, but is susceptible to whipsaw losses when the moving average is not responding as quickly as prices are moving. Most importantly, no matter what options are used to signal trades, certain moving average parameters provide "better" trading signals. After obtaining these "better" trading signals for live hog price data, a hog producer will be better equipped to determine the appropriate timing for placement and lifting of hedges.

Procedure

Daily closing prices from selected live hog futures contracts were used to compute moving averages over the time period from October 1, 1975 through March 31, 1981. The selected data were based on its availability and were considered representative of current hog price movements. Past analysis of optimizing moving average parameters had been viewed in an ex-post fashion. Moving average parameters were optimized and tested over the same data set. In this analysis, moving average combinations are chosen based on past performance then tested over a future time period.

Selecting Optimal Moving Average Parameters

To complete the first objective in this analysis an attempt was made to answer the following three questions: (1) what technique will be used to optimize moving average parameters, (2) at what frequency should moving average parameters be reoptimized, and (3) how much past price data should be used to update the moving average parameters.

The first question was answered through the implementation of a computerized moving average optimizer program. A moving average program, which simulates futures trading using moving averages to generate buy and sell signals, is incorporated into a direct search technique known as the Box Complex Procedure (Richardson, Ray, and Trapp, 1979). This hill climbing procedure, which solves constrained optimization problems, employs a closed-loop feedback process to search the surface of a performance measure for its global maximum or minimum. In this case, the performance measure, net profit, is maximized. The constrained control variables include length and number of moving averages, the option of linearly weighting, and variation of the penetration level. The program also has the capability of incorporating a stop-loss option, but was not used since the penetration rule achieves similar results. An initial moving average was provided, then the program randomly generated four more moving averages. An iterative procedure continued to solve the constrained optimization problem until changes in the constrained control variables no longer improved the performance measure.

Limitations exist when using the Box Complex Procedure. One problem was that moving averages are discrete variables while optimal control techniques are designed for continuous systems. A 4.24 day moving average does not make sense because the closing price for each day was used to compute the average. The program was modified to accommodate for this difficulty by truncating the values of the constrained variables. Due to truncation and the fact that many profit hills existed, difficulties arose in determining whether a local or global maximum had been ultimately attained. Sometimes more than one search was necessary to determine if a maximum was global or local.

After several trial runs of the program and reviewing published moving averages on live hog price data, boundaries and an initial starting position were chosen for the program. Since many computer trials were involved in completing the selected reoptimization combinations, options within the Box Complex Procedure were limited to a set of two moving average parameters with no penetration rule. The lower boundaries for the short and long moving average were chosen to be zero. The upper boundaries chosen for the short and the long moving average were 7 and 21, respectively.

The moving average program[2] computed moving averages for live hog futures price data, then implemented trades according to buy and sell signals. To make the program as realistic as possible, trading rules were incorporated into the program. They are as follows:

1. No trades occurred on days when the high and low prices were equal.
2. No trades were transacted on days when the closing price was up of down the daily limit.

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[2]The moving average program was programmed by Dr. Meg Kletke at Oklahoma State University. Roberta Helberg, also at Oklahoma State University, made appropriate changes in the program to accommodate the live hog futures price data.

3. Due to the threat of delivery, no new buy signals were honored after the first of the delivery month.

4. A charge of $50.00 per trade was assessed for commission cost.

The output of the program provides a comprehensive set of trading data. For each contract, the date of each transaction is followed by the open, high, low, close, type of transaction (buy or sell), transaction price, trade number, profit for each trade, and cumulative profit for short, long and total trades. Additional information includes the total number of trades, total profit from all trades and average profit per trade. Below this output are the moving averages values and the respective dates on which the trades were executed. Percentages of profitable short, long and total trades are also included in the annual and final summaries.

Selecting Optimal Reoptimization Time Spans in Conjunction with Optimal Length of Data Base

Figure 9 is provided to illustrate possible combinations of data base requirements and frequency the data need to be reoptimized. Since investigating all possible combinations is too costly with respect to time and money, selected combinations were identified for testing. A maximum data base of 24 months of live hog futures price data per combination was employed due to the amount of data needed to adequately test the various combinations over time. The following combinations were examined:

I. Reoptimizing 4 months of live hog futures price data every month

II. Reoptimizing 9 months of live hog futures price data every 3 months

III. Reoptimizing 12 months of live hog futures price data every 8 months

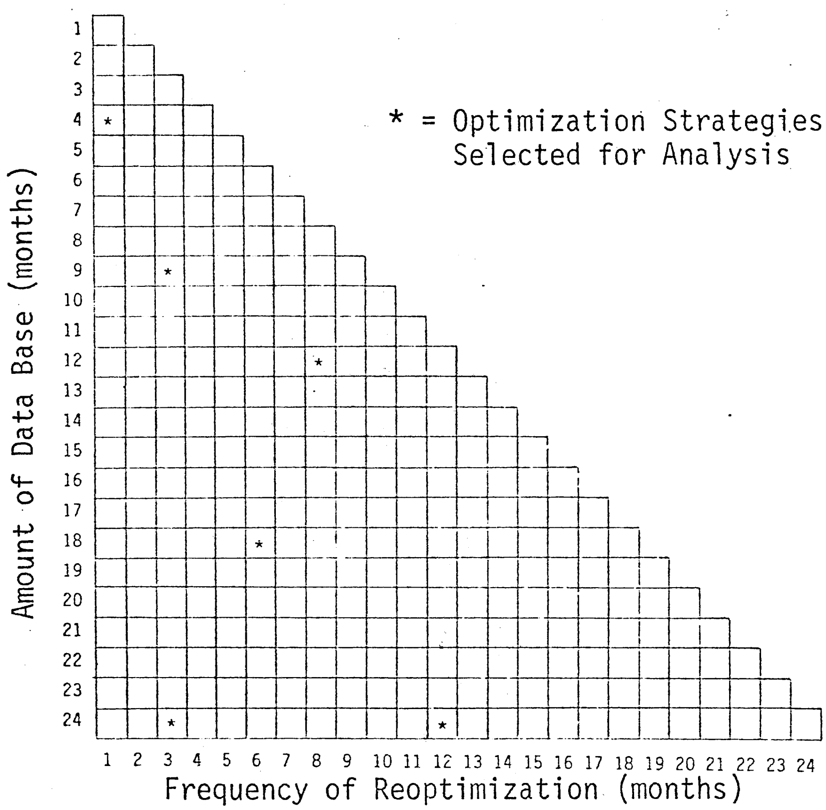

Figure 9. Possible Combinations of Frequency of Reoptimization and Size of Data Base

IV. Reoptimizing 18 months of live hog futures price data every 6 months

V. Reoptimizing 24 months of live hog futures price data every 3 months

VI. Reoptimizing 24 months of live hog futures price data every 12 months

Once computer trials were completed for the selected reoptimizations, options within the Box Complex Procedure were expanded to include 3 linearly weighted or unweighted moving averages and a penetration rule for the reoptimization which provided the best results. The upper boundaries for the short, medium and long moving averages were 8, 20, and 26, respectively. The lower boundaries were set at zero. The penetration rule was limited to 40 cents at the upper extreme and zero at the lower extreme.

According to the theory presented in Chapter II, this test is known as a dynamic test because of the implication that successful trading areas on a test map change over time. The idea is to reoptimize moving average parameters to stay within the successful trading areas.

Combination I

Four months of live hog futures price data were optimized each month. All 7 live hog futures contracts were used for this combination. They included February, April, June, July, August, October, and December contracts. Since the test period for all combinations was October 1, 1977 through March 31, 1981, optimization began 4 months prior to October 1, 1977. The first optimization period was from June 1, 1977 through September 30, 1977 and employed the October live hog contract. The set of moving average parameters which produced the highest net profit during this time frame, was tested on October 1977 price data using the December live hog contract. When optimizing over the second time period, price data from June 1977 were dropped and October 1977 was added to make a new four month time frame. Since no trading was permitted after the first day of the delivery month, price data from the December contract were used for optimization. The resulting optimal moving average parameters with their respective optimization time periods are listed in Table III.

A wide range of optimum moving average lengths resulted in this combination. The short moving average ranges from a length of 1 day to 6 days. The long moving average ranged from a length of 3 days to 19 days. With a relatively small data base one would expect significant changes in the moving average parameters over time.

Combination II

The next combination, optimizing 9 months of live hog futures price data every 3 months, employed 4 contracts: February, April, July and October. Each contract was assigned 3 months of price data. The first optimization time period included prices from January 1, 1977 through September 1, 1977 and employed the April, July, and October contracts. January 1, 1977 through March 31, 1977 prices came from the April 1977 contract, April 1, 1977 through June 30, 1977 were assigned to the July 1977 contract and July 1, 1977 through September 30, 1977 came from the October 1977 contract. After optimization for this time frame was completed, the results were employed on the ensuing 3 months of price data from the February 1978 contract. Each successive optimization dropped the oldest contract and added a new contract to the beginning of the series. The sets of moving average parameters developed from all optimizations are reported in Table IV.

TABLE III

OPTIMUM MOVING AVERAGES DEVELOPED FROM FOUR MONTHS OF LIVE HOG FUTURES PRICES AND REOPTIMIZED EACH MONTH (COMBINATION I)

Time Period of Optimization (dates)	Lengths of Moving Averages	
06/01/77 - 09/30/77	5	18
07/01/77 - 10/31/77	3	10
08/01/77 - 11/30/77	3	13
09/01/77 - 12/31/77	3	7
10/01/77 - 01/31/78	3	16
11/01/77 - 02/29/78	2	4
12/01/77 - 03/31/78	1	3
01/01/78 - 04/30/78	5	18
02/01/78 - 05/31/78	5	18
03/01/78 - 06/30/78	5	18
04/01/78 - 07/31/78	2	8
05/01/78 - 08/31/78	2	9
06/01/78 - 09/30/78	4	17
07/01/78 - 10/31/78	3	12
08/01/78 - 11/30/78	5	10
09/01/78 - 12/31/78	2	12
10/01/78 - 01/31/79	4	11
11/01/78 - 02/29/79	4	13
12/01/78 - 03/31/79	4	12
01/01/79 - 04/30/79	2	12
02/01/79 - 05/31/79	2	12
03/01/79 - 06/30/79	4	13
04/01/79 - 07/31/79	4	16
05/01/79 - 08/31/79	3	13
06/01/79 - 09/30/79	4	10
07/01/79 - 10/31/79	3	10
08/01/79 - 11/30/79	6	19
09/01/79 - 12/31/79	6	19
10/01/79 - 01/31/80	5	18
11/01/79 - 02/29/80	3	7
12/01/79 - 03/31/80	3	7
01/01/80 - 04/30/80	3	13
02/01/80 - 05/31/80	3	14
03/01/80 - 05/30/80	3	7
04/01/80 - 07/31/80	2	6
05/01/80 - 08/31/80	4	16
06/01/80 - 09/30/80	4	15
07/01/80 - 10/31/80	5	13
08/01/80 - 11/30/80	5	13
09/01/80 - 12/31/80	5	13
10/01/80 - 01/31/81	4	13
11/01/80 - 02/29/81	1	3

TABLE IV

OPTIMUM MOVING AVERAGES DEVELOPED FROM 9 MONTHS OF LIVE HOG FUTURES PRICES AND REOPTIMIZED EVERY 3 MONTHS (COMBINATION II)

Time Period of Optimization (Dates)	Lengths of Moving Averages	
01/01/77 - 09/30/77	5	13
04/91/77 - 12/31/77	5	8
07/01/77 - 03/31/78	6	19
10/01/77 - 06/30/78	5	18
01/01/78 - 09/30/78	3	12
04/01/78 - 12/31/78	3	14
07/01/78 - 03/31/79	4	12
10/01/78 - 06/30/79	4	11
01/01/79 - 09/30/79	4	13
04/01/79 - 12/31/79	5	18
07/01/79 - 03/31/80	6	19
10/01/79 - 06/30/80	3	15
01/01/80 - 09/30/80	3	7
04/01/80 - 12/31/80	4	15

The optimum moving averages in the strategy resulted in a smaller range of lengths compared to Combination I. The short moving average lengths ranged from a length of 3 days to 6 days while the long moving average ranged from a length of 7 days to 19 days. Of the 14 time periods, 4 time periods resulted in short moving averages 3 days in length, 4 time periods resulted in short moving averages 4 days in length, 4 time periods resulted in short moving averages 5 days in length and 2 time periods resulted in short moving averages of 6 days in length.

Combination III

The February, June and October contracts were used to optimize 12 months of live hog price data every 8 months. Prices from January 1 through April 30, May 1 through August 31, and September 1 through December 31 were taken from June, October and December contracts, respectively. The first optimization time period used the December 1976, June 1977 and October 1977 contracts. Each successive optimization dropped the 2 oldest contracts from the end and added 2 new contracts to the beginning of the series. Table V contains the optimization time period and respective optimal moving average parameters.

TABLE V

OPTIMUM MOVING AVERAGES DEVELOPED FROM 12 MONTHS OF LIVE HOG FUTURES PRICES AND REOPTIMIZED EVERY 8 MONTHS (COMBINATION III)

Time Period of Optimization (Dates)	Lengths of Moving Averages	
05/01/76 - 04/30/77	3	7
01/01/77 - 12/31/77	3	11
09/01/77 - 08/31/78	3	10
05/01/78 - 04/30/79	3	11
01/01/79 - 12/31/79	5	17
09/01/79 - 08/31/80	4	16

The optimum moving average lengths within this combination did not change significantly until the final two time periods. For the first 4 time periods the short moving average was 3 days in length. For the same 4 time periods the long moving averages ranged from a length of 7 days to 11 days. The short moving average lengths for the final 2 time periods were 5 days and 4 days respectively, while the long moving average lengths were 17 days and 16 days, respectively. The final 2 sets of moving averages were slower responding moving averages compared to the moving averages of the first 4 time periods.

Combination IV

Table VI contains the results of optimizing 18 months of live hog futures price data every 6 months. The contracts and price data assigned to each contract were the same as for Combination II. For this combination, 6 contracts were used for each optimization. On successive optimizations the oldest two contracts were dropped from the end and 2 new contracts were added to the beginning of the series.

TABLE VI

OPTIMUM MOVING AVERAGES DEVELOPED FROM 18 MONTHG OF LIVE HOG FUTURES PRICES AND REOPTIMIZED EVERY 6 MONTHS (COMBINATION IV)

Time Period of Optimization (Dates)	Lengths of Moving Averages	
04/01/76 - 09/30/77	6	11
10/01/76 - 03/31/78	6	15
04/04/77 - 09/30/78	6	15
10/01/77 - 03/31/79	3	12
04/01/78 - 09/30/79	4	13
10/01/78 - 03/31/80	4	11
04/01/79 - 09/30/80	6	17

The moving average lengths of this combination tended to be slower and less responsive than the moving averages in the previous combinations. Of the 7 time periods, 4 time periods resulted with a short moving average of 6 days in length. The long moving average lengths ranged from 11 days to 17 days.

Combination V

Optimizing 24 months of live hog futures price data every 3 months employed the same contracts and assigned price data as in Combination II. This combination employed 8 contracts for each optimization. The oldest contract is dropped from the end and a new contract is added to the beginning of the series for each successive optimization. The moving average parameters with their respective time period is pictured in Table VII.

The short moving averages ranged from a length of 3 days to 6 days, but 7 of the 14 time periods resulted in a short moving average of 4 days. The long moving averages ranged from a length of 5 days to 18 days. Six of the 14 time periods resulted in long moving averages ranging from 10 days to 13 days in length. Four of the time periods had long moving averages of a longer span than the previously mentioned time periods. The remaining 4 time periods were characterized by the shortest long moving averages depicted in Comabination V.

Combination VI

The final combination optimized 24 months of live hog futures price data every 12 months. Again, the contracts and respective price data for each contract were the same as Combination II. Eight contracts were used for each optimization. Four new contracts were

TABLE VII

OPTIMUM MOVING AVERAGES DEVELOPED FROM 24 MONTHS OF LIVE HOG FUTURES PRICES AND REOPTIMIZED EVERY 3 MONTHS (COMBINATION V)

Time Period of Optimization (Dates)	Lengths of Moving Averages	
10/01/75 - 09/30/77	4	12
01/01/76 - 12/31/77	4	5
04/04/76 - 03/31/78	6	16
07/01/76 - 06/30/78	4	8
10/01/76 - 09/30/78	3	10
01/01/77 - 12/31/78	3	12
04/01/77 - 03/31/79	4	8
07/01/77 - 06/30/79	5	18
10/01/77 - 09/30/79	3	9
01/01/78 - 12/31/79	5	18
04/01/78 - 03/31/80	4	11
07/01/78 - 06/30/80	3	10
10/01/78 - 09/30/80	4	13
01/01/79 - 12/31/81	4	15

added to the beginning and the oldest 4 contracts were dropped from the end of the series for each successive optimization. Table VIII contains moving average parameters derived from the optimization procedure with their respective time frames.

Of the four time periods in this combination, 2 of the short moving averages resulted in a length of 3 days and 2 resulted in a length of 4 days. The long moving averages ranged from a length of 9 days to 13 days.

Combination VII

Combination VII also optimized 24 months of live hog futures price data every 12 months. In this combination, the Box Complex Procedure included additional options of linearly weighted moving averages, a third moving average, and a penetration rule. The moving average parameters and their respective optimization time periods are reported in Table IX.

The short moving averages ranged from 2 days to 5 days in length. One of the short moving averages was a 4 day linearly weighted moving average. The medium moving average lengths ranged from 7 days to 15 days. Two of the medium moving averages were linearly weighted. The long moving averages ranged from 9 days to 17 days in length. The penetration levels ranged from 8 cents to 21 cents. These moving average parameters resulted in considerably fewer trading signals due to the addition of the confirming moving average and the penetration rule.

Results of Reoptimization Combinations

Table X contains the results of trading in the live hog futures

TABLE VIII

OPTIMUM MOVING AVERAGES DEVELOPED FROM 24 MONTHS OF LIVE HOG FUTURES PRICES AND REOPTIMIZED EVERY 12 MONTHS (COMBINATION VI)

Time Period of Optimization (Dates)	Lengths of Moving Averages	
10/01/75 - 09/30/77	4	12
10/01/76 - 09/30/78	3	10
10/01/77 - 09/30/79	3	9
10/01/78 - 09/30/80	4	13

TABLE IX

OPTIMUM MOVING AVERAGES WITH ASSOCIATED PENETRATION LEVELS DEVELOPED FROM 24 MONTHS OF LIVE HOG FUTURES PRICES AND REOPTIMIZED EVERY 12 MONTHS (COMBINATION VII)

Time Period of Optimization (Dates)	Lengths of Moving Averages*			Penetration Level
10/01/75 - 09/30/77	3	7	9	.21
10/01/76 - 09/30/78	5	W15	W17	.08
10/01/77 - 09/30/79	W4	W12	W17	.14
10/01/78 - 09/30/80	2	11	16	.18

*W denotes a linearly weighted moving average.

TABLE X

RESULTS OF SEVEN OPTIMIZATION COMBINATIONS USING LIVE HOG FUTURES PRICES, OCTOBER 1, 1977 - MARCH 31, 1981

	Total Net Profit	Net Profit from Long Trades	Net Profit from Short Trades	Total Net Profit Per Trade	Percent Profitable Long Trades	Percent Profitable Short Trades	Percent Profitable Trades
	($)	($)	($)	($)	(%)	(%)	(%)
I	-1704	377	-2081	-14.95	43.0	36.0	39.0
II	-1055	-135	-920	-12.41	47.6	32.6	40.0
III	5158	3993	1165	65.29	48.7	30.0	39.2
IV	-975	-20	-955	-12.50	51.4	31.7	42.3
V	-1273	-219	-1054	-13.40	50.0	30.6	40.0
VI	4077	2456	1621	45.30	45.5	34.8	40.0
VII	-433	-1106	673	-9.21	40.9	32.0	36.2

market with respect to each combination described above. Combinations III and VI were the only combinations resulting in positive total net profits. Combination III resulted in the highest total net profit and net profits on long trades. Combination VI resulted in the second highest total net profit, but outperformed Combination III with respect on short trades and percentage of profitable short trades. Combinations III and VI short trades netted $1,165 and $1,621, respectively. Total net profits were $5,158 for Combination III and $4,077 for Combination VI. Percentages of profitable short trades for Combinations III and were 30.0 and 34.8, respectively.

Since the focus of this analysis is concerned with multiple hedging strategies, short trade performance is viewed as an important criteria in choosing an effective combination. When multiple hedging slaughter hogs, a producer is in the futures market on short trades and out of the market on long trades. Due to a better performance on short trades, Combination VI was the reoptimization combination for expansion of options within the Box Complex Procedure. This combination was coined Combination VII and although short trades showed a short net price, $673, total net profit was negative.

Since reoptimization indicated unfavorable results, another approach was sought to attain a viable moving average trading system. Some sets of moving averages parameters responded quite well within their respective time frames. These moving averages were selected for testing over the entire test period. After examining the results of the selected sets of moving average parameters, 4 sets of moving average parameters were selected which performed significantly better than any of the reoptimization combinations. Table XI contains the results of these selected moving averaged. The percentage of profitable

TABLE XI

RESULTS OF SELECTED MOVING AVERAGE COMBINATIONS USING LIVE HOG FUTURES PRICES, OCTOBER 1, 1977 - MARCH 31, 1981

Moving Average Combination[a]		Total Net Profit	Net Profit from Long Trades	Net Profit from Short Trades	Total Net Profit Per Trade	Percent Profitable Long Trades	Percent Profitable Short Trades	Percent Profitable Total Trades
		($)	($)	($)	($)	(%)	(%)	(%)
7-10	(.26)	7174	3774	3400	121.43	48.1	42.9	45.4
4-11-14	(.17)	12504	7195	5309	347.33	56.3	45.0	50.0
4-10-12	(.14)	12207	7249	4958	290.64	52.6	43.5	47.6
3-13-20	(.09)	6524	3807	2717	171.68	55.6	40.0	47.4

[a]Lengths are in days. The number in parentheses is the minimum penetration required.

total, long and short trades for the top 4 sets of moving average parameters outperformed each of the reoptimization combinations. The 4-11-4 moving average set with a 17 cent penetration level generated \$12,504 in total net profits with 50.0 percent of total trades resulting in a net profit. Forty-five percent of the short trades resulted in a net profit of \$5,309. A close second is the 4-10-12 moving average set with a 14 cent penetration level. This moving average set generated \$12,207 in total net profits with 47.6 percent of total trades showing a net profit. Short trades netted \$4,958 on a 43.5 percent success rate.

Summary

This chapter began with an explanation of the moving average technique. Next, the first objective of this thesis was analyzed. To complete the analysis an attempt was made to answer three questions: (1) what technique will be used to reoptimize moving average parameters, (2) at what frequency should moving average parameters be reoptimized, and (3) how much historical price data should be used to update the moving average parameters. The Box Complex Procedure provided the technique to reoptimize the moving average parameters and a figure was constructed to select combinations of the final two questions. The results of the combinations were disappointing. Profit levels from trading were significantly lower than profit levels obtained by employing a single set of moving average parameters over the test period. Thus, objective one was accomplished. From the results of this analysis, reoptimization does not appear to improve trading results.

Four sets of moving average parameters were found which demonstrated significantly better results than the reoptimization combinations. In the next chapter, all of the reoptimization combinations and the 4 sets of moving average parameters will be employed in a multiple hedging program.

CHAPTER IV

TESTING MULTIPLE HEDGING STRATEGIES FOR MARKETING SLAUGHTER HOGS

A major goal of hog producers is to increase profits. The use of marketing techniques which are more flexible than those currently employed would permit producers to change their pricing positions as market conditions change. If successful, the potential for increased profits would increase.

As improved marketing techniques are learned and implemented by all producers, a more efficient, stable hog production system could be expected to develop. Risks would be passed to specialists and hog producers would be able to concentrate their efforts on the production side of their business. Results of such actions would be a more stable supply of pork for consumers and a more efficient use of the resources employed in pork production. Consequently, consumers as well as producers would benefit from the implementation of the improved marketing techniques.

This chapter contains the results of 11 multiple hedging strategies based upon the reoptimization combinations and the 4 sets of moving average parameters developed in Chapter III. The beginning of the chapter includes a discussion of the method used to compare the 11 strategies. Next, assumptions, data sources and calculations are presented to clarify the application of the model. Finally, results are presented and discussed with respect to mean net returns and the variability of net returns.

Method of Analysis

The 4 sets of moving average parameters and the selected reoptimization combinations presented in Chapter III are based on net profit generated from trading one futures contract over time. The next step in this thesis is to incorporate the trading signals into a multiple hedging marketing framework and observe the effects on mean net returns and the variability of net returns as measured by the coefficient of variation.

Many types of hog enterprises exist throughout the industry. One cannot represent all hog enterprise characteristics. In this analysis, the hog enterprise under consideration is a continuous farrow-to-finish operation. The first group of hogs was assumed marketed June 30, 1978. Each month a net group was marketed through March 31, 1981 for a total of 34 groups of hogs.

A total of 132 hogs were fed to 240 pounds each. After deducting an assumed 3.85 percent for shrinkage, the market weight for each hog was estimated as 230.77 pounds. Also, an average death rate of 1.5 percent was assumed.[1] The total market weight of 130 hogs, weighing 230.77 pounds each, equals 30,000 pounds which is the weight designated in one futures contract listed on the Chicago Mercantile Exchange.

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[1]Shrinkage rates and death rates vary among hog operations. The shrinkage and death rates for this analysis were calculated from the following publication: Brumm, Michael C. 1979. Swine Production Profile, OSU Extension Facts No. 3657.

In this model, raising a pig from conception to 240 pounds take 340 days divided into 4 time frames. The first 115 days is the gestation period. The next 60 days pigs are fed from birth weight to 40 pounds. The third time frame also lasts 60 days and pigs are fed a grower feed ration from a weight of 40 to 120 pounds. During the fourth time frame, hogs are fed a finishing feed ration from 120 to 240 pounds which lasts 105 days. Table XII depicts the assumed hog production process.

TABLE XII

GROWTH STAGES OF THE PRODUCTION PROCESS FOR A FARROW-TO-FINISH HOG OPERATION

	Number of Days
Conception to Birth	115
Birth to 40 Pounds	60
40 Pounds to 120 Pounds[a]	60
120 Pounds to 240 Pounds[b]	105
Total	340

[a]The grower feed ration is used to feed hogs through this time period.

[b]The finishing feed ration is used to feed hogs through this time period.

To simplify the analysis, the cost assumed for raising from farrow-to-finish pigs was the weekly average price for 40 pound feeder pigs on the southern Missouri markets as reported by the USDA in

Livestock Meat Wool Market News. Since the publication reports 30-40 pound and 40-50 pound feeder pig prices, an average of those two prices is assumed to represent the 40 pound feeder pig price. The price reflects the opportunity cost of raising pigs from farrow-to-feeder pig.

The largest cost of raising hogs is feed. Williams and Plain (1978) report that feed accounts for about 65-75 percent of the total cost of raising hogs. All other production costs were assumed fixed in this analysis. Feed prices for rearing pigs from 40 to 240 poonds were segmented into two categories: grower and finisher feed ration prices. The grower ration is used to feed pigs from 40 to 120 pounds. The grower ration feed price used was the monthly average Oklahoma price for 14-18 percent hog feed as reported by the USDA in Agricultural Prices. The finishing feed ration is used to feed pigs from 120 to 240 pounds. This ration price was calculated as 94 percent of the grower ration feed price.[2]

The rate of gain was assumed to be 1 pound of grain for each 3.75 pounds of feed. Grower ration feed requirements for each group of 132 hogs are 19,800 pounds of feed per month for two months. The finishing ration feed requirements are 16,971 pounds per month for three and one-half months. In total 99,000 pounds of feed are needed to feed 132 hogs from 40 to 240 pounds.

Costs of hedging include a $50 commission fee per round of trading and interest on the initial $1,200 margin requirement. Since accurate daily accounting of margin calls is not considered in this

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[2]After discussing the cost of the finishing ration feed price with local millers a price equal to 94 percent of the grower ration feed price was assumed.

analysis, a high initial margin requirement was set. The interest on the margin requirement was charged at a rate equal to the annual price rate of interest plus one percent (Council on Economic Affairs, January 1981).

Hogs are marketed in the final week of each month beginning June 30, 1978 through March 31, 1981. The respective market hog prices were taken from the weekly average of Oklahoma City cash prices for U.S. 1 and 2, 230 pound barrows and gilts.

The next step in the analysis is to explain and demonstrate the net return to the fixed factors. The equation for calculating total returns is as follows:

$$\text{Total Return} = 300 \text{ cwt} \times (\text{Net Price Received}) \qquad (1)$$

The net price change from futures trading was added to the cash price received for the slaughter hogs yielding the net price received for the slaughter hogs. The net price received times 300 cwt is the total return to all factors of production.

The hog production costs are calculated as follows:

$$\begin{array}{l} \text{Cost of 132 head of} \\ \text{40 pound feeder pigs} \end{array} = \begin{array}{l} \text{Current feeder pig price/cwt} \times \\ \times \text{ 132 head} \times \text{.4 cwt/head} \end{array} \qquad (2)$$

Equation (2) shows that the opportunity cost of raising each feeder pig group from farrow-to-feeder pig is equal to the current price per cwt of each feeder pig times the number of feeder pigs per group, 132 head, times the weight per pig, .4 cwt.

$$\begin{array}{c} \text{Grower Ration} \\ \text{Feed Cost} \end{array} = \begin{array}{l} 198.00 \text{ cwt} \times \sum_{t=1}^{2} (\text{Price of grower feed} \\ \text{ration})t \end{array} \qquad (3)$$

Equation (3) indicates the cost of the grower feed ration is calculated by multiplying the monthly quantity of feed, 198.00 cwt, times the sum of the appropriate two months' prices of grower feed ration.

$$\text{Finishing Ration Feed Cost} = .94[169.7143 \times \sum_{t=1}^{3} (\text{monthly price of grower feed ration})_t + 84.8571 \times \text{monthly price of growth feed ration}_4] \qquad (4)$$

The finishing ration feed cost is equal to the amount of feed required per month times the respective price of the grower ration times 94 percent. The total is multiplied by 94 percent since the price of the finishing ration is 94 percent of the grower ration feed price.

$$\text{Production Cost} = \text{Cost of Feeder Pigs} + \text{Grower Ration Feed Cost} + \text{Finishing Ration Feed Cost} \qquad (5)$$

The production costs considered in this analysis is simply the sum of equations (2), (3) and (4).

Another cost component is marketing cost.[3] Equations to compute each marketing cost and a description of each marketing cost are given below:

$$\text{Commission Fees} = \$50 \times \text{number of trading rounds} \qquad (6)$$

Equation (6) is the calculation of total commissions. The charge per trading round is $50. A trading round includes both the purchase and sale of a futures contract.

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[3]If the product is cash marketed then the number of trading rounds and the number of months of multiple hedging is equal to zero. Therefore, the marketing cost component becomes zero.

$$\text{Interest on Initial Margin Requirement} = \frac{\$1{,}200 \text{ x number of months of multiple hedging/12}}{\text{x annual prime interest rate plus one percent}} \quad (7)$$

The calculation of interest on the initial margin requirement is shown in equation (7). The initial margin requirement, $1,200, is multiplied by the fraction of the year multiple hedging is permitted. This number is then multiplied by the annual prime interest rate plus one percent resulting in the amount of interest on the initial margin requirement.

$$\text{Marketing Cost} = \frac{\text{Cost of Commission Fees + Interest on Initial}}{\text{Margin Requirement}} \quad (8)$$

The marketing cost is the sum of equations (6) and (7).

The final calculation is the net return to the fixed factors of production. This calculation is as follows:

$$\text{Net Return} = \frac{\text{Total Return - [Production Costs}}{\text{+ Marketing Costs]}} \quad (9)$$

The net return to the fixed factors of production is calculated by subtracting the sum of the marketing and production costs from the total return. An example of calculating the net return is given in Table XIII.

Eleven Selected Multiple Hedging Strategies

The no-hedge strategy was used as a benchmark to compare alternative multiple hedging strategies. The mean net return as well as the coefficient of variation are the modes of comparison. An ideal strategy is one which minimizes the coefficient of variation (price risk) and

TABLE XIII

AN EXAMPLE OF CALCULATING THE NET RETURN FOR COMPARING SELECTED MULTIPLE HEDGING STRATEGIES FOR HOG PRODUCERS

Returns				
Cash price received ($/cwt)	$ 48.75			
Net price change from future trading ($/cwt)	+ 2.25			
		$ 51.00		
Weight of hogs marketed (cwt)		X 300		
Total Returns				$15,300.00
Costs				
Production Costs				
Price of feeder pigs ($/cwt)	$ 35.50			
Weight of feeder pigs (cwt)	X 52.8			
Cost of feeder pigs ($)		$1,874.40		
Grower ration price ($/cwt)*	$ 17.10			
Quantity of grower ration (cwt)	X 196.00			
Cost of grower ration feed ($)		$3,385.80		
Finishing ration price, 3 months (cwt)**	$ 25.38			
Quantity of finishing ration (cwt)	X 169.71			
Cost of finishing ration feed, 3 months ($)		$4,307.24		
Finishing ration price ($/cwt)	$ 9.30			
Quantity of finishing ration (cwt)	X 84.857			
Cost of finishing ration feed, 5 months ($)		$ 789.00		
Total Production Costs			$10,356.61	
Marketing Costs				
Charge per trading round	$ 50.00			
Number of trading rounds	X 8			
Cost of commissions ($)		$ 400.00		
Initial margin requirement ($)	$1,200.00			
Interest rate charge, 9 months (%)***	X 0.105			
Cost of interest, 9 months ($)		$ 126.00		
Total Marketing Costs			$ 526.00	
Total Costs				$10,882.61
Net Return				$ 4,417.39

*Grower ration price = $\sum_{i=1}^{2}$ Oklahoma monthly price of 14-18 percent protein hog feed $_i$

= 8.50 + 8.60 = 17.10

**Finishing ration price = .94(8.60 + 9.40 + 9.00) = .94(27.00) = 25.38

***Interest rate charge = .14 X 9/12 = 0.105

increases the mean net return.[4] A satisfactory strategy would either (1) increase mean net return without significantly increasing the coefficient of variation or (2) decrease the coefficient of variation without significantly decreasing the mean net return.

Of the 11 selected multiple hedging strategies, the first 7 correspond to the 7 reoptimizing combinations described in Chapter III. The final 4 strategies were selected sets of moving average parameters also presented in Chapter III. For each strategy, multiple hedging is begun 9, 6, 3, and 2 months prior to marketing each group of hogs and corresponds to strategies denoted with the subscripts a, b, c, and d, respectively. The strategies are discussed and the results are presented below.

Results of the Multiple Hedging Strategies Employing the Reoptimization Combinations

Strategy I. Strategy I as discussed in Chapter III, used 4 months of live hog futures price data and optimized the data each month. Table XIV depicts the results of beginning this multiple hedging strategy at 9, 6, 3, and 2 months prior to marketing each group of slaughter hogs. As indicated in the table, the coefficient of variation was smaller and mean net return larger for Strategies Ic and Id than for the no-hedge strategy. The coefficient of variation and mean net return were .872 and $2,533.07, respectively for Strategy Ic, while for Strategy Id they were .886 and $2,493.17, respectively. The no-hedge strategy resulted in a mean net return of $2,339.11 and coefficient of variation of .925.

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[4]The mean net return refers to the mean net return per month.

TABLE XIV

THE MEAN NET RETURNS AND COEFFICIENTS OF VARIATION FOR THE NO-HEDGE STRATEGY AND MULTIPLE HEDGING STRATEGIES Ia-Id

Strategy	Mean Net Return	Coefficient of Variation
	($)	(%)
Ia	2265.17	1.074
Ib	2351.22	1.025
Ic	2533.07	0.872
Id	2493.17	0.886
No Hedge	2339.11	0.925

Strategy II. For this strategy, 9 months of live hog futures price data were reoptimized every 3 months then employed to signal placement and lifting of hedges. Table XV shows the results of Strategies IIa-IId and the no-hedge strategy. Although each strategy resulted in slightly higher mean net returns than the no-hedge strategy, neither IIa, IIb, IIc nor IId resulted in a lower coefficient of variation. Within Strategy II, the lowest coefficient of variation and highest mean net return was .961 and $2,419.65 associated with Strategy IIc.

Strategy III. These multiple hedging strategies employed the strategy of reoptimizing 12 months of live hog futures price data every 8 months. These results are shown in Table XVI. The mean net returns were slightly larger, yet each coefficient of variation was significantly higher than the no-hedge strategy. Among Strategies IIIa-IIId, Strategy IIIc resulted in the highest mean net return, $2,509.62, and lowest coefficient of variation, 1.018.

TABLE XV

THE MEAN NET RETURNS AND COEFFICIENTS OF VARIATION FOR THE NO-HEDGE STRATEGY AND MULTIPLE HEDGING STRATEGIES IIa-IId

Strategy	Mean Net Return	Coefficient of Variation
	($)	(%)
IIa	2405.69	1.132
IIb	2396.27	1.007
IIc	2419.65	0.961
IId	2395.28	0.963
No Hedge	2339.11	0.925

TABLE XVI

THE MEAN NET RETURNS AND COEFFICIENTS OF VARIATION FOR THE NO-HEDGE STRATEGY AND MULTIPLE HEDGING STRATEGIES IIIa-IIId

Strategy	Mean Net Return	Coefficient of Variation
	($)	(%)
IIIa	2481.78	1.169
IIIb	2483.57	1.129
IIIc	2509.62	1.018
IIId	2444.25	1.020
No Hedge	2339.11	0.925

Strategy IV. The results of multiple hedging moving average generated by reoptimizing 18 months of live hog futures price data every 6 months are presented in Table XVII. Each alternative, IVa, IVb, IVc, and IVd, resulted in a higher coefficient of variation than the no-hedge strategy. Only alternatives IVc and IVd resulted in a higher mean net return than the no-hedge strategy. Their mean net returns were $2,393.04 and $2,357.63, respectively.

TABLE XVII

THE MEAN NET RETURNS AND COEFFICIENTS OF VARIATION FOR THE NO-HEDGE STRATEGY AND MULTIPLE HEDGING STRATEGIES IVa-IVd

Strategy	Mean Net Return	Coefficient of Variation
	($)	(%)
IVa	2228.84	1.332
IVb	2285.86	1.217
IVc	2393.04	1.027
IVd	2357.63	1.029
No Hedge	2339.11	0.925

Strategy V. The coefficients of variation and mean net returns from multiple hedging with the strategy of reoptimizing 24 months of live hog futures price data every 3 months are depicted in Table XVIII. Alternative Vc indicated the most promising results of the 4 substrategies. This alternative resulted in a mean net return of $2,455.54 and a coefficient of variation of .976. The mean net return and coefficient of variation were both higher than the no-hedge strategy.

Strategy VI. Of all the reoptimization combinations used for multiple hedging, reoptimizing 24 months of live hog futures price data every 12 months indicated the best results. All alternatives resulted in higher mean net returns and lower coefficients of variation than the no-hedge strategy as depicted in Table XIX. The highest mean net return was indicated by alternative VIa, \$3,028.48. As evidenced in the table, mean net returns increased as the number of months of multiple hedging increased. Alternatives VIb, VIc, and VId resulted in mean net returns of \$2,888.18, \$2,705.18, and \$2,571.40, respectively. The coefficient of variation is lowest for alternative VIc, .879. Alternatives VIa, VIb, and VId had coefficients of variation of .909, .893, and .911, respectively.

TABLE XVIII

THE MEAN NET RETURNS AND COEFFICIENTS OF VARIATION FOR THE NO-HEDGE STRATEGY AND MULTIPLE HEDGING STRATEGIES Va-Vd

Strategy	Mean Net Return	Coefficient of Variation
	(\$)	(%)
Va	2203.92	1.180
Vb	2343.92	1.073
Vc	2455.54	0.976
Vd	2410.84	0.997
No Hedge	2339.11	0.925

TABLE XIX

THE MEAN NET RETURNS AND COEFFICIENTS OF VARIATION FOR THE NO-HEDGE STRATEGY AND MULTIPLE HEDGING STRATEGIES VIa-VId

Strategy	Mean Net Return	Coefficient of Variation
	($)	(%)
VIa	3028.48	0.909
VIb	2888.18	0.893
VIc	2705.80	0.879
VId	2571.40	0.911
No Hedge	2339.11	0.925

Strategy VII. The last reoptimization strategy used in multiple hedging also used 24 months of live hog futures price data and optimized the data every 12 months, but included options for 3 unweighted and linearly weighted moving averages in the optimization program. Table XX contains the results of this strategy. Each alternative resulted in lower mean net returns than the no-hedge strategy. Only alternative VIIc indicated a lower coefficient of variation, .901, than the no-hedge strategy.

Results of the Multiple Strategies Employing Sets of Moving Average Parameters

The next 4 strategies are not reoptimization strategies. They are selected moving average parameters which were introduced in Chapter III. The same time period and modes of comparison were used in these strategies as were used in the previous 7 strategies. The moving average parameters and their respective results are given below.

TABLE XX

THE MEAN NET RETURNS AND COEFFICIENTS OF VARIATION FOR THE NO-HEDGE STRATEGY AND MULTIPLE HEDGING STRATEGIES VIIa-VIId

Strategy	Mean Net Return	Coefficient of Variation
	($)	(%)
VIIa	1876.20	1.148
VIIb	1889.55	1.072
VIIc	2169.28	0.901
VIId	2207.70	0.979
No Hedge	2339.11	0.925

Strategy VIII. This multiple hedging strategy employed 7 and 10 day moving averages with a 26 cent penetration level. The results of this strategy with its alternatives are shown in Table XXI. All alternatives demonstrated significant improvement over using the no-hedge strategy. Alternative VIIIa resulted in the highest mean net return of $3,280.22 and had a coefficient of variation of .851. Alternative VIIIc had the lowest coefficient of variation, .802, with a mean net return of $2,603.98.

Strategy IX. The next multiple hedging strategy used a 3, 13, and 20 day moving average combination with a 9 cent penetration level. As seen in Table XXII, alternative IXa generated the highest mean net return and lowest coefficient of variation. The mean net return, $3,179.45, and coefficient of variation, .896, indicated significantly better results than the no-hedge strategy.

TABLE XXI

THE MEAN NET RETURNS AND COEFFICIENTS OF VARIATION FOR THE NO-HEDGE STRATEGY AND MULTIPLE HEDGING STRATEGIES VIIIa-VIIId

Strategy	Mean Net Return	Coefficient of Variation
	($)	(%)
VIIIa	3280.22	0.851
VIIIb	2865.51	0.867
VIIIc	2603.98	0.802
VIIId	2524.40	0.863
No Hedge	2339.11	0.925

TABLE XXII

THE MEAN NET RETURNS AND COEFFICIENTS OF VARIATION FOR THE NO-HEDGE STRATEGY AND MULTIPLE HEDGING STRATEGIES IXa-IXd

Strategy	Mean Net Return	Coefficient of Variation
	($)	(%)
IXa	3179.45	0.896
IXb	2780.71	0.967
IXc	2542.27	0.922
IXd	2442.22	0.951
No Hedge	2339.11	0.925

Strategy X. Multiple hedging Strategy X employed a 4, 10, and 12 day moving average combination with a 14 cent penetration level. The results of this strategy were also significantly better than the no-hedge strategy as indicated in Table XXIII. All alternatives performed better than the no-hedge strategy with respect to the mean net return and the coefficient of variation. The mean net return for alternatives Xa, Xb, Xc, and Xd were $3,692.39, $3,160.63, $2,716.04, and $2,562.61, respectively. The coefficients of variation were .564, .636, .738, and .840, respectively.

TABLE XXIII

THE MEAN NET RETURNS AND COEFFICIENTS OF VARIATION FOR THE NO-HEDGE STRATEGY AND MULTIPLE HEDGING STRATEGIES Xa-Xd

Strategy	Mean Net Return	Coefficient of Variation
	($)	(%)
Xa	3692.39	0.564
Xb	3160.63	0.636
Xc	2716.04	0.738
Xd	2562.61	0.840
No Hedge	2339.11	0.925

Strategy XI. The final multiple hedging strategy used a 4, 11, and 14 day moving average combination with a 17 cent penetration level. The results are contained in Table XXIV. Again, as in the previous strategy, all alternatives performed better than the no-hedge strategy. Alternative XIa showed the best results with a $3,505.30 mean net return and a coefficient of variation of .716.

TABLE XXIV

THE MEAN NET RETURNS AND COEFFICIENTS OF VARIATION FOR THE NO-HEDGE STRATEGY AND MULTIPLE HEDGING STRATEGIES XIa-XId

Strategy	Mean Net Return	Coefficient of Variation
	($)	(%)
XIa	3505.30	0.716
XIb	3051.24	0.778
XIc	2764.04	0.798
XId	2569.66	0.883
No Hedge	2339.11	0.925

Further Comparisons of Multiple Hedging Strategies

There exists a trade-off between risk and return. Some producers are willing and able to accept more risk for a higher return while other producers cannot. The decision as to which strategy a producer should choose is ultimately his own.

Tables XXV and XXVI contain a ranking of the 10 best multiple hedging strategies with respect to the mean net return and coefficient of variation. As seen in the tables, Strategy Xa resulted in the highest mean net return and lowest coefficient of variation of all strategies considered in this analysis. The performance of the remaining strategies are difficult to rank according to their performance with respect to both mean net return and coefficient of variation because of the risk and return trade-off.

TABLE XXV

RANKING OF THE TEN BEST MULTIPLE HEDGING STRATEGIES WITH RESPECT TO MEAN NET RETURN

Rank	Strategy	Mean Net Return
		($)
1	Xa	3692.39
2	XIa	3505.30
3	VIIIa	3280.22
4	IXa	3179.45
5	Xb	3160.63
6	XIb	3051.24
7	VIa	3028.48
8	VIb	2888.18
9	VIIIb	2965.51
10	IXb	2780.71
	No Hedge	2163.06

TABLE XXVI

RANKING OF THE TEN BEST MULTIPLE HEDGING STRATEGIES WITH RESPECT TO COEFFICIENT OF VARIATION

Rank	Strategy	Coefficient of Variation
		(%)
1	Xa	.564
2	Xb	.636
3	XIa	.716
4	Xc	.738
5	XIb	.778
6	XIc	.798
7	VIIIc	.802
8	Xd	.840
9	VIIIa	.851
10	VIIId	.863
	No Hedge	.925

To examine the results of this analysis more extensively, strategies which displayed lower coefficients of variation and higher mean net return than the no-hedge strategy are selected for further comparison. Table XXVII contains the distribution of net returns per head by year for each of these strategies. Although other strategies indicated higher net returns per head in some years, Strategy Xa exhibited the highest total net return per head, $28.40. Another point to note is that for all strategies the net return per head declined from 1978 through 1981. This phenomena is due to higher input costs and lower prices received for slaughter hogs during this time period. Figure 3 in Chapter I indicates that monthly net margins were below the zero level from early 1979 through mid-1980, then returned to the zero level by late 1980. For this reason, continued declines in net return are not expected.

Summary

The chapter began with a discussion of those who benefit from hog marketing studies. After introducing the model used to compare the 11 multiple hedging strategies developed in Chapter III, the discussion continued with a description of the assumptions, data sources, and calculations of the net return. Next, comparisons of the multiple hedging strategies were made with respect to mean net returns and the coefficients of variation as proxies for profits and risk. Within the presentation of results was a discussion of risk versus return.

TABLE XXVII

DISTRIBUTION OF NET RETURN PER HEAD BY YEAR AND COEFFICIENTS OF VARIATION FOR MULTIPLE HEDGING STRATEGIES WITH HIGHER MEAN NET RETURNS AND LOWER COEFFICIENTS OF VARIATION THAN THE NO-HEDGE STRATEGY

Strategy	1978	1979	1980	1981	Average	Coefficient of Variation
	($)	($)	($)	($)	($)	(%)
Xa	43.14	34.68	21.75	-4.47	28.40	0.564
XIa	50.90	31.01	17.67	-7.87	26.96	0.716
VIIIa	34.98	37.95	19.40	-25.03	25.23	0.851
IXa	47.95	31.24	15.57	-21.92	24.46	0.896
Xb	42.04	28.90	15.29	0.70	24.31	0.636
XIb	49.80	25.54	12.43	-2.06	23.47	0.778
VIa	31.80	41.38	9.87	-15.16	23.30	0.909
VIb	40.12	33.61	6.56	-2.53	22.21	0.893
VIIIb	33.94	34.12	11.91	-13.50	22.04	0.867
IXb	47.34	26.06	10.67	-14.97	21.39	0.967
XIc	44.44	21.23	11.09	7.99	21.26	0.798
Xc	37.91	22.90	12.46	6.87	20.89	0.738
VIc	43.69	23.85	8.37	6.07	20.81	0.879
VIIIc	36.89	24.91	9.97	1.41	20.03	0.802
VId	42.48	20.85	9.67	2.99	19.78	0.911
XId	42.29	18.95	11.31	4.30	19.77	0.883
Xd	37.56	20.91	12.36	2.67	19.71	0.840
IXc	42.82	20.61	9.57	0.97	19.56	0.922
Ic	38.67	20.05	10.07	10.14	19.49	0.872
VIIId	37.92	21.89	10.62	1.60	19.42	0.863
No Hedge	39.99	15.77	11.96	-0.32	17.99	0.925

CHAPTER V

CONCLUSIONS, IMPLICATIONS AND IDEAS FOR FUTURE RESEARCH

Since 1974, hog producers have experienced volatile input and output prices. Also, hog producers have needed to expand financial investments to realize economies of size resulting from technological advancements. These factors have contributed to marketing risks confronting hog producers. To aid in the management of marketing of risks, more flexible marketing techniques which can decrease price risk while maximizing profits need to be developed.

Chapter II contained a discussion of marketing techniques available to hog producers and theoretical considerations of choosing viable moving average parameters. A description and comparison of cash marketing, forward pricing, and multiple hedging were the marketing techniques considered. Production flexibility was also described and briefly discussed. Multiple hedging was considered the most appropriate marketing technique which could reduce price risk and maximize profits.

The theoretical model of test mapping, developed by Kaufman (1978), was discussed and illustrated to aid in determining more profitable moving average parameters. Dynamic and static testing were also briefly discussed.

Chapter III contained a description of the moving average technique and of the method employed to obtain optimal moving average parameters.

A direct search technique known as the Box Complex Procedure was used to locate optimal moving average parameters. In addition, this procedure was used to explore two additional questions: (1) at what frequency should the moving average parameters be reoptimized, and (2) how much data should be used for each reoptimization. The following combinations were selected to aid in answering those questions:

I. Reoptimizing 4 months of live hog futures price data every month

II. Reoptimizing 9 months of live hog futures price data every 3 months

III. Reoptimizing 12 months of live hog futures price data every 8 months

IV. Reoptimizing 18 months of live hog futures price data every 6 months

V. Reoptimizing 24 months of live hog futures price data every 3 months

VI. Reoptimizing 24 months of live hog futures price data every 12 months

To accomplish objective one, each combination was tested over futures price data beginning October 1, 1977 through March 31, 1981. After examining the results, Combination VI was found to yield the best results based on net profit resulting from short trades. Other data such as total net profit, net profit from long trades, profit per total trades and percentages of total, long and short trades were also considered. The total net profit and net profit from short trades for Combination VI were \$4,077 and \$1,621, respectively. Next, options (within the Box Complex Procedure) were expanded for Combination VI to allow for three linearly weighted or unweighted sets of moving average parameters and a penetration rule. The new combination was called Combination VII. The results of Combination VII were disappointing, as total net profit declined to -$433.00 and net profits from short trades totaled a mere $673.00. Since the results of the reoptimization combinations were not as favorable as expected, another approach was taken to locate moving average parameters which could provide better results. Instead of reoptimizing, sets of moving average parameters were tested singly over the same data set as used for testing the reoptimization combinations. Four sets of moving average parameters were selected that resulted in total net profits greater than any of the 7 reoptimization combinations. The most successful set of moving average parameters was the 4-11-14 set with a 17 cent penetration rule. This set netted $12,504.00 in total net profits with 50.0 percent of total trades resulting in a profit. In concluding the analysis of the first objective, more profit resulted by using one set of moving average parameters over the entire test period as opposed to reoptimizing at selected intervals over the test period. The evidence appears to indicate that reoptimization is only necessary when a major change in the character of the market occurs and no major changes occurred during the selected test period.

In Chapter IV, each of the reoptimization combinations and each of the sets of moving average parameters were employed to signal placement and lifting of hedges in a farrow-to-finish hog operation. To compare the selected multiple hedging strategies, several assumptions were made with respect to the hog operation. First, an opportunity cost of rearing a pig from conception to 40 pounds was charged as the initial production cost to the hog operator. The charge was equivalent to the 40 pound feeder pig price as determined at the southern Missouri market. Next, a grower feed ration was fed to the pigs from a weight of 40 to 120 pounds. A finishing feed ration was fed to the pigs from a weight of 120 to 240 pounds. Hogs were fed a total of 165 days using a 3.75 feed conversion rate. Also, a 3.85 percent shrinkage and 1.5 percent death rate were assumed for the hog operation.

In total, there were 11 multiple hedging strategies. The first 7 multiple hedging strategies were the reoptimization combinations and the final 4 were sets of moving average parameters presented in Chapter III. A no-hedge strategy was also included for comparative purposes. In addition, for each strategy, multiple hedging was permitted to begin 9, 6, 3, and 2 months prior to the marketing of each group of hogs[1] and correspond to alternatives designated with the subscripts a, b, c, and d, respectively.

Objectives two and three for this analysis were solved simultaneously. To accomplish objective two, all 11 multiple hedging strategies plus the 4 alternatives for each strategy were employed in the assumed continuous farrow-to-finish hog operation. Comparisons were made on the basis of mean net return per group of hogs and the coefficient of variation. Strategy Xa, a 4-10-12 moving average combination with a 14 cent penetration rule, resulted in the best performance. The mean net return and coefficient of variation were $3,692.39 and .564, respectively. The results compared very favorably to the mean net return and coefficient of variation of the no-hedge strategy, $2,339.11 and .925, respectively.

Objective three was accomplished by examining the results of allowing multiple hedging to begin 9, 6, 3, and 2 months prior to marketing each group of hogs. The evidence appears to indicate that the strategies which tended to show profitable trading results, as

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[1]Each group of 130 hogs was marketed monthly.

presented in Chapter III, also tended to result in higher mean net returns and lower coefficients of variation for the longer time periods. For instance, Strategies Xa-Xd resulted in mean net returns of \$3,692.39, \$3,160.63, \$2,716.04, \$2,562.61, and \$2,339.11, respectively. The coefficients of variation yielded were .564, .636, .738, .840, and .925, respectively. The mean net returns declined and coefficients of variation increased as the length of time multiple hedging was allowed to decrease. The opposite tended to occur for those combinations, in Chapter III, which showed little profit or even losses from futures trading.

Future Research

New avenues for research are everpresent. Upon completing this study, additional areas which merit research became apparent. First, other technical tools, such as point-and-figure charting, could be incorporated into the Box Complex Procedure. After optimizing point-and-figure parameters, the generated trading signals could be used in conjunction with the signals generated by moving average parameters found in this or other studies. Also, other commodities, especially the grains, could be explored to locate optimal moving average parameters to be implemented into a multiple hedging framework.

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