LONG-HEDGING FEEDER CATTLE WITH THE AID OF MOVING AVERAGES

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Long-Hedging Feeder Cattle With The Aid of Moving Averages

John R. Franzmann and Mike E. Shields*

During 1979 stockmen saw record prices for both feeder cattle and finished cattle. Feeder cattle prices reached $95 per hundred-weight and prices for slaughter steers neared $80 per hundred-weight. Yet, with record prices in the early Spring, by late Summer feeder cattle and slaughter cattle prices had decreased by 20 percent and losses of $100 per head or more were incurred on many slaughter steers and heifers. Such volatility is characteristic of cattle prices and underscores the need for sound marketing practices that permit cattlemen to manage the large price risks in a manner that maximizes monetary returns.

The feeder cattle futures market can serve the price risk management needs of both the feeder cattle producer and the cattle feeder. The feeder cattle producer can use the futures market for short hedging anticipated production of feeder cattle while the cattle feeder can use it to place long hedges in anticipation of a need for feeder cattle. The futures market in both live cattle and feeder cattle have matured into liquid, functional markets since their inception in 1965 and 1972 respectively.

With the prospect that price risk will continue and in all probability increase, hedging programs are needed which achieve optimal timing of the placement and lifting of hedges. When properly implemented, this form of risk management can lead to greater producer profits.

In an earlier study, Franzmann and Lehenbauer [1] demonstrated the usefulness of moving averages systems in a multiple hedging program for feeder cattle.[1] The results indicated that a multiple hedging program using optimized moving averages produced greater average profits and less risk compared with a no-hedge strategy. Greater average profits were also obtained as compared with a hedge-and-hold strategy, but at the cost of some increase in risk. This study updates the work by Franzmann and Lehenbauer.

The Moving Average Technique

Moving averages are a technical price analysis tool which can assist the feeder cattle hedger in deciding objectively when to place and lift a hedge, and work on Isaac Newton's first law of motion applied to price action—a price trend once established is more likely to continue than to reverse.

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Professor, Department of Agricultural Economics, OSU, and Agricultural Economist, Frenchman Valley Farmers Cooperative, Imperial, Nebraska, respectively.

[1]Multiple hedging, as the name implies, means to hedge the same commodity more than once.

A moving average of prices is a progressive average in which the number of prices used remains the same. A new price is added to the end of the series at periodic intervals, e.g. daily, as a price is simultaneously dropped from the beginning of the series.

Various weighting schemes can also be used in connection with a moving average. A linear weighting scheme consists of giving the oldest price in the series a weight of one, and then adding one to the weight of the next oldest price in the series. This process continues in a similar manner with the most recent price having the largest weight which is equal to the number of prices in the series. The divisor for a linearly weighted moving average is the sum of the weights.[2]

Buy and sell signals are generated by the "crossing over" of one moving average with respect to another moving average. Any day that the shorter length moving average crosses the longer length moving average from below, a buy signal (placement of a long hedge or lifting of a short hedge) is generated. Conversely, when the shorter length average penetrates the longer length average from above a sell signal is generated.

Three moving averages can also be used to generate buy and sell signals. The three moving averages consist of a short, medium, and long moving average. The shortest average is used to confirm the signal. For example, in order for a buy signal to be honored, the shortest moving average must be above the medium length average at the time or after the medium length average crosses the longer length average from below.

There are two basic variations in the arrangement of moving averages: (1) the length of time used in computing the average; and, (2) the amount of penetration required. The length of time used in computing the moving average involves an important tradeoff. The shorter the length of time, the more sensitive the moving average will be to any change in trend. However, the more sensitive the moving average, the greater the number of trades and the number of whipsaw losses. A longer moving average will reduce the number of trades and the number of whipsaw losses, but will signal new trends much later—with the possibility of the trend closer to completion than initiation.

The penetration rule used with moving averages is an option used in an effort to reduce false signals. Before a trade is initiated a penetration of some fixed amount may be required before the signal will be honored. Again, a tradeoff exists. Too small a penetration results in whipsaws and excess trading; too large a penetration has the effect of cutting down profit on successful signals. By determining the optimal moving average combination and penetration rule for the feeder cattle market, feeder cattle producers and cattle feeders will be better able to place and lift hedges.

Day	Closing Price		Weight		Product
n	63.00	X	4	=	252.00
n-1	62.42	X	3	=	187.26
n-2	63.27	X	2	=	126.54
n-3	64.10	X	1	=	64.10
			10		629.90

The 4-day linearly weighted average is 629.90 ÷ 10 = 62.99.

[2]Illustration of the calculation of a 4-day linearly weighted moving average. Let n be the most recent closing price.

Procedure

The March, May, August, and October contracts were used beginning with the 1975 contract year and ending with the 1979 contract year. These delivery months were treated as representative of all delivery months. The size of the open position was limited to one 42,000 pound contract for each delivery month at any point in time. The settlement price was used to calculate the moving average, and trades were executed on the same day the averages crossed.[3]

In order to simulate the real world more closely, certain trading rules were incorporated into the moving average trading program. These trading rules are:

(1) No trades are executed on days when the high and the low are equal to each other. This is based on the assumption that no trading occurred for this day.
(2) No trades are executed on days when the closing price is up or down the daily limit.
(3) Due to the threat of delivery, no new buy signals are honored after the first of the delivery month.
(4) A charge of $50 per trade is assessed for commission costs.

To facilitate the problem of finding a moving average combination that maximizes profit, a direct search technique known as the Box Complex Procedure was employed. The Complex Procedure is a hill-climbing procedure capable of solving for the optimal set of controls in a multi-variable model.

In this problem the objective function was profit and the goal of the Box Complex Procedure was to maximize the profit. The control variables were the moving average lengths and minimum penetration requirements. Upper and lower boundary constraints were placed on the control variables and combined with commands that require a logical order of moving average lengths.

Analysis of Results

Table 1 presents the net profitability of ten of the more profitable sets of averages obtained using the direct-search method. The results include profitability from both long and short positions as well as the volume of trade and the profit per trade.

The most profitable combination of averages was the 3w-4w-14 day moving average combination used with an eight cent minimum penetration. A 3-4-6 day combination with a three cent minimum penetration was also a very profitable set of moving averages.

Of the ten moving average combinations, six incorporate a three and four day average in some form for the shortest and medium length average respectively. All but one of the remaining set employed a simple three day average for the medium length average. These results indicate that some form of three and four day combinations are involved in the optimum.

The Box Complex Procedure locates a maximum, but it is difficult, in this application, to say whether it is a local or a global maximum. Therefore, the two best combinations derived from the Box Complex Procedure were subjected to further analysis. Any changes in the parameters of either weighting the averages, deleting the

[3]In practice this requires the trader to anticipate the crossing of the average and requires some additional arithmetic to be performed. Some traders prefer to place the hedges on the next day.

Table 1. Net Profits in Dollars From the Best Ten Moving Averages Selected by the Box Complex Procedure Using Feeder Cattle Futures Market Prices, 1975-1979

Lengths of Moving Averages[a]	Minimum Penetration Required[b]	Total Net Profit	Total Number of Trades	Average Profit per Trade
3w-4w-14	.08	80,981	173	468
3-4-6	.03	78,885	405	195
2w-3-14	.05	78,324	219	358
3-4w-9	.00	77,613	343	226
3w-4w-14	.05	77,514	220	352
4w-5w-16	.00	74,504	168	443
2w-3-14	.00	73,792	286	250
3w-4w-13	.08	73,521	192	383
2w-3-12	.10	72,732	223	326
3-4-8w	.01	72,404	360	201

[a]Length is in days. w denotes a linearly weighted moving average.
[b]Minimum penetration required is in $/cwt.

weighted component, or by increasing or decreasing a parameter by one day in length reduced total profits. However, changes in the minimum penetration requirement resulted in increased total profits for both combinations (Table 2).

During the period 1975-1979, feeder cattle were generally in an uptrending market. Therefore, profit from long trades was much greater than from short trades. However, profits from short trades did exist during this period and were significantly greater than the profits obtained with the 4-8w (.05) combination which had proved to be optimal in earlier research (Table 3, Table 4 and Table 5).

Table 2. Net Profits in Dollars From Selected Moving Averages Using Feeder Cattle Futures Market Prices, 1975-1979

Length of Moving Average[a]	Minimum Penetration Required[b]	Total Net Profit
3-4-6	.02	77,892
3-4-6	.03	78,885
3-4-6	.04	72,150
3-4-6[c]	.07	81,080
3w-4w-14	.06	85,046
3w-4w-14	.07	80,981
3w-4w-14	.08	80,981
3w-4w-14[c]	.09	72,582

[a]Length is in days. w denotes a linearly weighted moving average.
[b]Minimum penetration required is in $/cwt.
[c]Most profitable minimum penetration for the appropriate combination of moving averages.

Table 3. Net Profits in Dollars From Selected Moving Averages Using Feeder Cattle Futures Market Prices, 1975-1979

Length of Moving Average[a]	Net Profit			Percent Profitable			Total Number of Trades
	Long Trades	Short Trades	Total	Long Trades	Short Trades	Trades	
3w-4w-14 (.06)	71,640	13,406	85,046	60.9	41.1	50.5	182
3-4-6 (.07)	67,726	13,355	81,080	49.7	38.5	44.0	307
3w-4w-14 (.08)	69,572	11,409	80,981	56.6	41.1	48.6	173
3-4-6 (.03)	67,144	11,742	78,885	48.2	39.4	43.7	405
4-8w (.05)	59,899	1,584	61,481	50.0	37.4	43.5	416

[a]Length is in days. w denotes a linearly weighted moving average. The number in parentheses is the minimum penetration required.

Table 4. Summary Analysis of the Profitability With Net Profit in Dollars of Selected Moving Average Combinations Using Feeder Cattle Futures Market Prices, 1972-1979

Combination[a]		Net Profit		Total Profit Per Trade	Percent Profitable		
		Long Trades	Short Trades		Long Trades	Short Trades	Trades
4-8w	(0.5)	90,790	16,831	196	50.00	36.8	43.1
3-4-6	(.07)	98,841	27,586	311	51.5	38.6	44.8
3w-4w-14	(.06)	98,477	22,330	474	60.2	38.6	49.0

[a]Length is in days. w denotes a linearly weighted moving average. The number in parentheses is the minimum penetration required.

Table 5. Yearly Distribution of Profits in Dollars From Selected Moving Averages Using Feeder Cattle Futures Market Prices, 1972-1979

Combination[a]		1972	1973	1974	1975	1976	1977	1978	1979	Total
4-8w	(.05)	5,956	22,082	18,101	8,421	14,987	11,028	21,936	5,110	107,621
3-4-6	(.07)	5,893	22,218	17,234	6,460	13,677	6,295	28,554	26,096	126,427
3w-4w-14	(.06)	5,128	22,024	8,607	11,988	12,683	2,239	33,298	29,318	120,807

[a]Length is in days. w denotes a linearly weighted moving average. The number in parentheses is the minimum penetration required.

Hedging Strategies

No two feedlot operations are exactly alike nor managed in the exact same manner, making it impossible to create a single simulation that is similar in all respects to all feedlot operations. However, this simulation is meant to be as typical as possible of actual feeding operations in Western Oklahoma.

Feeder steers are placed on feed beginning the first of January 1975 and appropriate dates thereafter so as to ensure that one lot of cattle is marketed in each and every month through December 1979. This results in 56 lots of cattle being fed and marketed during the entire simulation period. Feeder steers are assumed to be placed on feed at 650 pounds for 140 days and slaughtered at a weight of 1050 pounds. A one percent death loss is assumed for each feeding period. A $1200 per contract margin requirement and an interest rate on the margin money equal to the average annual prime interest rate were assumed. It is further assumed that the feedlot feeds cattle continuously.

Feeder cattle costs are calculated in the following manner:

$$NFC_t = PFC_t \pm FCHP_{t-k,t} + IM_{fc}$$

where NFC_t = the net feeder cattle cost at time t;

t = date that feeder cattle are purchased in the cash market and corresponding hedges liquidated;

k = length of feeding period (140 days);

PFC_t = average weekly cost of 600-700 pound feeder steers at Oklahoma City for date t times number of head purchased;

$FCHP_{t-k,t}$ = profit from futures market transcations on long hedges dictated by the selected moving average combination (a $50 per round trade commission charge is included);

IM_{fc} = interest accrued on initial margin requirements ($1200 per contract times annual average prime interest rate plus one percent).

NFC_t is a cost, therefore if $FCHP_{t-k,t}$ is a positive figure this will decrease the net cost of feeder cattle, and if $FCHP_{t-k,t}$ is negative, the results are higher feeder cattle costs. The cash only position is simply the value of the cost of PFC_t, with $FCHP_{t-k,t}$ and IM_{fc} equal to zero. PFC_t and $FCHP_{t-k,t}$ must involve approximately the same number of feeder cattle or the position will be over hedged or underhedged. For this simulation a feeder cattle contract of 42,000 pounds is equal to 64 head of 650 pound feeder steers.

The margin between the costs of feeder cattle and corn and the revenues from the sale of finished cattle was computed as follows:

$$PM = LC_{t+k} - NFC_t + CC_t$$

where: PM = production margin

LC_{t+k} = Value of the finished cattle at slaughter time

CC_t = cost of corn at time t.

Two hedging strategies were examined. Strategy I is a no-hedge strategy representing complete exposure to price risk. Strategy II is a multiple hedging strategy which employs signals from the 3-4-6 set of moving averages with a $0.07 penetration rule to place and lift hedges. In Figure 1, the points on the graph represent the production margin for each of the 56 lots of 190 head of cattle marketed from May, 1975 through December, 1979. As Figure 1 indicates, complete exposure to price risk results in both large profits and losses for the cattle feeder.

The production margins derived from the simulation vary from a negative $85.23 per head to a positive $225.54 per head. Nine of the 56 lots marketed resulted in feeder cattle and corn costs greater than the gross value of the fat cattle. (Figure 1) The standard deviation about the mean for Strategy I is $14,563 with the coefficient of variation equal to 1.10. The mean production margin is $13,182.

Figure 1 shows that the production margin for each feeding period during 1975 was greater than the mean of the complete test period. This is in contrast with 1976 and 1977 where only one lot of cattle produced a margin above the mean. These two years proved to be the least profitable for cattle feeders. The year 1979 illustrates the price risk associated with feeding cattle. Both the second most profitable lot and the least profitable lot occurred in 1979, only four months apart.

Figure 2 shows the production margin when feeder cattle were multiple hedged. The multiple hedging strategy reduced the number of negative margins to only two lots. The maximum production margin achieved under this strategy was $269.98 per head

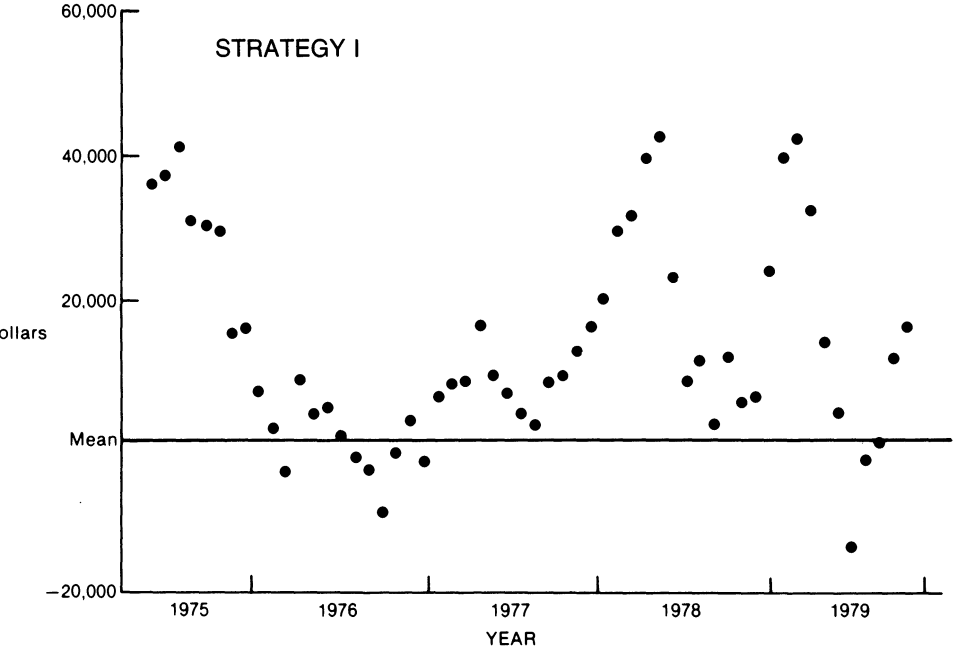

Figure 1. Simulated Production Margin for each Lot of Cattle Marketed Under Strategy with No Hedging, May, 1975-1979

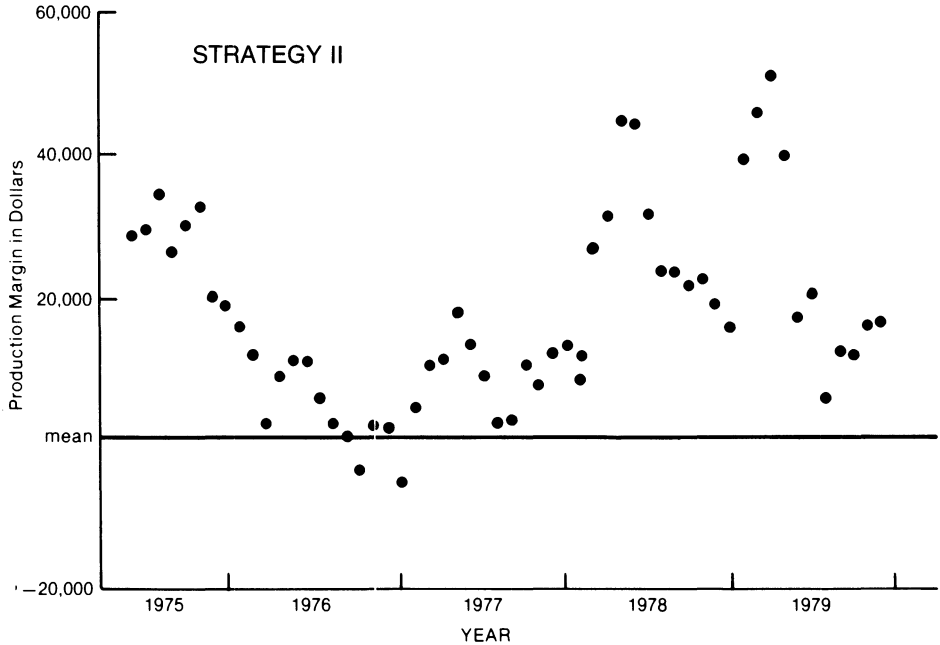

Figure 2. Simulated Production Margin for Each Lot of Cattle Marketed Under Strategy With Feeder Cattle Multiple Hedged, May, 1975-1979

Table 6. Futures Market Profits From Long Hedging Of Feeder Cattle, 1975-79[a]

Month Cattle Marketed	1975	1976	1977	1978	1979
			Dollars		
January		2068	-725	-486	3533
February		2832	-218	-1846	5524
March		2832	1100	-1056	2391
April		837	1110	-48	3067
May	-1909[b]	3020	947	1093	2711
June	-662	2459	1257	841	1081
July	-662	2354	732	2857	6180
August	-486	2072	-283	5318	7568
September	1131	1834	922	4239	5575
October	2558	2366	795	6578	4260
November	2118	734	-242	3798	1577
December	892	0	493	4738	422
Total	2980	23408	5888	26026	43889

[a]Hedging transactions are based on buy and sell signals from the 3-4-6 (0.07) moving average combinations.

[b]Net profits from hedging transactions are in dollars per futures contract including a $50 per round trade commission fee but excluding interest charges on the margin funds.

and the minimum margin was -$22.32 per head. The standard deviation and coefficient of variation for the production margin were $13,556 and 0.73, respectively. Using the multiple hedging strategy, the average cost of the 192 head of feeders was reduced from $59,798 to $54,457 or a savings of $27.82 per head purchased. The standard deviation and coefficient of variation associated with the cash costs of the 192 head of feeders had a value of $21,999 and 0.37 respectively. When the moving averages were employed for multiple hedging, the comparable statistics were $18,293 and 0.34, respectively.

Use of the moving average technique for hedging purposes does not guarantee futures markets profits with which to reduce the costs of feeder in each and every production period. Table VI illustrates the profits and losses generated from the long hedging of feeder cattle over the period 1975-1979. The fact of consecutive losses in the period April-August in 1975 and the period January-April 1978 underscores the need for familiarity with such hedging systems and the discipline to follow the system long enough to reap the potential benefits. The totals for each of the years reveals significant variability over time and suggests that operators should not build an expectation for the future on any one year's results.

Summary

Instability in the political and general economic environment, changes in the degree of competition from pork, chicken and other products, and changes emanating from regulatory agencies seem destined to provide cattlemen with highly volative market prices for their finished product and for some of their major resources. Such volatility increases the market risk producers will face. Successful cattle feeders will be able to manage these market risks.

One method of managing market risk is to multiple hedge the feeder cattle resource in the futures market, employing some technical device to regulate the placement and lifting of the hedges.

In this study the Box Complex Procedure was used to ascertain the most profitable set of moving averages to incorporate into the hedging program. The results indicate that over the 1972-79 period a 3-4-6 ($.07) set of moving averages was optimal.

A simulation was developed to correspond with a continuous feedlot operation in Northwest Oklahoma. Feeder cattle were placed on feed at a rate such as to ensure the marketing of one lot of cattle each month. This resulted in 56 lots of cattle being fed and marketed during the simulation. The difference between the feeder cattle costs plus corn costs and the return from the sale of slaughter cattle, called a production margin, was calculated and analyzed for two strategies—a no hedge strategy and a multiple long hedging strategy for the feeder cattle input.

The results indicated that over the period 1975-79 a strategy of multiple hedging of feeder cattle inputs with the use of a set of optimized moving averages reduced the cost of this resource to the feedlot and also reduced the price risk as compared with a strategy of not hedging.

Although profits were enhanced by the multiple hedging technique, this result did not occur with every lot of cattle. On about 80 percent of the lots, profits were enhanced through multiple hedging feeder cattle. The multiple hedging strategy reduced costs of feeder cattle by an average of $27.82 per head.

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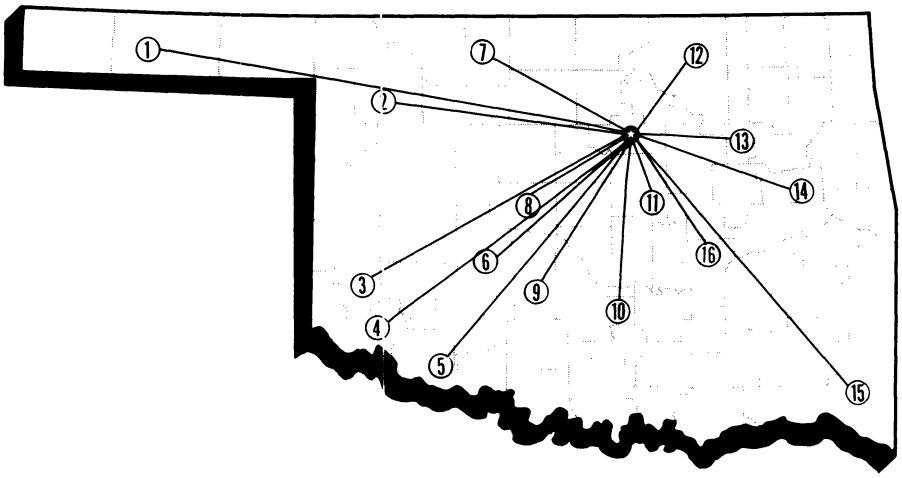

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