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Michael A. Hudson, Robert J. Hauser,
and T. Randall Fortenbery

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Commodity Futures Versus Commodity Options:
An Analysis of Price Risk Management Strategies
for Commercial Cattle Feeders

Michael A. Hudson, Robert J. Hauser,
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Price risk management strategies for cattle feeders have received considerable attention in the research literature.^{1/} Typically, a mean-variance approach is used to evaluate a variety of strategies for timing the placement of hedges on live cattle or integrated hedging strategies involving some combination of live cattle, feeder cattle, and feed grain. The initiation of trading of live cattle options in late 1984 greatly expanded the number and types of price risk management strategies available to feedlot operators. However, since options on live cattle futures are a new phenomenon, little work has been done in comparing price risk management strategies using options versus futures.^{2/} This paper offers a preliminary comparison of these risk management alternatives.

The objectives of this study are: (1) to simulate returns to cash market, put options, and short hedging strategies using live cattle futures prices settled during 1974-1982 and (2) to compare two alternative methods for ranking the strategies in a risk efficiency context.

*The authors are, respectively, Assistant Professor, Assistant Professor, and Research Assistant in the Department of Agricultural Economics of the University of Illinois at Urbana-Champaign. The research reported herein was supported by a grant from the University of Illinois Research Board.

Price Risk Management Strategies

Price risk management strategies were simulated over the period from January 1974 through December 1982. Closing futures prices for each contract month were used. Cash prices used were weekly averages of central Illinois quotes.^{3/} Option prices were estimated with the Black formula, using the historical variance calculated with futures prices over the previous 40 trading days and a constant annualized interest rate of ten percent.

The commercial feedlot is assumed to have a 1,000 head capacity. One pen (192 head) of 650 pound feeder steers is placed at the beginning of each month. The cattle are kept on feed for approximately 150 days. Assuming a 2.8 pound per day rate of gain and a two percent death loss, 190 head are marketed at 1070 pounds on the last day of the fifth month on feed. Five futures or options positions are required for each pen to be fully hedged. A total of 103 pens were finished and marketed during the study period.

The five marketing strategies simulated were:

Cash Market (CASH) - All cattle were priced in the cash market at time of sale, assuming a three percent shrink.

Routine Hedge (RHEDGE) - All cattle were hedged routinely at time of placement using the nearest futures contract which matured at least six months in the future to assure that offset would occur prior to the delivery month. For example, cattle placed in January were hedged on the June futures contract, whereas cattle

placed in February were hedged on the August contract, etc.

Routine Put (RPUT) - All cattle were priced via the purchase of an at-the-money put option on the nearest futures contract which matured at least six months in the future. In cases where the option expired prior to the physical sale of the cattle, the option was offset (if the intrinsic value was nonzero) on the day prior to its expiration. In all other cases, the option was offset at the time the cattle were sold.

Moving Average Hedge (MAHEDGE) - All cattle were hedged by acquiring a short position in the futures market when the first sell signal was generated by a 7/13 day moving average after the cattle were placed on feed.^{4/} The hedge was lifted when the 7/13 day moving average indicated a buy signal and was replaced on the next subsequent sell signal, etc. If a short position was held when the cattle were sold, it was liquidated at that time.

Moving Average Put Option (MAPUT) - All cattle were priced by purchasing an at-the-money put when the first sell signal was generated by the 7/13 day moving average after the cattle were placed on feed. The option position was offset when the moving averages indicated a buy signal. If an option position was held when the cattle were sold, it was liquidated at that time. Option positions held one day prior to expiration were offset if the option had a nonzero intrinsic value.

Returns (in dollars per cwt.) for the above strategies were computed for each pen by adding the gain/loss from the strategy to the cash market outcome. Commissions and potential slippage (caused by the inability to trade at the closing price) were accounted for with a \$.15 per cwt. deduction per transaction for both futures and options positions.^{5/}

Comparing Price Risk Management Strategies

The most frequently used criterion to evaluate returns to hedging strategies is mean-variance (E-V) efficiency. However, the mean-variance approach, suggested by Markowitz, requires that the decision maker be risk averse. In addition, E-V analysis requires either that the distribution of the returns be normal or that the decisions maker's utility function be quadratic.

Stochastic dominance with respect to a function is a more discriminating efficiency criterion that allows for greater flexibility in incorporating decision maker preferences by allowing the ordering of uncertain choices for decision makers whose absolute risk aversion lies within specified upper and lower bounds (Meyer).^{6/} Although King and Robison demonstrate that the criterion does not always reduce the efficient set to a minimal number of strategies, examination of the returns to options and futures risk management strategies in this context will indicate how risk preferences affect the choice among alternative price risk management tools.

Ranking the Strategies

Trends in the simulated return streams for each hedging strategy were examined prior to ranking the risk management strategies. The trend analysis was motivated by the observation of a strong upward trend in the cash price series. Each return stream for the 1974-82 period was regressed on time. If the estimated coefficient was significantly different from zero at the 95 percent level, the returns were detrended in the following manner. The estimated model was used to forecast the next observation beyond the sample period. The forecast values for each strategy were added to the respective residuals to generate a detrended series. All of the return streams exhibited significant time trends and were thus detrended in this manner.

Probability distributions for the detrended return streams were generated by assigning equal probabilities to each sample point. The distributions were then ranked using the stochastic dominance algorithm developed by Meyer.

The procedure developed by Meyer depends on the Arrow and Pratt measure of local risk aversion, $r(x) = -U''(x)/U'(x)$, where x is generally income or wealth and U represents the decision maker's utility function. The sign of $U''(x)$ indicates whether the decision maker is risk averse [$U''(x) < 0$] or risk preferring [$U''(x) > 0$]. However, because $U''(x)$ is affected by linear transformations, its absolute magnitude does not reveal risk attitude. The Arrow-Pratt measure avoids this problem by expressing the degree of risk aversion as $r(x)$, allowing any utility function to be expressed in standardized units.

Table 1. Risk-Aversion Coefficients.

Utility Group	r(x)	
	Lower Bound	Upper Bound
Group 1	-.04000	-.03000
Group 2	-.03000	-.02000
Group 3	-.02000	-.01000
Group 4	-.01000	.00000
Group 5	.00000	.00125
Group 6	.00125	.00250
Group 7	.00250	.00500
Group 8	.00500	.00750
Group 9	.00750	.01000
Group 10	.01000	.01500
Group 11	.01500	.02000
Group 12	.02000	.03000

The upper and lower bounds of the risk aversion coefficient used in the analysis are presented in table 1. These bounds define of these intervals identify utility groups based on the level of absolute risk aversion possessed by the decision maker. Negative values of $r(x)$ indicate risk proneness and positive values of $r(x)$ indicate risk aversion. When $r(x)$ is equal to zero the decision maker is risk neutral. The intervals in table 1 were selected to cover the range of risk aversion coefficients reported in previous studies (e.g., Kramer and Pope and Tauer). Empirical evidence indicates that many individuals would fall within utility group 5 (King and Robison). This is further supported by the Kramer and Pope argument that "if one assumes the certainty equivalent is to surpass the lowest observation 90% of the time, then most decision makers would be in the lower portion of the risk averse range (positive but close to zero) for constant risk-averse bounds and using most of the distributions studied" (p. 124).

Results

The detrended return streams for each strategy were first examined in a mean-variance context. Table 2 presents the mean and variance for each return stream. The highest mean return is realized with the moving average hedge strategy (MAHEDGE). Relative to the MAHEDGE strategy, the cash market return is \$3.78 lower, but the CASH variance is only slightly lower, suggesting that under most risk preference assumptions the MAHEDGE strategy would be preferred to the CASH strategy. The CASH strategy produces a higher mean return than the routine hedge (RHEDGE), routine put (RPUT), and moving average put (MAPUT) strategies. Although the variance of the RHEDGE approach is less than the variance of the CASH strategy, the RPUT and MAPUT variances are both larger than the CASH variance.

The mean-variance comparisons suggest the CASH strategy would, for risk averse decision makers, be preferable to either of the put options strategies (RPUT or MAPUT). The CASH strategy may also be preferable to the RHEDGE strategy given the large reduction in mean return associated with the lower variance. The reduction in both return and variance from routine hedging is consistent with past studies (e.g., Purcell, Hague, and Holland; Leuthold, McCoy and Price).

Using stochastic dominance with respect to a function, as suggested by Meyer, the strategies were examined to obtain more specific information on the effects of decision-maker preferences on strategy selection. The stochastic dominance rankings are presented in table 3. Each strategy is compared to the cash strategy. A "1" in the table indicates that the strategy is

Table 2. Mean-Variance Comparisons of Alternative Price Risk Management Strategies for Cattle Feeders, Detrended Series, 1974-1982.

Strategy	Mean*	Std. Dev.
CASH	71.4816	5.3473
RHEDGE	62.0469	3.0503
RPUT	71.1555	7.9537
MAHEDGE	75.2663	5.6371
MAPUT	67.4534	5.6823

* The means were generated for the detrended return streams and therefore are in levels which reflect the forecasts from the detrending models for prices during January 1983.

Table 3. Stochastic Dominance Ranking of Hedging Strategies.

CASH Versus	Utility Group											
	1	2	3	4	5	6	7	8	9	10	11	12
RHEDGE	1	1	1	1	1	1	1	1	1	1	1	1
RPUT	0	0	0	1	1	1	1	1	1	1	1	1
MAHEDGE	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
MAPUT	1	1	1	1	1	1	1	1	1	1	1	1

Note: A "1" indicates that the cash market return is preferred and a "-1" indicates preference for the price risk management strategy. A "0" indicates that the group is not unanimous in its ranking.

dominated by the cash strategy, a "-1" indicates that strategy dominates the cash strategy, and a "0" indicates the ranking is not unanimous for the utility group.

As suggested by the mean-variance estimates, the MAHEDGE strategy dominates the CASH strategy for all utility groups considered. The stochastic dominance rankings are also consistent with the mean-variance implications in that both the RHEDGE and MAPUT strategies are dominated by the CASH strategy for all utility groups. The ranking for the RPUT strategy, however, is not unanimous for risk prone decision makers.

Conclusions

Based on this analysis of simulated price risk management strategies for commercial cattle feeders, the following conclusions are offered:

1. With regard to futures strategies, (a) routine hedging strategies reduce the variance of returns, but at the cost of a significant decrease in mean return levels and (b) moving average hedging strategies can provide significantly higher mean returns while not markedly increasing their variability. This result is consistent with previous findings (e.g., Purcell, Hague, and Holland; Leuthold; Erickson).
2. During the 1974-82 period, routine put purchases made when the cattle were placed on feed provided a similar mean return to the cash market strategy, but increased the variance considerably. Consistent with previous hedging results, this result suggests that put options should be used selectively (for example, when prices are expected to move lower).

3. The stochastic dominance results suggest that put options are preferred by some risk prone individuals. This finding seems counter intuitive, given the similarity of put options to insurance and the perception that risk averse individuals will purchase insurance. However, Hauser and Eales reach similar conclusions based on dominance arguments within a target-deviation framework. Further research is needed to clarify this result across methodology, time period, and for other put option strategies.

4. Finally, as illustrated in the preceding point, stochastic dominance provides additional information not obtainable through mean-variance. The information obtained with this technique, in the form of identifying dominant strategies within regions of risk attitudes may provide valuable information for price risk management and education.

Suggestions for Further Research

Although limited in scope, the above results provide insight into the long-run performance of various price risk management strategies and into the usefulness of stochastic dominance analysis as a method for ranking these strategies. There are, however, many additional topics which should be pursued in this methodological context, some of which are offered below:

1. Additional option strategies should be examined, including writing call options, purchasing out-of-the-money puts, and selective options strategies (e.g., purchasing puts only when declining prices have been forecast). The use of technical signals in conjunction with options strategies also merits further investigation.

2. Strategies which combine futures and options should be examined. In the period over which the current return streams were simulated, prices increased steadily. Despite detrending of the returns, put options performed as perhaps expected in that the cash market outperforms the put option in a rising market. An integrated strategy, which employs both futures and options based on market forecasts (e.g., Brandt) may outperform strategies which rely only on futures or options.
3. Investigation should be directed to the use of options in a "ratio hedging" context whereby options are traded in proportion to the degree of comovement of futures prices and option premiums.
4. Cash flows for the strategies should be examined and incorporated into the analysis. The amount of capital required to trade each of the strategies will likely have an impact on their ranking in a stochastic dominance or mean-variance context.
5. The research should be replicated with actual or simulated feedlot data to provide insight into how the strategies could be used by feedlot operators (e.g., Carter and Lyons). This type data would also allow the inclusion of long hedges (using futures and options) on feeder cattle and feed grains to assess the usefulness of these strategies.
6. The current research suggests that the results may be sensitive to the time period of analysis, particularly when comparing options with futures. Therefore, if strategies are identified which are clearly dominant, they should be replicated in a post-sample evaluation to verify their performance. An alternative approach would be to generate prices based on the

observed distribution of prices during the study period, allowing evaluation of strategy performance, perhaps in a Monte Carlo context.

Footnotes

- 1/ See, for example, Purcell, Hague, and Holland; Leuthold; McCoy and Price; Erickson; Shafer, Griffin, and Johnston; Leuthold and Mokler; Caldwell, Copeland, and Hawkins; or Peterson and Leuthold.
- 2/Catlett and Boehlje consider options versus futures for live cattle hedging and a recent, unpublished manuscript by Sporleder and Winder examines options versus futures for live cattle in the mean-variance context. Hauser and Eales measure risks and returns of hedging live cattle sales with options using probability distributions implied by observed option premia.
- 3/ Cash and futures price data were obtained from tapes provided by the MJK Associates, Inc., and Iowa State University. The January futures contract was traded for a short time during the study period but was not included in the analysis.
- 4/ The 7/13 day moving average was advocated throughout the 1970s by a Merrill Lynch, Pierce, Fenner, and Smith, Inc. in periodic trading reports. Several studies have examined optimal moving averages for live cattle. In the most recent study, Franzman and Shields suggest that a 3/4/7W (3 day, 4 day, 7 day weighted) set of moving averages was the optimal combination during the 1975-1979 period. However, it would

be unfair to evaluate the performance of an optimal moving average combination over the period for which it was optimized. Future research efforts will examine reoptimization of the moving average on a year-to-year basis.

5/The \$.15 per cwt. deduction represents a \$60 round turn charge on each trade. Margin requirements and cash flows for the strategies were not considered.

6/For a more complete review of efficiency analysis and the use of stochastic dominance to rank distributions, see King and Robison or Kramer and Pope. Anderson, Dillon and Hardaker provide a thorough treatment of the theory.

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