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Hedging on the Live Cattle Futures Contract

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Feeders who wish to hedge should consider more than the price for which they sell a fed cattle futures contract. They should also consider the efficiency of the hedge and the expected effective price which results from hedging. This is shown by selected comparisons of results for fed cattle marketed in Chicago, Phoenix, and Denver, May 1965 through December 1968.

Key words: Hedging, futures trading, cattle prices.

Hedging on the futures market has been used by many cattle feeders as protection against adverse changes in the price of fat cattle occurring within the feeding period. However, the results of a hedging operation, i.e., the amount of reduction in price uncertainty and the actual net price received for the hedged cattle, vary considerably depending upon the case in question. The results of a hedging operation are strongly influenced by the location of the feeder. Since at a point in time the price of the spot cattle futures contract is based primarily upon the Chicago cash market, regional differences in the level and seasonality of cattle production often lead to situations where the actual net price received by a feeder for hedged cattle differs considerably from the price for which he sold the futures contract. In addition, where delivery against the contract is not economically feasible, the relationship between the price for which the futures contract is sold and the net price received on a hedged contract may change over time.

The purpose of this paper is to investigate the relationship between the results of a feeder hedging on the live cattle contract and the location of the feeder. The investigation is a partial analysis, in that it explores only the relationships between spot and futures market prices for fed cattle. The prices of inputs are not considered. Specifically, this paper is concerned with developing estimates of the change in fed cattle price variability, hereafter referred to as "the efficiency of the hedge," and monthly estimates of the closeout basis[1] for three markets—Chicago, Denver, and Phoenix. The latter estimates are used to calculate the realized price, hereafter referred to as the "effective hedged price."

The Denver and Phoenix markets were chosen for this analysis because feeders marketing their live cattle based on prices in these markets find that it is by and large economically infeasible to make delivery against a Chicago futures contract. Consequently, the uncertainty relating to a hedging operation is particularly pronounced in these cases. The Chicago market is included for comparative purposes.

The first step in the analysis is the formulation of a theoretical model of the hedging operation. The theoretical model designed to provide estimates of the effective hedged price is then used as the basis for an empirical analysis of the actual relationships existing in the Chicago, Phoenix, and Denver markets from May 1965 through December 1968.

The Effective Hedged Price

A hedge against product price changes involves the cattle feeder making offsetting transactions in the live cattle cash and futures market. Thus, the price results of a hedge can be expressed as:

$$EP = FS + B - TC \qquad (1)$$

where

EP = effective hedged price
FS = price for which contract is sold
B = closeout basis (this is the price for which cattle are sold minus the price for which the contract is bought back)
TC = transaction cost of hedging

[1] Closeout basis refers to the difference between the price for which a feeder sells his fat cattle and the price at which he buys back the futures contract.

The above equation defines the effective hedged price.[2] The efficiency of a hedge depends directly upon a comparison of the variability of the effective hedged price with the variability of the cash price and is best defined in relation to the concept of an ideal hedge.

An Ideal Hedge

An ideal hedge may also be defined in terms of equation (1). Given the above definition of the effective hedged price, an ideal hedge can be defined as a hedge under which the effective price received by the feeder for his fat cattle is exactly equal to the net sales price of the futures contract (sales price of the futures contract minus the transaction cost). The significance of an ideal hedge is directly related to the reduction of variability in the effective price. From the definition of the effective price (equation 1), it is obvious that under the conditions of an ideal hedge, the price variability is zero, since at the time the hedge is placed, the only unknown is the basis. Under the ideal hedge, the closeout basis equals zero and, therefore, introduces no uncertainty into the effective price.

A Realistic Example

Very seldom does the theoretical norm appear as an economic reality, and the operation of hedging is no exception. The ideal hedge is seldom achieved because of the factors of time, location, weight, and quality. The earlier the sale of the fat cattle before the closing date for the futures contract, and the further the cattle feeder is from the delivery point, the more the uncertainty about the basis.

An obvious feature of a nonideal hedge is that the effective price the feeder receives for his cattle does not equal the net sales price of the futures contract, but instead equals the net sales price of the futures contract plus the closeout basis. In addition, if the closeout basis has as a component random or unpredictable elements, a second feature of a nonideal hedge is a degree of risk in the effective price equal to the variability in the basis. The output price risk is equal to the variability of the closeout basis since all other components of the effective price are known to the feeder at the time he places the hedge.

The rest of this research is concerned with investigating the nature of this basis for the Chicago, Denver, and Phoenix fat cattle markets.

The hypothesis to be tested is:

Ho: The level, seasonal pattern, and variability of the closeout basis in the cattle futures market differs among areas.

To test this hypothesis, a multiple linear regression technique using a dummy variable for each month was employed.[3] The following specific model was fitted to weekly data from each area:

$$B = bj + e$$

where

B = closeout basis
bj = estimate of closeout basis for month j
e = random term

Thus, the expected effective price for a hedged contract in a cattle feeding area is equal to the net sales price of the futures contract plus the monthly estimate of the closeout basis bj. Note that this is only an expected effective price, for the closeout basis is influenced by a random effect as well as the expected monthly pattern. A comparison of the variance of the random component of the basis provides a measure of the efficiency of the hedge. This comparison is presented in terms of a ratio of the variances, which may be used directly to test for the reduction in variability by application of an F-test. For this comparison, seasonal influence in the cash market was removed by fitting a regression model of the same form as the model used to estimate the basis, i.e., dummy variables for each month were used as the independent variables.

The data used in this study are prices of 900-1,100-pound Choice steers as reported by USDA's Consumer and Marketing Service for the three markets studied, and the Chicago Mercantile Exchange weekly closing prices for the live cattle contract with the nearest closing date. For example, the closeout basis for the Denver market during the second week in May would be calculated as the Denver cash market price for

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[2]This applies to a commodity which is not storable. For the corresponding definition of effective hedged price for storable commodities, see Jerome L. Stein. "The Simultaneous Determination of Spot and Future Prices." Amer. Econ. Rev., Vol. 51, pp. 1012-25, Dec. 1965.

[3]For a discussion of "dummy variable" regression, see Arthur S. Goldberger. Econometric Theory. John Wiley and Sons, Inc., New York, 1964.

900-1,100-pound Choice steers minus the closing price of the June futures contract for the second Friday in May. The data used in the analysis apply to the period May 1965 through December 1968 (192 weeks).

Results

Expected Effective Price

The adjustments, which must be added to the price for which a feeder sells a futures contract to determine the expected effective price (the closeout basis), are presented in table 1.

As was expected, the general magnitude of these adjustments was greater for Arizona and Colorado feeders than for Illinois feeders. An *F*-test was performed to test whether all of the coefficients for each regression were equal to zero. This hypothesis was accepted for the Illinois hedge and rejected for the Arizona and Colorado hedge at the 1 percent confidence level.

Table 1.—Estimates of the monthly closeout basis for the Chicago, Denver, and Phoenix live cattle markets

Item	Region		
	Chicago	Denver	Phoenix
Month:			
January	0.065	-0.957	-0.718
February	-0.024	[a]-1.537	-0.585
March	[a].345	[a]-1.645	[a]-.139
April	-.039	[a]-1.546	[a]-.217
May	-.059	-1.138	[a]-.425
June	-.416	-.767	[a].192
July	-.498	[a]-.489	[a]-.156
August	-.345	[a]-.551	-.784
September	-.163	[a]-.582	-.947
October	.028	-1.117	-1.649
November	[a].384	-.933	[a]-1.450
December	-.218	-.930	-.941
Mean of basis	-.097	-.976	-.670
R squared	.135	.298	.376
F statistic	2.558	[b]6.938	[b]9.855
Standard error	.690	.584	.715
Standard deviation of cash price	1.224	1.105	1.251
Efficiency of the hedge (ratio of variances)	[c]3.147	[c]3.580	[c]3.061
Number of observations	192	192	192

[a]Significantly different from the December estimate at the 95 percent level.

[b]The hypothesis that all regression coefficients equal zero was rejected at the 99 percent level.

[c]The variances were significantly different at the 95 percent level.

Therefore, the expected effective price for an Illinois feeder is the price for which he sells the futures contract. For an Arizona or Colorado feeder, the expected effective price is the price for which he sells the futures contract plus or minus the estimated adjustment. For example, if an Arizona feeder sells a contract for $27 a hundredweight for cattle which will be ready to sell in November, the expected effective price is $25.55 per hundredweight (27 – 1.45).

The seasonal pattern of the basis is different for the Phoenix and Denver markets. The data analyzed indicate that the most favorable closeout basis for Colorado feeders occurs in the last half of the year, while for Arizona feeders the most favorable period is in the first half of the year (see table 1).

Efficiency of the Hedge

The reduction in price variability was of a similar order of magnitude for all markets. The ratio of the price variance in the cash market to the price variance for hedged cattle ranged from 3.06 to 3.58. The hypothesis that hedging reduces price variability of cattle feeding was accepted for all markets at the 1 percent confidence level (see table 1).

Conclusion

Feeders who are considering use of the Chicago live cattle futures contract as a means of reducing product price risks, must consider more than just the price for which they sell a futures contract. They must, as pointed out by the Phoenix example, consider both the efficiency of the hedge and the expected effective price which results from hedging. While the estimates presented in this article may not be directly applicable to any given feeder's decision process, nevertheless, the model and results are offered as usable in their present form.

Ideally, of course, the feeder's decision model would also include expectations relating to price trends in the product and input cash market. When expectations of product cash prices and input costs are included in a feeder's decision model, a choice can be made between the expected profit of hedged cattle versus the expected profit associated with utilizing the cash market, and the associated price risks. It is suggested that further research to provide a theoretical and empirical basis for the integration of the hedging decision into the feeder's total decision-making process would prove fruitful.