Cross Hedging Cull Cows

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Cull cow sales are an important component of cow-calf producer profitability, representing 15 to 25 percent of ranchers' gross income. Cow-calf producers, cow feeders, and processors face significant price risk. For example, from January 1995 to December 1996, Dodge City Boner cull cow prices ranged from $29.41 per hundredweight to $48.00 per hundredweight Similar variability prevails across other locations and cow grades. Given this variability, it is important that cow-calf producers, cull cow feeders, and cow processors have some mechanism to manage price risk.

Currently, there is no futures market in which to directly hedge cull cows. One alternative is to use live cattle futures as a cross hedge. However, the Chicago Mercantile Exchange (CME) is introducing a new futures contract that provides better risk protection for cull cows than live cattle futures.

90-percent lean, boneless beef futures is the new contract being offered by the CME. This new futures contract provides producers, packers, processors, and retailers the opportunity to reduce their price risk by hedging in a commodity market more closely linked to cull cow prices. The purpose of this bulletin is to explain how to cross hedge cull cows in the 90-percent lean, boneless beef futures contract and to examine the associated hedging risk. This analysis uses weekly data from several locations and across several cow grades.

Lean Beef Futures Contracts

The 90-percent lean, boneless beef contract is to be traded in 20,000-pound increments and will be cash settled based upon the volume-weighted, 5-day average, USDA wholesale price. The weighted average settlement price will be based on transactions for fresh 90-percent lean, boneless beef, at Omaha, Neb., and Texas-Oklahoma. The cash settled price will be calculated using volume-weighted prices from the five most recent trading days, which are reported by the USDA Market News on the *National Carlot Meat Report*. Options on this futures contract will expire on the same day and time as the futures. The exercise price will be specified in 2-cent-per-pound intervals. The new futures contract will be traded with expiration months of February, April, June, August, October, and December. Trading will cease on the sixth to last business day of each contract month, except in December, when it will end on the tenth business day.

Cross Hedging

Because no futures contract for cull cows exists, a cross hedge is necessary to hedge cull cows. Cross hedging involves hedging a commodity in a futures contract of a different commodity. Generally, when hedging cash commodities in similar futures commodity contracts, a hedging relationship of one-to-one is assumed (i.e., the futures quantity equals the cash quantity being hedged). However, this may not be appropriate when cross hedging because the cash and futures prices might not change on a one-to-one basis. For example, cull cow prices and 90-percent lean, boneless beef futures prices may change differently than one-to-one because they represent different, but related, commodities. This implies different quantities of cash commodity are needed to minimize risk associated with value changes in the hedged relative to cash position. To determine the size of the futures position to take for a given cash position, a hedge ratio needs to be estimated. The hedge ratio provides an estimate of the size of the futures position relative to the cash quantity needed to minimize hedged price risk.

Cow Markets Analyzed

Several geographic cull cow market locations were analyzed to determine differences in the hedge relationship. Weekly cull cow price data for Sioux Falls, S.D.; Sioux City, Iowa; and Oklahoma City, Okla., were collected from the United States Department of

Agriculture *Livestock, Meat, and Wool Market News* for the period of 1991 through 1996. In addition, Torrington, Wyo. and Dodge City, Kan. weekly cull cow price data were compiled from the United States Department of Agriculture, Agricultural Marketing Service, Livestock Market News in Torrington and Dodge City, respectively. Prices were collected for Commercial, Breaker, Boner, and Cutter cow grades. Prices for Commercial cows in Oklahoma City and Dodge City were not used because of infrequency of quotes.

Live cattle weekly average closing futures prices for the nearby contract were collected from the CME. Historical futures price data for the newly approved CME 90-percent lean, boneless beef contract do not exist. Therefore, the 5-day moving-volume-weighted average of 90-percent lean, boneless beef price series, the prices at which the contract will cash settle, was used as a proxy for the closing cash-settled lean futures price and was obtained from the *National Carlot Meat Report* (USDA) provided by the CME.

Results

Hedge ratios for hedging cull cows with the 90-percent lean, boneless beef contract are reported in Table 1. Hedging risk (basis plus hedge ratio) can be determined by the R-squares and root mean squared percentage errors (RMSPE) reported. Locations with R-squares closer to 1.0 and RMSPEs closer to 0.0 have lower risk associated with hedging in the lean futures contract. When the R-square is close to 1.0 and the RMSPE is small, the cull cow price is highly correlated with the lean futures price and basis risk is low. Torrington tends to have slightly lower R-square values for all quality grades, ranging from 0.70 to 0.79, than the other four locations. Across the remaining locations, the R-square values range from 0.84 to 0.91, with the strongest relationship occurring in Oklahoma City.

Table 1. Cross Hedge Estimates for Hedging Cull Cows in 90-percent Lean, Boneless Beef Futures, 1991-1996.

Location/ Quality Grade	Hedge Ratio[a]	Constant	RMSPE[b]	R-Square	No. Obs.
Sioux Falls					
Commercial	0.398 (49.49)[c]	2.934 (3.20)	6.00	0.89	305
Breaker	0.348 (44.66)	5.716 (6.45)	6.18	0.87	306
Boner	0.347 (50.34)	2.910 (3.71)	5.85	0.89	306
Cutter	0.380 (54.16)	-2.958 (-3.71)	6.28	0.91	306
Sioux City					
Commercial	0.350 (40.52)	8.396 (8.54)	6.43	0.84	306
Breaker	0.380 (46.14)	4.437 (4.74)	6.21	0.88	306
Boner	0.382 (46.62)	3.021 (3.25)	6.34	0.88	306
Cutter	0.412 (45.60)	-2.743 (-2.67)	7.38	0.87	307
Oklahoma City					
Breaker	0.332 (50.79)	6.705 (9.01)	5.25	0.90	299
Boner	0.347 (54.38)	5.391 (7.44)	5.09	0.91	302
Cutter	0.366 (52.49)	2.921 (3.69)	5.60	0.90	302
Dodge City					
Breaker	0.358 (32.63)	5.870 (4.74)	7.25	0.84	205
Boner	0.339 (43.43)	8.479 (9.56)	5.80	0.87	278
Cutter	0.408 (48.60)	-1.862 (-1.95)	6.75	0.89	300
Torrington					
Commercial	0.278 (26.54)	14.281 (11.94)	8.37	0.70	298
Breaker	0.279 (27.04)	14.192 (12.07)	8.30	0.71	301
Boner	0.322 (32.68)	8.713 (7.77)	8.18	0.78	309
Cutter	0.328 (33.79)	4.679 (4.24)	8.63	0.79	303

[a]Hedge Ratio represents pounds of futures per pound of cull cow hedged.
[b]RMSPE is root mean squared percentage error which is RMSE as a percentage of the respective average cull cow price.
[c]Numbers in parenthesis are t-statistics for testing whether parameter is different from zero.

No particular quality grade results in the highest R-square across all locations. In general, however, the Boner grade has the lowest RMSPE in all locations except Torrington with an average of 6.66 percent. This means that, on average, about two-thirds of the time, the net price received from cross hedging cull cows in lean futures will be within 6.6 percent of the expected price. Although there were differences between locations and quality grades, the hedge ratios were similar across both attributes. The mean hedge ratio was 0.353 with a standard deviation of 0.037. This ratio indicates that when placing a hedge, the futures contract quantity needed is 0.353 times the cash quantity being hedged.

A related Kansas State University study determined which futures contract (90-percent lean, boneless beef; 50-percent lean; or live cattle futures) provided the least amount of risk to cross hedge cull cows. Any of these contracts could be used to hedge cull cows, however, the least amount of risk would be associated with the 90-percent lean, boneless beef contract.

The R-Squares using 90-percent lean, boneless beef suggest a lower-risk hedge than using 50-percent lean or live cattle futures. In addition, the RMSPEs were less than half as large in the 90-percent lean, boneless beef contract compared to the other two contracts, indicating basis risk would be much lower using 90-percent lean, boneless beef than the alternatives.

A couple of limitations regarding these results are important to consider. First, because the 90-percent lean, boneless beef futures market was not yet trading, futures prices for these commodities did not exist. Therefore, the 5-day, volume-weighted, moving-average, USDA boxed-beef cash price data, to which these contracts will cash settle, were used as proxy variables for the unavailable futures prices for each respective commodity. How close the futures prices will track these cash price series, especially in nondelivery months, is not yet known. If cull-cow prices are not as highly correlated with 90-percent lean, boneless beef futures prices as they are with the settlement price index, the model may underestimate hedging risk.

Second, numerous factors affect cow and cull-cow prices across pens in a particular auction. This study used USDA-reported prices for particular markets and cow grades. Price of any particular pen of cows sold can vary substantially as quality of the cows varies. This suggests that on a pen-by-pen basis, hedging risk associated with cross hedging cull cows using any of the contracts examined are greater than those presented here using USDA price quotes.

Hedge Ratio Example

An example of how the hedge ratio could be used to hedge cow sales in the 90-percent lean, boneless beef futures contract is described here.

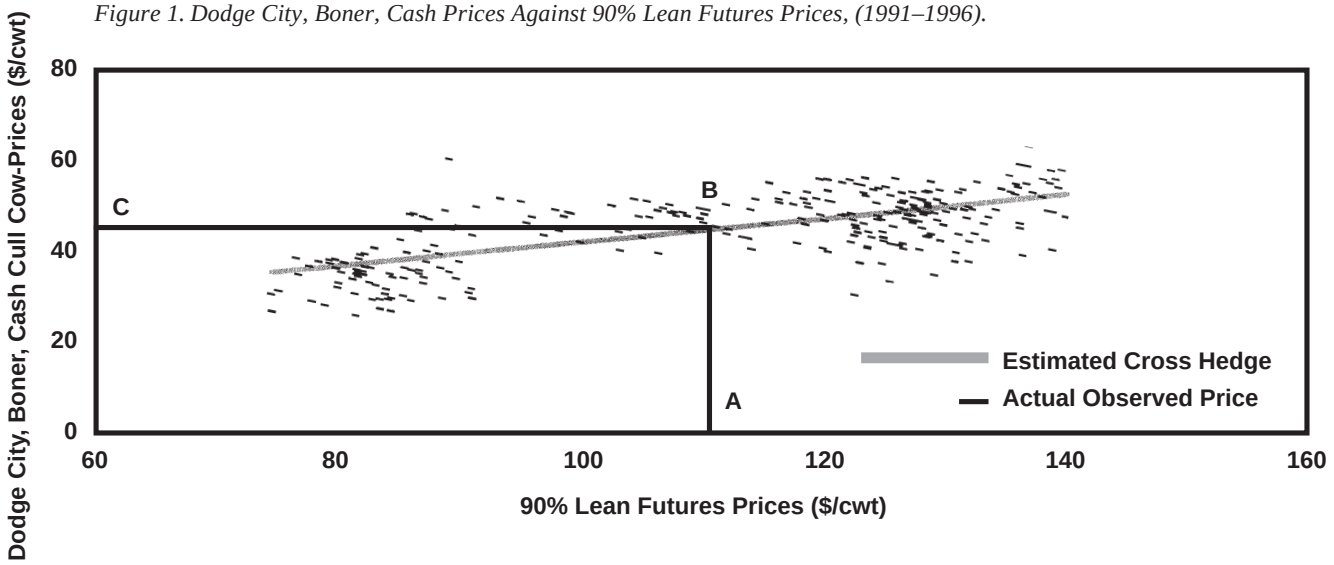
Suppose a cull-cow feeder wanted to reduce price risk by hedging the selling price of cull cows in Dodge City, Kan., using the December 90-percent lean, boneless beef futures contract. In June, the futures price is $110 per hundredweight and the hedge ratio for Dodge City Boner cows is 0.339 (Table 1). The expected cull cow price (EP) could be calculated using the following equation:

$$EP = \beta_0 + \beta_1 (90\%\text{Lean, Boneless beef})$$

Where β_0 is the constant from the regression, and β_1 is the hedge ratio. Applying the numbers from Table 1 and the constant to the equation, EP = 8.479 + 0.339 × $110 per hundredweight, the expected cull-cow price is $45.77 per hundredweight The number of cows actually hedged per futures contract can be found using a second equation:

$$\text{Pounds of cows hedged} = \frac{\text{Pounds per futures contract}}{\beta_1}$$

Figure 1. Dodge City, Boner, Cash Prices Against 90% Lean Futures Prices, (1991–1996).



Using the same hedge ratio, recall that one contract of 90-percent lean, boneless beef is 20,000 pounds, the pounds of cull cows to hedge would be 58,997 (20,000 pounds ÷ 0.339). Converting this to number of head, using a 1,000 pound cow, yields approximately 59 cows.

Figure 1 provides a graph of the cull-cow cash price as a function of the 90-percent lean, boneless beef futures price. This is an alternative method with which to forecast the cash price and hedge ratio for cull cows, given the futures price.

The cull cow cash prices for Dodge City Breakers were plotted from 1991 to 1996, and an estimated line was then fit through these points. To determine the expected cash price, move vertically from the futures price, on the horizontal axis, to the fitted line. Once this point is found, move horizontally to the associated cash price on the vertical axis. This will be the expected cash price for cull cows, given the futures price.

For example, using the futures price given above, $110 (point A), and moving vertical to the fitted line (point B) and then horizontally to the cash price (point C), it can be seen, once again, that the expected cash price is approximately $45. The hedge ratio is the slope of the fitted line, 0.339. This indicates that when the 90-percent lean, boneless beef futures price increases by $1.00 per hundredweight, the cash cull-cow price typically increases by $0.34 per hundredweight.

For many cow-calf producers, hedging 59 cull cows is not feasible. For example, in 1996 the average cow herd size was only 39 head (USDA), and cow culling rates would typically be less than 20 percent of the herd annually. Unless individual small operations are able to combine cull cow sales with others, this contract would not be a viable hedging mechanism for them. This contract is more viable for packers or those feeding larger numbers of cull cows.

Conclusion

The most viable contract for hedging cull cows is the 90-percent lean, boneless beef contract. When applying this model, the estimated hedge ratios indicate that the total pounds of cull cows to be hedged would be roughly three times greater than the total pounds in the lean futures contract. Given contract size specifications of 20,000 pounds, roughly 60 cows (assuming 1,000 pounds per head average weight) would be cross hedged per 90-percent lean, boneless beef contract.

Implementation of this 90-percent lean, boneless beef futures contract, in general, may allow producers to reduce the risk they face. However, given contract size specifications, the contract is too large for most cow-calf producers to use directly. Therefore, to hedge, these producers would need to group cull-cow sales with other producers. Alternatively, cow packers could more readily offer forward contract prices to cow-calf producers and cull-cow feeders and, by pooling cows from several producers, offset their risk by cross hedging these forward-contracted cows in the 90-percent lean, boneless beef contract.

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