LOCATION BASIS VARIABILITY EFFECTS ON SLAUGHTER CATTLE HEDGING IN THE SOUTH AND SOUTHERN PLAINS*

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Location basis variability is a matter of potential concern to livestock producers who contemplate the use of livestock futures contracts as hedging devices and who are removed from a designated futures contract delivery point. Recent attention has been given this problem by Heifner [3] in an analysis of minimum-risk hedging ratios for cattle and hogs, among other commodities, in which measures of risk-shifting effectiveness were generated for comparison among locations. Heifner found no significant differences among locations for either cattle or hogs, indicating that location basis variability is not a significant factor for these commodities. Using a somewhat different approach, and a different set of markets and time frame, the author [1] came to the same conclusion for slaughter hogs in the South. Results obtained for slaughter cattle, however, are somewhat at variance with the findings reported by Heifner. These results and their interpretation are the subject of this paper.

The concept of location basis variability is fairly straight-forward. Location basis is the price differential between a local cash market and a futures contract delivery point. Basis variability results from fluctuations in this differential. Hedgers who have access to the delivery market tend to be insulated from its effect by the delivery option and the consequent tendency for cash and futures prices to converge as futures contracts mature. For hedgers in distant markets, however, delivery is not a practical option, so that any difference between the price differential expected at the placement of a hedge and the actual differential experienced upon lifting it causes a deviation in results from those anticipated. Thus, location basis variability can add an increment of risk for the distant hedger, reducing the effectiveness of hedging as a risk-averting device.

Location basis variability is not theoretically inherent in the situation of a distant hedger but depends rather on the nature of spatial competition. In perfectly competitive spatial markets, price change will be reflected simultaneously across the spatial price surface, leaving differentials along the surface unchanged. These differentials reflect spatial patterns of supply and demand and transfer and exchange costs. In theory, they change only as these underlying factors change. In the real world, however, leads and lags in price change can occur, and some markets may be isolated from minor price fluctuations that occur in others. In a broad national market such as exists for beef cattle, price differentials tend to be maintained over time, but this does not exclude the possibility of temporary fluctuations which could cause location basis variability to occur.

The existence and magnitude of location basis variability is, therefore, an empirical question. While there are a number of ways to measure location basis variability, the method adopted in this study was a direct comparison of hedging revenue variances. If it can be shown that price variances among markets are not significantly different from one another, then differences in hedging revenue variances between a delivery point market and distant markets can be ascribed to location-related factors. To anticipate a bit, no significant differences in cash market price variances for choice steers were found among the markets studied, but significant differences in hedging revenue variances were found.

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*Kentucky Agricultural Experiment Station Article No. 73-1-74.

MARKETS AND LENGTHS OF HEDGES STUDIED

Three fed cattle markets in the South and Southern Plains were selected for use in the study. These were Kentucky, Georgia, and the Southern Plains region of Texas and Oklahoma. Omaha was selected as the contract delivery point reference market. Prices used for the four markets were weekly average prices as reported by the USDA Market News Reporting Service. Futures contract prices used were weighted weekly averages of daily prices. Minor reporting differences occur in the cash price series. Prices for Omaha and Kentucky are reported from terminal market sales while Georgia prices are reported on an at-plant direct basis, and Southern Plains prices are reported F.O.B. feedlot with a 4 percent shrink. While these reporting differences have some minor effect on the level of price differentials among markets, no effect on variances occurs. No scalar change in reporting basis is involved as would be the case in live-weight versus carcass-weight comparisons.

A total of 21 successive live cattle futures contracts and their hedging results were observed from January 1969 to June 1972. This period encompassed a structural change in the live cattle futures contract in that, beginning with the August 1971 contract, Omaha became the par delivery point. Before, Omaha had been a delivery point but at a 75¢ per hundredweight discount. At the same time, Guymon, Oklahoma, which is in the Southern Plains marketing region, was designated a delivery point at a $1 per hundredweight discount. The discontinuity caused by this structural change was accounted for in the analysis by the use of within-contract variances only, that is, the variances within the 2-month span of each contract. Since the change occurred between contracts, this procedure abstracted from its effect. The Southern Plains market was considered to be a distant market despite the location of a delivery point within it. Justification for this lay in the fact that the delivery point was established only for the last year of the 3-1/2 year study period and because, as shown by Crow, Riley, and Purcell [2], the delivery discount is so unrealistically large as to render the point ineffective anyhow.

Three lengths of hedge were postulated for purposes of the study. These were a long-term (30-week), a medium-term (21-week), and a short-term (13-week) hedge. These hedge lengths correspond to feeding periods required to carry light, medium, and heavy weight feeder steers to a finished weight of 1,000-1,050 pounds, as shown by National Research Council rate of gain standards [5].

HEDGING MODEL

The procedure used to calculate hedging revenue was as follows:

(1) $R_{ijt} = P_{it} + S_{jm} - L_{mt}$

where:

R_{ijt} is hedging revenue in market i for hedging period j in week t,

P_{it} is the average price for choice steers in market i, week t,

S_{jm} is the price at which cattle were sold short in the week prescribed by hedging period j in the delivery month m contract, and

L_{mt} is the price at which the same contract was purchased in week t.

The model is descriptive of the hedging process that was postulated, with calculation of hedging revenues being oriented on the marketing date. Hedges were assumed to be placed routinely at the weekly average price 30, 21, and 13 weeks prior to the marketing date. Choice steer futures contracts are established for delivery every other month, February through December. For marketings in a delivery month, hedges were assumed to be placed in that contract up to the week containing the 20th of the month, the date on which contracts normally expire. Marketings for the latter part of the month were hedged in the succeeding contract, as were marketings in the following month.

The model takes an *ex post* view of the hedging process, in which results are measured on the basis of realized revenues.[1] Hedging revenues are compared on a hundredweight for hundredweight basis, so the model does not provide for portfolio-type analyses of hedging strategies, such as the derivation of hedged/unhedged inventory ratios. The model abstracts from commission charges and interest charges on margin deposits since these would tend to be equal in all markets.

Hedging revenues were generated on a weekly basis for the study period, and pooled variances were calculated for comparisons between markets. Pooled cash market price variance is defined as:

[1] An *ex ante* view of hedging can also be adopted, as shown in [1] and elsewhere, in which hedge placement is the reference period for measuring results. *Ex ante* measures have the advantage of being independent of length of hedge, but on the other hand they are dependent on the hedgers' basis expectations. Since expectations cannot be measured from market data, the *ex post* formulation was adopted here.

$$(2)\quad Var(P_i) = \sum_{mt}^{MT_m} \sum (P_{it} - \bar{P}_{im})^2 \Big/ \sum_{m}^{M} T_m - M$$

$m = 1,2,\ldots M$

$t = 1,2,\ldots T_m$

where:

$Var(P_i)$ is within-contract pooled variance for price in market i,

$\bar{P}_{im}$ is average price in market i for cash prices corresponding to contract m,

M is the number of contracts observed (21), and

T_m is the number of cash prices associated with contract m.

Pooled hedging revenue variance is defined in similar fashion as:

$$(3)\quad Var(R_{ij}) = \sum_{mt}^{MT_m} \sum (R_{ijt} - \bar{R}_{ijm})^2 \Big/ \sum_{m}^{M} T_m - M$$

$m = 1,2,\ldots M$

$t = 1,2,\ldots T_m$

where:

$Var(R_{ij})$ is within-contract pooled hedging revenue variance in market i for hedge length j,

$\bar{R}_{ijm}$ is the mean hedging revenue in market i, hedge length j, in contract m, and other variables are as previously defined.

RESULTS

Results of the analysis are summarized in Table 1. Means and standard deviations of cash market prices and hedging revenues for the four markets are presented. Means are included as a matter of general interest, but the primary focus of the analysis is on the variances. F-ratios calculated for Bartlett's test of equality of variances are presented in the right-hand column of the table. They refer to the variances (standard deviations squared) appearing on their respective rows. All standard deviations in the table were calculated from pooled within-contract variances for the variables indicated.

At the 5 percent level of significance, no differences were found between cash market price variances. On the other hand, differences were found between hedging revenue variances for all three hedging periods at the same level of significance. These results indicate that location basis variability was a factor in the distant markets during the study period. Cattle feeders in these markets apparently could not have hedged as effectively during the study period as feeders with access to the Omaha market.

Inspection of the standard deviations presented in Table 1 indicate something of what occurred to hedging revenue variances as the length of hedge was altered. Compared to cash markets, it can be seen that the 30-week hedge caused a general reduction in revenue variances, though the reduction was proportionately greatest for Omaha. As length of hedge was reduced, to 21 weeks and then to 13, there was a tendency for revenue variances to increase, although, with the exception of the Georgia market, they remained below the corresponding cash market price variances. Revenue variances for Omaha remained below those for other markets, with the exception of the 21-week hedge in the Southern Plains. This exception will be discussed in the next section. Increasing revenue variance is accounted for by a tendency for futures contract price variances to increase as the contracts approached maturity. That is, prices at which the shorter-length hedges were placed tended to be more variable than some weeks before, when the longer-length hedges were placed, even though the contract maturity dates were the same.

INTERPRETATION OF HEDGING REVENUE VARIANCES

A better understanding of how location basis variability affects hedging revenue can be gained by examining the components of hedging revenue variance. These components can be derived from equation (1) and are as follows:

$$(4)\quad Var(P_{ijt}) = Var(P_{it}) + Var(S_{jm}) + Var(L_{mt}) + 2\,Covar(P_{it}, S_{jm}) - 2\,Covar(P_{it}, L_{mt}) - 2\,Covar(S_{jm}, L_{mt})$$

where the variables are as previously defined. Of primary interest is the covariance term linking cash market prices with prices at which futures contracts are covered, Covar (P_{it}, L_{mt}). This is the term which shows how closely local market prices are tracking with futures market prices as the futures contract nears maturity. Because of the delivery option, this relationship can be expected to be fairly close in a delivery market. It may be close in distant markets as well, but if so, the linkage works through the delivery market rather than with the futures market directly.

Covariances can be further decomposed to correlation coefficients, which provide standardized measures of the cash-futures price relationships. The correlation coefficients for the cash market-maturing futures contract price relationships for the four markets were as follows:

Table 1. CHOICE STEER PRICE AND HEDGING REVENUE SUMMARY STATISTICS FOUR MARKETS, JANUARY 1969 - JUNE 1972

Item	Omaha	Kentucky	Georgia	Southern Plains	F-Ratio, Bartlett's Test[a]
	dollars per hundredweight				
Price					
Mean	31.13	31.12	31.75	31.01	
Std. Dev.	.86	.94	.87	.97	1.10
Hedging Rev. (30 Weeks)					
Mean	28.65	28.63	29.15	28.49	
Std. Dev.	.64	.78	.82	.76	3.28*
Hedging Rev. (21 Weeks)					
Mean	29.07	29.06	29.60	28.92	
Std. Dev.	.74	.85	.94	.75	4.96*
Hedging Rev. (13 Weeks)					
Mean	29.64	29.62	30.20	29.49	
Std. Dev.	.74	.85	.93	.87	2.66*
No. of Observations[b]	179	182	160	180	

[a]*Significant at the 5 percent level. Critical value of F is 2.60.

[b]The study period covered 182 weeks. Variance estimates were obtained for each contract in each market, despite missing observations.

1. Omaha . . . . . +.76
2. Kentucky . . . . . +.69
3. Georgia . . . . . +.58
4. Southern Plains . . . . . +.72

While the differences between these coefficients were not large, such differences as did exist were amplified by a multiplier of 2 and were primarily responsible for differences in hedging revenue variances among markets. As was to be expected, Omaha had the highest correlation coefficient, indicative of its delivery point status.

It is another covariance term which explains the low variance for the 21-week hedge in the Southern Plains. The covariance between cash prices and prices for hedges placed 21 weeks previously, Covar (P_{it}, S_{jm}), in this market was negative and sufficiently large to reduce revenue variance to a level equal to that at Omaha. It seems perverse to find that what amounts to a negative price forecast will reduce variance and so improve hedging effectiveness, but it is nevertheless so.[2] This seeming quirk may explain the disparity between Heifner's results and the findings of this study with respect to the Southern Plains market. Heifner found little difference in hedging effectiveness between Omaha and the Southern Plains, but he assumed a 4-month hedge which was terminated prior to the delivery month [3, p. 22]. Thus, Heifner's hedge placements were at about the same point in time as in the 21-week hedge used in this study. Little is known about the behavior of choice steer futures prices over the life of a contract, but it is conceivable that length of hedge

[2] For a somewhat similar effect in portfolio analysis, see Markowitz [4, pp. 113-114].

has some quasi-forecasting effect on revenue variability.

CONCLUDING REMARKS

This study has shown that location basis variability was a significant factor in three Southern and Southern Plains markets for choice steers during the period 1969 to mid-1972. Hedgers in these markets would not have been able to operate with the same degree of risk-shifting effectiveness as hedgers in the Omaha area. This does not mean that hedging would have been totally ineffective in these markets. Variances of hedging revenues were consistently below their respective cash price variances in Kentucky and the Southern Plains. In Georgia, however, this was only true for the 30-week hedge. It is clear that location basis variability reduces the level of potential hedging activity. Analyses such as Heifner's show that optimum hedged/unhedged inventory ratios vary inversely with the risk-shifting effectiveness of the hedge [3, p. 29]. Thus, location basis variability reduces the supply of hedges that might be forthcoming from these markets and so should be concerned to the futures trading fraternity as well as to cattle feeders.

A final word should be said about the hedging revenue means in Table 1. They were all lower than their respective cash market means, which quantifies what is obvious to the most casual observer of cattle prices over the past few years: that hedging has been a money-losing proposition. Cash prices have been rising, and futures prices have persistently underestimated the increase. This might be taken as evidence of bias in the price formation process for choice steer futures. On the other hand, it seems more likely that it is symptomatic of the general forecasting problem that has plagued the livestock industry in recent years, in which cattle and beef prices have been persistently underestimated. Since futures markets are more nearly places where forecasts are put into effect than where they are made, it is not surprising that choice steer futures prices should suffer the same forecasting malady as the rest of the industry.

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