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## EFFECTS OF LOCATION BASIS VARIABILITY ON HEDGING OF SLAUGHTER HOGS IN THE SOUTH\*

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The location basis variability aspect of hedging commodities in futures should be of especial concern to Southern hog producers who might contemplate hedging in the live hog futures market. Location basis variability affects hedgers who, like Southern hog producers, are distant from designated futures contract delivery points and cannot, as a practical matter, make (or take) physical delivery to discharge their obligation under a futures contract. To liquidate hedges, Southern producers would have no real alternative but to market hogs locally and purchase offsetting futures contracts. Any change in the spatial relationship of hog prices between the time a hedge was placed and when it was lifted causes a disparity between the intended and actual outcome of the hedge, hence, the term location basis variability. Hedgers with access to a delivery-point market are more or less insulated from its effect, because of the delivery option. Since hedging is presumably conducted to reduce the effects of price variability on the enterprise, location basis variability stands as a potential barrier to the usefulness of hedging to Southern hog producers.

The question as to whether this potential barrier is an actual barrier is essentially an empirical one. Is location basis variability in Southern markets in fact significant? That is, if one were to compare the results of hedging hogs on feed in the South with the results obtained by producers with access to a delivery-point market, holding grades constant, would one find significant differences in the variances of the results? The purpose of this paper is to report the findings of just such an inquiry.

While the study is strictly applicable only to one period of time, calendar year 1971, and to the particular markets considered, the results indicate virtually no trace of location basis variability. Variances of hedging results in the Southern markets studied were not significantly different from variances in the delivery-point market.

### MARKETS AND GRADES STUDIED

Three Southern hog markets were selected for use in the study. These were the Western Kentucky (Purchase Area) buying stations, the Southeast direct market (southwestern Georgia and adjacent areas of Alabama and Florida), and the North Carolina auctions. By Southern standards, these are regions of concentrated slaughter hog production and marketing, and their markets have the virtue of daily price reports. In selecting the delivery-point comparison market, the par delivery market of Peoria, Ill., was passed over in favor of Omaha, Neb., which is also a delivery market, but at a 50 cent per hundredweight discount, according to current contract specifications. Omaha was selected over Peoria because of the apparent wider dissemination of Omaha market prices in Southern news media and because of its long standing as a premier livestock market. For these reasons, Southern producers interested in hedging are perhaps more likely to look to Omaha as a basis of comparison.

Prices in the Kentucky buying station market and the Southeast direct market are reported on the U.S. grading system, as is Omaha. North Carolina auctions, however, are reported for "North Carolina

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top hogs." Prices for lesser grades are not reported. "North Carolina top hogs" do not necessarily conform to U.S. grade standards, but they are said to be generally comparable to U.S. 1's and 2's weighing 200-220 pounds [3].

### HEDGING MODELS

Two hog production and marketing systems were postulated for purposes of calculating hedging results. So far as hedging is concerned, the two systems differ by the length of run of the hedge. The longer run system was a farrow-finish operation, in which a hedge is placed when pigs are farrowed and lifted 174 days later, when the finished hogs are assumed to be marketed. The other system was a specialized feeding enterprise, in which 50-pound feeder pigs are purchased and fed to market weight. The hedge is placed when the feeder pigs are acquired and lifted 106 days later, when the finished hogs are marketed. The lengths of the hedges, 174 and 106 days respectively, are derived from National Research Council growth rate standards and expected lengths of time necessary to achieve a weight of 225 pounds [5].

The general model for calculating hedging revenue is as follows:

$$(1) R_{ijgt} = P_{igt} + S_{jm} - L_{mt}$$

where  $R_{ijgt}$  is hedging revenue in market  $i$  for hedging system  $j$  for hogs of grade  $g$  on market date  $t$ ,

$P_{igt}$  is the cash market price in market  $i$ , grade  $g$ , date  $t$ ,

$S_{jm}$  is the price at which hogs were sold short on the date corresponding with hedging system  $j$  in the delivery month  $m$  futures market, and

$L_{mt}$  is the price at which the same contract is purchased on date  $t$ . The model is descriptive of the hedging process that was postulated. It allows for comparisons of hedging with cash marketing on a hundredweight-for-hundredweight basis for purposes of measuring location and grade basis variability. It does not provide for portfolio-type analysis of hedging strategies. Calculation of hedging revenues was oriented on the marketing date. Hedges were assumed to be placed 174 and 106 days prior to the marketing date. If a hedge fell on a weekend or holiday, it was placed on the next available date. Hedges were assumed to be lifted on the date hogs were marketed or on the next available date in the few cases where holidays did not coincide.

Hedges were placed in contracts for delivery in the marketing month, up to the 15th of that month, and in the succeeding contract after the 15th. Marketings in months without futures contracts were

hedged in the next succeeding contract. Use of the 15th of a contract month as the cut-off point rather than the 20th, when contracts normally expire, was a conservatively oriented procedure and was adopted to avoid liquidity problems that might arise closer to the contract expiration date.

Comparability of hedging results is an issue which merits some consideration. Cash market price means and variances and their hedging revenue counterparts can be generated, but are they comparable among markets? The answer is that differences among means are to be expected because of spatial differentials and differences in type of market at which prices are reported. Variances, on the other hand, can be hypothesized to be equal among markets for similar grade and weight reporting ranges. This follows from the theory of competitive spatial price equilibrium. For a homogeneous commodity, the theory indicates that price changes will be reflected uniformly among spatially separated markets, leaving spatial price differentials unchanged [1]. Uniform price changes over time result in equal price variances among markets. Differences among means will, in the simplest case, just equal transfer costs among markets.

In the current case, differences in exchange costs arising from differences in types of markets at which prices were reported are also contained in the observed prices. However, the commodity itself remains homogeneous, with only slight variations in grade and weight ranges among markets. No scalar change in the magnitude of price change is involved as would be the case if physically transformed products were being compared, e.g. live hogs versus dressed carcasses. Differential exchange costs will, therefore, behave in the same manner as transfer costs and will not affect price variances. The exceptions to this argument are (1) major changes in transfer or exchange costs which might have taken place during the study period, or (2) the markets are not competitive. While equality of cash market price variances is not a sufficient condition to test these larger issues, it is a necessary condition for low location basis variability and is subject to empirical verification along with the question of equality of hedging revenue variances.

### HEDGING REVENUE RESULTS

Hedging revenues were calculated on a daily basis for calendar year 1971 for the two postulated production-marketing systems. Means and variances of cash hog prices and hedging revenues for the four markets in 1971 are presented in Table 1. Bartlett's test of equality of variances was employed to test the hypotheses of equality of variances of cash market

Table 1. HOG PRICE AND HEDGING REVENUE SUMMARY STATISTICS, BY GRADE, FOUR MARKETS, 1971

—dollars per cwt. and (dollars per cwt.) <sup>2</sup> —			
A. Omaha Terminal Market (252 observations)			
Grade	U. S. 1-2 (200-220 lbs.)	U. S. 1-3 (200-240 lbs.)	U. S. 2-4 (240-270 lbs.)
Cash Market			
Mean	19.31	19.03	18.36
Variance	2.39	2.45	2.45
Hedging Revenue			
1. Farrow Finish			
Mean	20.36	20.09	19.41
Variance	2.57	2.61	3.01
2. Feeder Pig-Finish			
Mean	19.25	18.97	18.29
Variance	4.58	4.78	5.20
B. Kentucky Buying Stations. <sup>a</sup> (254 observations)			
Grade	U. S. 1-3 (200-240 lbs.)	U. S. 2-4 (190-240 lbs.)	U. S. 2-4 (240-260 lbs.)
Cash Market Price			
Mean	18.56	18.14	17.73
Variance	2.72	2.79	2.85
Hedging Revenue			
1. Farrow-Finish			
Mean	19.61	19.20	18.79
Variance	2.83	2.88	2.89
2. Feeder Pig-Finish			
Mean	18.48	18.07	17.66
Variance	4.77	4.81	4.84
C. Southeast Direct (251 observations)			
Grade	U. S. 1-2 (200-230 lbs.)	U. S. 2-3 (190-240 lbs.)	U. S. 2-4 (240-270 lbs.)
Cash Market Price			
Mean	18.46	17.83	17.33
Variance	2.52	2.62	2.66
Hedging Revenue			
1. Farrow-Finish			
Mean	19.51	18.88	18.39
Variance	2.97	3.06	3.10
2. Feeder Pig-Finish			
Mean	18.41	17.77	17.28
Variance	4.81	4.88	4.90
D. North Carolina Auctions (242 observations)			
Grade	North Carolina Top Hog		
Cash Market Price			
Mean	17.96		
Variance	2.71		
Hedging Revenue			
1. Farrow-Finish			
Mean	19.03		
Variance	2.98		
2. Feeder Pig-Finish			
Mean	17.91		
Variance	4.79		

<sup>a</sup>A fourth grade of heavy hogs is reported for Kentucky but not included here.

prices and of hedging revenue variances. For the latter, tests were made by hedging system, as it is evident from inspection of Table 1 that the feeder-finish system had considerably higher variances than the farrow-finish system. Computed F-ratios for Bartlett's test for cash market prices, the farrow-finish, and the feeder pig-finish systems for the highest grade range reported in each market were 1.60, 1.06, and 0.31 respectively. The critical value of  $F(3, \infty)$  at the 5% level of significance is 2.6, well above the computed ratios.<sup>1</sup> Similar tests for the heavier, lower grades of hogs came to the same conclusion.

It is evident that variances of hedging revenues in the Southern markets were no larger than in the contract delivery point market, Omaha. Location basis variability was no barrier to the hedging of hogs on feed in the Southern markets in 1971. So far as variability is concerned, producers in these markets could have hedged as effectively as their colleagues in the Omaha area.

### HEDGING ERROR

One further point needs to be taken up, and that is the absolute sizes of the hedging revenue variances in Table 1. These variances were consistently larger than cash market variances, so one might be tempted to argue that the analysis has shown that Southern producers could have hedged just as INEFFECTIVELY as in the Omaha area. This apparent contradiction is reconciled through the concept of hedging error. As Professor Hieronymous puts it, "hedging is done with a view to the market," meaning that hedgers hold some price expectations when they place a hedge [2]. In futures market parlance, this is an expectation of a basis, as in equation 2:

$$(2) \quad E(R_{ijgt}) = S_{jm} + C$$

where C is the anticipated basis, which reflects spatial or grade price differentials and, perhaps, the hedger's own price forecast. The anticipated basis is the differential which relates the futures price to the hedger's own situation.

Hedging error is the difference between received and expected hedging revenues, or

$$(3) \quad U_{igt} = R_{ijgt} - E(R_{ijgt})$$

where  $U_{igt}$  is the measure of the magnitude of hedging error. Substituting equations (1) and (2) into equation (3), the hedging error function reduces to

$$(4) \quad U_{igt} = P_{igt} - L_{mt} - C$$

Note that the length of hedge does not affect hedging error except as it affects expectations. Hedging error is composed of the realized basis ( $P_{igt} - L_{mt}$ ) less the anticipated basis (C). The anticipated basis cannot be measured from market data, since it is in the mind of the hedger. The realized basis component can be measured, however, and is comparable among markets. Means and variances of realized bases for the markets under study are presented in Table 2.

Two salient observations can be made from Table 2. One is that the realized basis variances are small - around one-half as large as cash market prices variances. While total hedging error variances may differ from the realized basis variances, depending upon the skills of hedgers, the data indicate that hedging could have shifted risk away from hog producers, a conclusion which is not conveyed by the hedging revenue variances. Price risk, in the sense of a dispersion of actual from expected results, could have been reduced.

The other thing to be noted from Table 2 is that realized basis variances are virtually equal among markets. Only one outlying value is to be found, and that is at Omaha for U.S. 2-4 hogs weighing 240-270 pounds. These hogs are too heavy to be eligible for delivery against futures contracts, and their basis variance was considerably higher than for other grades. Evidently the price differentials among grades are much more rigid in the Southern markets, because their realized basis variances for heavy hogs were the same as for lighter ones. The equality of realized basis variances among markets supports the conclusion that there was no inherent location basis variability working against Southern producers in 1971. Southern hog producers could have conducted hedging programs with no disadvantage compared with their Midwestern colleagues.

### CONCLUDING REMARKS

The findings of this study do not comprise an advocacy of hedging, nor did the study attempt to derive hedging strategies. Routine hedging activities were postulated in order to generate hedging revenue

<sup>1</sup>While not actually infinite, the numbers of degrees of freedom in the denominator of the F-ratios are very high because of the large numbers of observations and the nature of Bartlett's test.

Table 2. REALIZED BASIS STATISTICS FOR HEDGING REVENUES, BY GRADE, FOUR MARKETS, 1971

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—dollars per cwt. and (dollars per cwt.)<sup>2</sup>—

A. Omaha Terminal Market			
Grade	U. S. 1-2 (200-220 lbs.)	U. S. 1-3 (200-240 lbs.)	U. S. 2-4 (240-270 lbs.)
Mean	-0.78	-1.05	-1.73
Variance	1.48	1.53	1.85
B. Kentucky Buying Stations			
Grade	U. S. 1-3 (200-240 lbs.)	U. S. 2-4 (190-240 lbs.)	U. S. 2-4 (240-260 lbs.)
Mean	-1.52	-1.94	-2.35
Variance	1.49	1.48	1.44
C. Southeast Direct			
Grade	U. S. 1-2 (200-230 lbs.)	U. S. 2-3 (190-240 lbs.)	U. S. 2-4 (240-270 lbs.)
Mean	-1.61	-2.25	-2.74
Variance	1.45	1.46	1.47
D. North Carolina Auctions			
Grade	North Carolina Top Hog		
Mean	-2.11		
Variance	1.47		

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variances attributable to location. The findings show that hedging programs could have been carried out in the South in 1971 as effectively as in the Midwest. This equality of hedging opportunity would seem to make it worthwhile to pursue hedging strategies that might fit into Southern hog production and marketing systems.

The fact remains, of course, that there are no delivery points in the South, so continuing equality of hedging opportunity depends upon liquidity in the hog futures market and stability of spatial price relationships in the cash markets. The liquidity outlook is promising, since both trading volume and open interest in the futures contracts have been

increasing from year to year. As to the question of spatial relationships, the ones existing in 1971 appear fairly normal to this observer. They can change, of course. The Louisville case comes to mind, where the spread between Louisville and Indianapolis practically reversed itself in a matter of days [4]. This came about because of a collapse of competition at Louisville, from which a lesson may be drawn for prospective hedgers. They may well find hedging in live hog futures to be a rewarding and effective management tool, but they will need to have as lively an interest as ever in maintaining competition in their local markets.

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