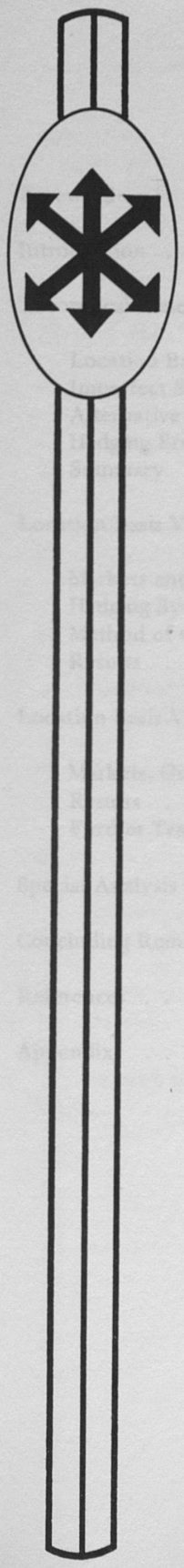

EFFECTS OF LOCATION BASIS VARIABILITY ON LIVESTOCK HEDGING IN THE SOUTH

By

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CONTENTS

LIST OF TABLES

APPENDIX TABLE

FOREWORD

The research summarized in this report represents Kentucky's contribution to the Southern regional livestock marketing research project, "Economic Evaluation of Alternative Forms of Vertical Coordination in the Livestock-Meat Industry." It was performed under the auspices of the Chicago Mercantile Exchange's "Research in Futures" fellowship program. Some of the material contained in this report has been published in the form of two articles in the 1973 volume of the *Southern Journal of Agricultural Economics*. One article dealt with slaughter hogs and the other with slaughter cattle. This paper brings these two topics together and expands upon them. Much new material, particularly on cattle hedging, has been added.

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Introduction

Live animal futures contracts have had a spectacularly successful development. Starting with a radical departure in futures markets, the concept of trade in a nonstorable commodity, contracts in choice steers, slaughter hogs, and feeder cattle have been established. Trading volume and open interest in these contracts are increasing year by year. Yet at the same time, the hedging activity represented in these contracts is very small compared with the potential afforded by the livestock industry. Public relations and educational efforts have been and are being made to arouse interest in potential hedgers. For potential hedgers in business circles, the sanction of the Harvard Business School has been placed on hedging in livestock and other commodities by the publication of a book by Arthur (1). Efforts have been directed towards farmers too, with some success, as noted by Futrell (6).

Live animal futures contracts provide an alternative marketing procedure for cattle and hog producers. This alternative is best described in the context of the vertical coordination of marketing that takes place between livestock producers and buyers. The simplest means of coordination between livestock feeders and packers is the open market: feeders sell to the highest-bidding packer with no prior arrangements concerning the timing of the sale, quality of livestock offered, or price. If one takes the open market as a base, a spectrum of alternative coordinating arrangements can exist, ranging from informal agreements through written contracts, which specify one or more of the terms of trade, to vertical integration, in which feeding and packing are carried out by the same firm and coordination becomes a matter of adminstrative arrangement. Hedging fits into this spectrum in a variety of ways. It can be used in conjunction with open markets, with various kinds of contracts, or even by vertically integrated firms. The potential for hedging in a region, therefore, is an important aspect of efforts to devise vertical coordination methods to improve the efficiency of livestock marketing in the region.

Regionality is stressed because of the geographic structure of livestock feeding in the United States. The traditional heartland of cattle and hog feeding is the Corn Belt, and most livestock futures contract delivery points have been located there. The presence or absence of futures contract delivery points is an important factor influencing the potential of hedging in a region. Hedging in areas remote from contract delivery points can be rendered ineffective by a condition known as location basis variability. In general, the Southeastern and South Central states lack contract delivery points. None of the delivery points for hogs is located in this region. No delivery point for choice steers was

located in the region until August 1971, when Guymon, Okla., in the westernmost part of the study area, was so designated. Since Southern livestock markets are susceptible to location basis variability, the object of the study was to measure the degree of location basis variability occurring in these markets and to assess its effects on hedging.

The basic procedure of this study was to generate hedging revenues for Southern markets, estimate their variabilities, and compare them with similar measures for a central futures contract delivery market. It is in the nature of location basis that, if it exists, it will result in higher variabilities in the distant markets. The point of view taken in the study was that of livestock producers. That is, short hedges intended to avert the risk of price declines on inventories of livestock on feed were postulated, and the timing of hedges was tailored to fit various feeding situations. Since timing is an important aspect of hedging management, the results of the study are less applicable to the situation of long hedgers, such as packers, whose timing requirements are likely to be different from those of feeders.

No significant effects due to location basis variability were found for slaughter hogs for the markets, study period, and hedging systems used in the study. Southern hog feeders in the markets studied would have found hedging as effective in averting the risk of price change as would feeders in the central, Corn Belt contract delivery market. However, significant location effects were found for fed cattle in the Southern and Southern Plains markets studied. Hedging was generally not so effective as in the central delivery market. In some instances, hedging would actually have increased price risk rather than reducing it. Details and interpretations of these findings are presented later in this report.

Theoretical Issues

Location Basis Variability

Location basis variability can be defined as the distortion in hedging results that occurs by virtue of the hedger's location at some point distant from a futures contract delivery point market. Location basis is by its very nature unhedgeable. At the same time, variation in location basis does not necessarily exist. If it does exist, it has its origin in the state of spatial competition in a geographically dispersed market for the commodity in question rather than in the futures market for that commodity. It can be shown that in a perfectly competitive spatial market, with free trade, perfect knowledge, large numbers of buyers and sellers, and so on, price differences between any two points cannot exceed the transfer cost between them in the short run (2). In the long run, entry, exit, and resource price revaluation will cause price differences to just equal transfer costs. Short run or long run, the perfectly competitive spatial market implies stable price differentials among points in a geographic market--otherwise known as a price surface. Fluctuations in demand or supply at various points in the market cause fluctuations in price which are reflected evenly across the price surface, leaving the transfer cost-generated gradient of the surface unchanged.

Stability of the price surface for a commodity has two implications of interest in an analysis of hedging in a spatial market. First, the stability of the surface itself suggests predictability. If prices at points A and B bear a certain relationship to one another at one point in time, the same relationship can be safely predicted to hold in the future, given only that transfer costs remain constant. While the absolute level of

prices at A and B may be very unpredictable, the relationship between them is highly predictable. The other implication is that prices at points A and B will be perfectly correlated, so that, when price changes are linear, price variance will be everywhere the same, even though means will vary along the price surface.

It also follows from the perfect correlation among prices that location basis variability will not exist in a perfectly competitive spatial market. This can be seen by examining the variance components of a short-hedge revenue equation. Omitting brokerage fees, the hedging revenue function is formulated as follows:

$$R_{ijgt} = P_{igt} + H_{jm} - C_{mt} \qquad (1)$$

where R_{ijgt} is hedging revenue in market region i, hedge length j, for commodity grade g which is sold on date t; H_{jm} is the futures contract price at which the hedge was placed on a date specified by hedge length j in the contract maturing in period m; C_{mt} is the price at which the contract is repurchased on date t. All variables are measured in units appropriate to the commodity. For livestock, this is dollars per hundredweight for the various grades. Since futures contract prices are everywhere the same at a given time, hedging revenues among markets will vary as cash market differentials vary. For a series of hedges over time, mean hedging revenue is the algebraic sum of the means of the prices in equation (1), and hedging revenue variance is a linear combination of the variances and covariances of its price components, as shown in equation (2):

$$V(R_{ijg}) = V(P_{ig}) + V(H_{jm}) + V(C_m) + 2CV(P_{ig}, H_{jm}) - 2CV(P_{ig}, C_m) - 2CV(H_{jm}, C_m), \; t = 1, 2, \ldots T \qquad (2)$$

where V and CV stand for variance and covariance respectively, and T is the total number of sales dates. This variance equation applies to any given market region i. Where prices have equal variances and are perfectly correlated, the variance and covariance components of equation (2) are equal in all markets, and hedging revenue variances are everywhere the same. Whatever risk transference can be accomplished through hedging can be accomplished equally in all markets.

Imperfect Spatial Competition

In the real world, knowledge is imperfect because large numbers of buyers and sellers are not present in all areas, rigidities in commodity transport exist, and quality differences represented by commodity grades are not perceived in the same way at all places and at all times. Leads and lags in price adjustments among markets can exist. Under these conditions of imperfect spatial competition, location basis variability may occur. With less than perfect correlations between futures contract delivery market and distant market prices, and possibly different variances as well, hedging revenue variances may be higher in distant markets than at the contract delivery market. This is an empirical question, however. The existence of significant location basis variability cannot be inferred *a priori* from an imperfect state of spatial competition. The question of how much of an effect there is must be addressed.

Alternative Measures of Location Basis Variability

The foregoing discussion leads to two alternative measures of location basis variability: (a) comparisons of cash market correlation coefficients between contract

delivery markets and distant markets, and (b) comparison of hedging revenue variances through estimates of equation (2) for various markets. The latter procedure was chosen for this study. A comparison of cash market correlations has the virtue of simplicity, but it would not capture the time dimension of hedging. Equation (2) shows that hedging revenue variance is affected by the relationship between cash and futures prices at two different points in time. Covariance terms relate local price to the futures price at which a hedge is placed and to the futures price at which it is lifted or covered. A contemporaneous correlation between local cash prices and cash prices in the delivery market ignores the lagged relationship, and a lagged correlation ignores the contemporaneous relationship. For these reasons, a direct comparison of variances seems the better alternative.

A third analytical alternative is to use a portfolio-type procedure of the sort suggested by Ward and Fletcher (13) and applied empirically by Heifner (7) and by Holland, Purcell, and Hague (9). Certainly, work on optimal and minimum-risk hedging strategies, as used in these studies, is necessary, and the type of analysis implied by alternative (b) is no substitute for micro-analysis of hedging for local markets. However, data problems crop up when portfolio-type analyses are used for interregional comparisons. This type of analysis requires knowledge of the production function in each area of application. As Ehrich (5, pp. 31-32) points out, available (secondary) cost data may not represent the minimum-cost situation for a region. Also, the degree of upgrading of livestock while on feed introduces a bias unless the degree of upgrading is known and taken into account. Thus, intimate knowledge of local conditions is necessary for the successful application of portfolio-type procedures. Under these circumstances, the simpler model, which is specifically directed toward measuring location basis variability without at the same time trying to solve hedging management problems in a number of regions, was adopted.

Hedging Error and Bias

Equations (1) and (2) provide measures of hedging performance which are essentially *ex post* in outlook. That is, hedging results are measured at the end of the marketing process and incorporate cash market prices actually received. Consideration of futures price bias follows from this *ex post* outlook. Bias is essentially comparison of hedging revenue with the revenue that would have been obtained had hedging not been undertaken. An alternative to the *ex post* point of view is to evaluate hedging performance from the standpoint of expectations held at the time hedges are placed. Hedging error is an *ex ante* measure of the deviation of results from expectations.

In the textbook example of the perfect hedge, a commodity is sold short in futures, convergence betweenash and futures prices in the delivery month is exact, and the commodity is sold and the short position covered to achieve an outcome just equal to the short sale price. Expectations are exactly realized. Realism calls for two modifications of this concept. First, the assumption that the expected revenue equals the short sale price implies not only location at the par delivery point but also that the hedger has no price expectation of his own other than what is reflected in the futures price. As Hieronymous (8) has indicated, hedging is really done with some price expectation in mind. The other point is that convergence between cash and futures prices is seldom exact, nor do the price changes in the two markets necessarily parallel each other

exactly. Cash prices will be highly correlated with futures prices in the nearby contract, but not perfectly so.

Basis expectation can be quantified in the following manner:

$$E(R_{ijgt}) = H_{jm} + Z_{igt} \quad (3)$$

where $E(R_{ijgt})$ is expected hedging revenue, H_{jm} is the hedging price as previously defined, and Z_{igt} is the basis differential which relates the futures price to the hedger's own situation. The basis differential has spatial, grade, and time dimensions, and it may also reflect the hedger's own price forecast. Expected hedging revenue therefore contains an objective component (the futures contract price) and a subjective component (the hedger's estimate of the basis differential).

Hedging error is defined as the difference between received and expected hedging revenue, or

$$U_{igt} = R_{ijgt} - E(R_{ijgt}). \quad (4)$$

Substituting equations (1) and (3) into equation (4), hedging error reduces to

$$U_{igt} = P_{igt} - C_{mt} - Z_{igt}. \quad (5)$$

Note that length of hedge does not affect hedging error. Hedging error as expressed in equation (4) is composed of the realized basis ($P_{igt} - C_{mt}$), less the anticipated basis Z_{igt}. In the par delivery market, realized basis will be zero for the delivery grade if convergence is exact. This meets the condition for a perfect hedge, so hedging error will be zero, if anticipated basis was also zero. For nonconvergence and for other cash markets, realized basis will be different from zero, but hedging error may be zero or not, depending on the level of the anticipated basis.

Hedging error cannot be estimated in its entirety without knowledge of the anticipated basis, which is fundamentally in the mind of the hedger, and so cannot be measured except on a case by case basis. However, the realized basis component can be estimated from market data. Estimates of this component are useful, because they give a measure of the error against which a hedger must work in his particular market. The realized basis component of hedging error will be referred to as U'_{igt} and is

$$U'_{igt} = P_{igt} - C_{mt} \quad (6)$$

with variance

$$V(U'_{ig}) = V(P_{ig}) + V(C_m) - 2CV(P_{ig}, C_m), \quad t = 1, 2, \ldots T. \quad (7)$$

Realized basis variance is a major component of hedging revenue variance and both may be affected by location.

An intriguing aspect of hedging error is the role of the individual in anticipating basis change. It is clear from equation (5) that hedging error will always be zero if the anticipated basis is of an appropriate value. This is to say that a clever forecaster can overcome the difficulties imposed by imperfect convergence, location, and grade basis variability, at least in principle. Of course, the ability of our hypothetical clever forecaster to know fairly precisely the outcome of a hedge does not mean that he will necessarily place that hedge, which brings us to the bias.

Bias is usually defined as the persistent deviation of futures prices at different points in time. A downward bias is said to exist when futures prices persistently tend to underestimate eventual cash prices; upward bias is the reverse of this. From the point of view of the hedger, bias is equivalent to an *ex post* evaluation of hedging results which compares hedging revenues with the revenue that would have been received without hedging. In the context of the prices models

developed here, this is

$$B_{jgt} = R_{ijgt} - P_{igt}, \quad (8)$$

$$\text{where } B_{jgt} = H_{jm} - C_{mt}. \quad (9)$$

Note that bias is not affected by location. Bias, if it is present in a futures market, affects hedgers in all locations equally. Because of its neutrality with respect to location, bias was of only passing concern in this study.

Summary : Theoretical Issues

Three measures of hedging effectiveness have been developed in this section. The first, and the one of primary importance in the empirical portion of the study, is hedging revenue variance. While hedging revenue variance will be the same everywhere in a perfectly competitive spatial market, in the real world market imperfections may give rise to locational differences. The second measure of effectiveness was hedging error, in which expected hedging revenue is taken as the basis of comparison. While hedging error is not observable in its entirety, its realized basis component can be measured from market data. Since location enters into the realized basis component, its variance may differ by location. Last, the concept of bias was examined, to find that location was not a factor in it.

Location Basis Variability for Slaughter Hogs

Location basis variabilities for three Southern markets and a central delivery point market were estimated and compared. Two production-hedging systems with differing lengths of hedge were assumed. Daily market price data for calendar year 1971 were used in the analysis. It was not considered worthwhile to extend the analysis further back because of illiquidity in the live hog futures market prior to 1971. Daily price observations were used because of the frequency of price change for hogs. Lags in price change between markets which might be apparent in daily data might well be covered up in weekly averages.

Markets and Grades Selected

Southern markets selected for use in the study 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. Their markets also have the virtue of having daily price reports made for them. Omaha was selected as the reference delivery market, even though deliveries at Omaha are discounted relative to Peoria, which is the par delivery market. The Omaha market was selected because of the wider distribution of price reports for it in market news media available to Southern producers.

Prices in Kentucky, the Southeast market, and at Omaha were reported on the basis of USDA grades. Prices for North Carolina, however, were reported on the basis of a state grade, called "North Carolina Top Hog." Prices were not reported for any lower grades in North Carolina. While a state grade does not necessarily conform to U.S. grade standards, "North Carolina Top Hogs" are reported to be essentially comparable to U.S. 1s and 2s weighing 200-220 pounds (9).

Hedging Systems

The two hog production-hedging systems which were assumed were (a) a farrow-finish system and (b) a specialized feeding enterprise

in which 50-pound feeder pigs are purchased and fed to market weight. So far as hedging is concerned, the systems differ by the length of run of the hedge. In the longer run, farrow-finish system, the hedge was placed when pigs were farrowed and lifted 174 days later, when the finished hogs were assumed to be marketed. In the feeder pig finishing enterprise, the hedge was assumed to be placed at the time the feeder pigs were purchased and lifted 106 days later, when the finished hogs were marketed. The lengths of the hedges, 174 and 106 days, respectively, were derived from National Research Council growth rate standards and expected lengths of time necessary to achieve a market weight of 225 pounds (12). Variation around the mean growth rate would cause a dispersion of weights and grades around this mean weight so that individual lots of hogs might fall into any of the reported grade and weight ranges.

Method of Calculation

Hedging revenues were calculated for all combinations of markets, grades and hedging systems for calendar year 1971. Equation (1) describes the calculation process employed. Calculations were oriented on the marketing date, with hedges placed 174 and 106 days prior to that date. Adjustments for holidays and weekends were made by placing or lifting hedges on the next available date on which hog futures contracts were traded.

Marketings which were scheduled for a contract delivery month were assumed to be hedged in that contract up to the 15th of the month. Marketings scheduled after the 15th were assumed to be hedged in the next contract, as were marketings in noncontract months. For example, marketings scheduled for Jan. 1 - Feb. 15, 1971 were assumed to be hedged in the February contract. Marketings for Feb. 16 - April 15 were hedged in the Arpil contract, and so on. The 15th of a contract month was used as the cut-off point rather than the 20th, when contracts normally expire, to avoid liquidity problems that might arise nearer the expiration date.

Daily closing prices of futures contracts and the midpoints of daily trading ranges for cash market hogs were the prices used in the calculations. Means, variances, and covariance components for hedging revenues and realized hedging error were calculated. These statistics were adjusted for missing cash price data. No attempt was made to interpolate missing data from nearby prices.

Results

Hedging revenue results are summarized in Table 1. In respect to location basis variability, the focus of attention is on the variances presented in the table. To review the conditions of the hypothesis of location basis variability, if it can be shown that hedging revenue variances are not equal, given equality of cash market price variance, then it is concluded that location basis variability is present. Inequality of cash market price variances would indicate a highly imperfect state of spatial competition in which location basis variability would be presumed to be large. Bartlett's test of equality of variances was used to test the null hypothesis of equality in cash market price variances and in hedging revenue variances. Results of these tests are presented in Table 2.

The figures in the top portion of Table 2 are the Bartlett's test statistics for equality of variances of prices and hedging revenues by grade. The figures in the lower portion of the table show the critical values of F against which the test statistics should be compared. No test statistic exceeds its critical value of F, indicating no significant differences in variances among the variables tested. Cash price variances within grades were not significantly different from one another, nor

Table 1.--Hog Price and Hedging Revenue Summary Statistics, by Grade, Four Markets, 1971.

	----dollars per cwt and (dollars per cwt)^2----		
A. Omaha Terminal Market (252 observations)			
Grade	U.S. 1-2 (200-220 lb)	U.S. 1-3 (200-240 lb)	U.S. 2-4 (240-270 lb)
Cash Market Price			
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[1/] (254 observations)			
Grade	U.S. 1-3 (200-240 lb)	U.S. 2-4 (190-240 lb)	U.S. 2-4 (240-260 lb)
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

(continued)

Table 1.--Continued

C. Southeast Direct (251 observations)

Grade	U.S. 1-2 (200-230 lb)	U.S. 2-3 (190-240 lb)	U.S. 2-4 (240-270 lb)
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

1/ A fourth grade of heavy hogs is reported for Kentucky but not included here.

Table 2.--Bartlett's Test of Equality of Variance of Cash Hog Prices and Hedging Revenues, by Grade, Four Markets, 1971.[1/]

Test Item	Light Weight, High Grade Hogs	Medium Weight Medium Grade Hogs[2/]	Heavy Weight, Low Grade Hogs[2/]
	F-Ratios		
Cash Prices	1.60	0.54	0.70
Farrow-Finish Hedging System	1.06	0.80	0.17
Feeder Pig Finish Hedging System	0.31	1.05	0.19
$F_{.05}(3,\infty)$	2.60	--	--
$F_{.05}(2,\infty)$	--	2.99	2.99

[1/] The procedure for Bartlett's test of equality of variances is summarized in (4, pp. 179-180).

[2/] North Carolina omitted.

were hedging revenue variances. Thus, there was no indication of any significant location basis variability. Within-grade comparisons were not quite identical owing to the wider reporting ranges for weights in the Southern markets. However, the wider reporting ranges would, if anything, tend to increase variance difference with respect to Omaha, so the results are not weakened by the reporting differences.

The implications of the equality of variances tests are clear. Location basis variability was not a significant factor for Southern hedgers in 1971. So far as basis was concerned, they could have hedged as effectively as hog feeders in the Omaha area. Mean hedging revenues were less in the Southern markets, but so were cash market means. Both corresponded to the spatial price surface. Timing of the hedge had a great effect on the variability of results, as shown by the variances in Table 1. Location, however, had no bearing on this.

Hedging revenue variances for both hedging systems were larger than corresponding cash market price variances, which indicates that hedging was ineffective in all markets in averting price risk. However, these are implicitly *ex post* comparisons. As was pointed out previously, hedging effectiveness also needs to be evaluated *ex ante*, that is, from the point of view of expectations held when hedges were placed. The realized basis component of hedging error provides a partial measure of *ex ante* hedging effectiveness. Data for this component are presented in Table 3.

Means of the realized basis statistics in Table 3 primarily reflect spatial differentials and are of little concern here. Comparing variances in Table 3 with those in Table 1, it can be seen that realized basis variances were substantially less than both hedging revenue and cash market price variances. They too showed no location effect. While total hedging error variances may have differed from their realized basis components, depending on the skills of hedgers, the data indicate that price risk from the *ex ante* point of view could have been shifted away from hog producers in 1971. In summary, hedging of slaughter hogs in 1971 appeared to have been effective *ex ante* but ineffective from the *ex post* point of view. In any case, location basis variability did not appear to be present.

Location Basis Variability for Fed Cattle

Somewhat different problems were confronted in analyzing location basis variability for fed cattle. Since the frequency of price change is much less for cattle than for hogs, weekly prices were considered adequate to encompass the detail of price change for cattle. On the other hand, sex as well as grade is an important quality variable, and a large range of feeding periods is possible. As will be shown, 11 different lengths of hedge for 4 sex-grade combinations were required to analyze the feeding systems postulated by the regional livestock marketing research committee. Also, a structural change in the choice steer futures contract occurred during the study period. The par delivery point was shifted, and a discount delivery point was established in one of the distant markets under study.

Market, Grades, and Hedging Periods

Market selection was guided by location of cattle feeding in the Southern region and by the accompanying availability of price reports. Markets selected were Kentucky, Georgia, and Southern Plains area of Texas and Oklahoma. Omaha was selected as the reference delivery market. Prices in Kentucky and at Omaha were reported on the basis of terminal market sales. Prices in Georgia

Table 3.--Realized Basis Statistics for Hog Hedging Revenues, by Grade, Four Markets, 1971.

	----dollars per cwt and (dollars per cwt)^2----		
A. Omaha Terminal Market			
Grade	U.S. 1-2 (200-220 lb)	U.S. 1-3 (200-240 lb)	U.S. 2-4 (240-270 lb)
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 lb)	U.S. 2-4 (190-240 lb)	U.S. 2-4 (240-260 lb)
Mean	-1.52	-1.94	-2.35
Variance	1.49	1.48	1.44
C. Southeast Direct			
Grade	U.S. 1-2 (200-230 lb)	U.S. 2-3 (190-240 lb)	U.S. 2-4 (240-270 lb)
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		

(reported from Thomasville) were on a direct, at-plant basis for choice steers and from auction sales for other sex-grade combinations. Prices in the Southern Plains region were reported F.O.B. feedlots, assuming a 4% shrink. Choice and good steers and choice and good heifers were the 4 sex-grade combinations reported at all markets. Where different weight ranges were reported for the same grade of cattle, as for choice steers in the Southern Plains, prices for the lighter weight range were used.

The study period ran from January, 1969 through June, 1972 for a total of 21 successive contract periods. This span of time encompassed a structural change in the choice steer futures contract when, with the August 1971 contract, the par delivery point was shifted from Chicago to Omaha. Before, Omaha had been a delivery point but at a 75 cent per hundredweight discount. At the same time, Guymon, Okla., in the Southern Plains, was designated a delivery point at a $1 per hundredweight discount. The discontinuity in hedging results caused by these changes was taken into account by shifting the time focus of the analysis to a contract period basis and using pooled, within-contract variances for analytical purposes. The Southern Plains area was treated as a distant market throughout the study period despite the establishment of a delivery point there. Justification for this was that the delivery point was in effect only for the last six contracts and because the delivery discount seemingly was so large as to render the point ineffective (3).

Hedging periods were derived from feeding situations postulated by the Southern regional livestock marketing technical committee. These feeding situations were differentiated by sex, grade, and breed of feeder cattle. Times on feed were derived for these different types, both as weaned calves and as backgrounded yearlings, from National Research Council rate-of-gain standards (12). Hedging periods were assumed to be equal in length to the number of weeks on feed for each feeding system. Breed, sex, grade, and derived feeding period combinations are summarized in Table 4.

Hedging revenues were calculated according to equation (1) for all the breed-sex-grade combinations shown in Table 4. Hedging revenue variances were calculated according to equation (2). Moments were taken about individual contract means, and variances were then pooled for the 21 contracts represented in the data. This procedure avoided any difficulties due to the structural shift in the futures contract. It did not impair the analysis, since any location effects are contained within contracts rather than among them.

Procedures used to calculate hedging revenues were similar to those used for hogs. Marketings in the contract month were assumed to be hedged in that contract up to the week containing the 20th of the month (the contract expiration date) and in the succeeding contract thereafter. Marketings in months without contracts were hedged in the nearby contract. Thus, hedges were placed in each contract for a 2-month period.

Results

Summary statistics for fed cattle hedging revenues are presented in Table 5. The cash market and hedging revenue means presented are overall means, while the variances are pooled, within-contract variances. Numbers of weeks of observations are also included. No attempt was made to interpolate for missing prices. Missing prices were especially troublesome for the Georgia market, where quantities of cattle offered were often too small to establish a meaningful price. Even so, sufficient observations were available to estimate variances for every hedge except the December 1970 contract period for choice heifers in Georgia.

Table 4.--Feeding-Hedging Periods for Selected Feeder Cattle Types

Table 4.--Feeding-Hedging Periods for Selected Feeder Cattle Types

Grade, Sex, and Breed Types	Weights		Average Rates of Gain[1/]		Feeding Periods	
	Starting	Finishing	Weaned Calf	Background Yearling	Weaned Calf	Background Yearling
	-------Pounds-------		----Pounds per day----		-------Weeks-------	
Choice Steers						
English Crossbred	600	1100	2.40	2.87	30	25
English Straight	550	1050	2.32	2.87	31	25
Okie No. 1	550	1050	2.32	2.87	31	25
Good Steers						
Large Breed Crossbred	600	1100	2.41	2.87	29	25
English Straight	500	950	2.34	2.87	27	22
Okie No. 2	550	1000	2.37	2.87	27	22
Choice Heifers						
English Crossbred	600	900	2.20	2.65	19	16
English Straight	550	850	2.20	2.65	19	16
Okie No. 1	550	850	2.20	2.65	19	16
Good Heifers						
Large Breed Crossbred	550	800	2.10	2.65	17	13
English Straight	450	750	2.04	-	21	-
Okie No. 2	450	750	2.04	-	21	-

[1/] Source: National Research Council (12).

Table 5.--Summary Statistics for Fed Cattle Hedging Revenues, Four Markets, January 1969 - June 1972.

Prices Hedging Revenues	Omaha	Kentucky	Georgia	Southern Plains
	--------- $ per cwt and ($ per cwt)^2 ----------			
Choice Steers				
No. Weeks	178	181	159	179
Cash Price				
Mean	31.13	31.12	31.75	31.01
Variance	0.73	9.87	0.76	0.94
31-week Hedge				
Mean	28.62	28.59	29.11	28.45
Variance	.39	.62	.63	.59
30-week Hedge				
Mean	28.65	28.63	29.15	28.49
Variance	.41	.60	.67	.58
25-week Hedge				
Mean	28.84	28.83	29.37	28.68
Variance	.47	.67	.80	.64
Good Steers				
No. Weeks	181	181	171	177
Cash Price				
Mean	28.68	28.21	28.71	29.08
Variance	.57	1.00	.31	.63
29-week Hedge				
Mean	26.24	25.76	26.19	26.64
Variance	.37	1.04	.57	.43
26-week Hedge				
Mean	26.32	25.84	26.29	26.73
Variance	.40	1.02	.63	.47
25-week Hedge				
Mean	26.39	25.92	26.38	26.81
Variance	.41	1.00	.61	.45
22-week Hedge				
Mean	25.56	26.08	26.54	26.98
Variance	.45	1.15	.74	.44
Choice Heifers				
No. Weeks	181	179	133	180
Cash Price				
Mean	30.23	30.23	30.14	29.66
Variance	.77	.81	.49	.68
19-week Hedge				
Mean	28.31	28.29	27.81	27.73
Variance	.65	.71	.99	.63

(continued)

Table 5.--Continued

Prices Hedging Revenues	Omaha	Kentucky	Georgia	Southern Plains
	$ per cwt and ($ per cwt)^2			
16-week Hedge				
Mean	28.52	28.51	28.05	27.94
Variance	.61	.67	.84	.65
Good Heifers				
No. Weeks	180	181	173	170
Cash Price				
Mean	27.56	27.04	27.40	28.38
Variance	.57	.90	.29	.58
21-week Hedge				
Mean	25.51	24.98	25.30	26.33
Variance	.48	.90	.79	.54
17-week Hedge				
Mean	25.80	25.27	25.58	26.61
Variance	.61	.97	.72	.62
13-week Hedge				
Mean	26.08	25.55	25.88	26.88
Variance	.56	.90	.67	.66

As in the case of hogs, location basis variability was concluded to be significant if the hypothesis of equality of hedging revenue variances was rejected, given that cash market price variances were equal among markets. Bartlett's test of equality of variances was first applied to cash market prices. If the hypothesis of equality of cash market price variances was accepted for a given grade of cattle, tests of equality of hedging revenue variances were performed. On the other hand, rejection of the hypothesis of equality of cash market price variances halted the test procedure, because hedging revenue variances in such case would not be comparable.

The hypothesis of equality of cash market price variances could be accepted only for choice steers, as shown in Table 6. The hypothesis was rejected for the other grades. Tests of hedging revenue variances were therefore performed only for choice steer hedges. F-ratios for these test were significant, indicating significant location basis variability for distant markets.

These tests appear discouraging from the standpoint of hedging in the South and Southern Plains. A basis for hedging seems to exist for choice steers, which is the most important class of fed cattle and is also the deliverable grade for the futures contract. Effectiveness, however, appears to be reduced by location basis variability. For the other grade-sex combinations, the underlying requirement of spatial competition was not met, so that the feasibility of hedging these grades becomes questionable.

Further Tests

Several questions concerning the hedging of fed cattle were not answered in the foregoing analysis. First, although significant location basis variability was demonstrated for choice steers in the distant markets as a group, it is not clear that it applies to them individually. In this connection, it is especially important to see if the conclusion holds for the Southern Plains, since it is the most important of the feeding areas under study. Second, it can be argued that hedging is a viable procedure if it can shift price risk away from the hedger even though it is more effective elsewhere. These questions call for individual comparisons among markets.

Table 7 presents individual F-ratio tests of the significance of differences between price and hedging revenue variances for choice steers. These tests confirm the results of the group test of Table 6. The conclusion of significant location basis variability applies to each market individually as well as to the group. There was, however, a tendency for the F-ratios to fall as hedging periods became shorter. The question of location basis variability for even shorter hedging periods will be considered later in this report.

Table 8 provides an alternative set of measurements of hedging effectiveness. In Table 8, hedging revenue variances are expressed as percentages of cash price variances for the indicated grade and sex at each market. Thus, the lower the index or percentage the greater is the reduction in revenue variance relative to cash marketing. While formally less satisfactory that measurements against pooled among-market variances, these indexes provide some indication of risk-shifting potential by market, and they also illustrate the effect of grade basis variability. Index values generally rise as grade and sex diverge from the choice steer delivery grade. If one compares the Southern Plains with Omaha, little difference is seen in index values for the nondeliverable grades. For choice steers, there is a tendency for the indexes to converge with shorter hedging periods. Results for Kentucky indicate that hedging was moderately effective for choice steers, less effective for choice heifers (but little different from Omaha), and ineffective for good steers and heifers.

Table 6.--Bartlett's Test of Equality of Variances of Fed Cattle Prices and Hedging Revenues, by Grade, Four Markets, January 1969 - June 1972.

Test Item	Choice Steers	Good Steers	Choice Heifers	Good Heifers
	----------F-Ratios----------			
Cash Prices	1.10	16.85*	2.94*	15.61*
31-Week	3.89*			
30-Week	3.28*			
25-Week	3.63*			

*Indicates significance at 5% level. The critical value of $F_{.05}(3, \infty) = 2.60$.

Table 7.--Individual F-Ratios of Cash Price and Hedging Revenue Variances for Choice Steers in Three Markets Compared to Omaha, January 1969 - June 1972[1/]

Test Item	Kentucky	Georgia	Southern Plains
	F-Ratios		
Cash Price	1.20	1.03	1.29
31-week Hedge	1.59*	1.61*	1.52*
30-week Hedge	1.47*	1.64*	1.42*
25-week Hedge	1.45*	1.71*	1.36*

[1/] The source of data is Table 5. The test statistic is $F = \frac{\text{Var (i)}}{\text{Var (Omaha)}}$ for price and revenue variances. The critical value of F is approximately 1.33 at the 5% significance level for Kentucky and the Southern Plains and 1.35 for Georgia.

* Indicates significance at the 5% level.

Table 8.--Ratios of Hedging Revenue Variances to Cash Market Price Variance, Four Markets, January 1969 - June 1972.

Hedge Type, Length	Omaha	Kentucky	Georgia	Southern Plains
	------percent of cash market price variance------			
Choice Steer				
31-week Hedge	53	70	83	63
30-week Hedge	56	69	89	62
25-week Hedge	64	77	105	67
Good Steer				
29-week Hedge	64	104	186	68
27-week Hedge	69	102	204	75
25-week Hedge	73	100	200	72
22-week Hedge	78	116	240	69
Choice Heifers				
19-week Hedge	84	88	202	92
16-week Hedge	79	82	172	95
Good Heifers				
21-week Hedge	85	100	272	92
17-week Hedge	107	108	248	106
13-week Hedge	98	101	229	113

Source: Data are from Table 5.

Results for Georgia indicate that hedging was generally ineffective there, although the indexes for nondeliverable grades probably exaggerate the degree of ineffectiveness. Price variances for these grades were all substantially below comparable variances in other markets (see Table 5). These grades were reported on the basis of broad price ranges in Georgia auction markets. Considerable fluctuations could take place within the ranges with no reported price change. Thus, the price variances were probably underestimated with a consequent upward bias in the variance ratios. The fact that such broad reporting ranges persist indicates a tenuous tie with the national market, so that hedging was unlikely to be effective in any case. Results for choice steers, which were reported direct and were much more responsive to national market fluctuations, indicate this, as hedging was only marginally effective for them.

The realized basis statistics of Table 9 provide the alternate, *ex ante* measure of hedging effectiveness for fed cattle. The means of Table 9 represent mean differences between cash prices and choice steer futures prices for the nearby contract. They give some measure of spatial and grade price differentials. However, these means were not adjusted for the change in par delivery market. Variances were pooled within contracts and were unaffected by the structural change. As before, direct comparisons of variances among markets could be made only where cash price variances were not significantly different. Since this condition held only for choice steers, the test was applied only to that grade. Realized basis variances for choice steers were significantly different among markets. The individual F-ratio for the Southern Plains relative to Omaha was, however, not significant.

Variance ratios were required for comparisons of the other grades, as shown in Table 10. These variance ratios were computed in the same manner as in Table 9, except that realized basis variances were the numerators. As before, the lower the ratio the more effective the hedge, in this case from the *ex ante* point of view. Compared with ratios for hedging revenues, among-market differences between realized basis ratios were much compressed. That is, the relative loss in hedging effectiveness owing to grade and location basis variability appeared much less sharp when viewed *ex ante* than *ex post*.

These results throw an interesting light on the differences in components between the two variance equations, equations (2) and (7). The terms $V(H_{jm})$, $CV(H_{jm}, C_m)$, and $CV(P_{ig}, H_{jm})$ are present in hedging revenue variance but not in realized basis variance. The first two terms deal with relationships of futures prices over time and have no grade or location dimensions. However, the third term is a covariance which varies by location, grade, and length of hedge. This term seemed to be primarily responsible for differences in *ex ante* and *ex post* measures of hedging effectiveness in both the location and the grade dimensions.

Special Analysis For Choice Steers

There is evidence to suggest that the timing of hedges may affect the magnitude of location basis variability when measured *ex post*. First, Heifner (7) found no significant difference in hedging effectiveness between Omaha and the Southern Plains for choice steers for four-month hedges.[1] This was shorter than any of the periods used for choice steers so far in this study. Second, there is the apparent convergence of variance

[1] Only these markets coincided in this study and in Heifner's.

Table 9.--Realized Basis Means and Variances, by Grades, Four Markets, January 1969 - June 1972.

Grade and Class of Fed Cattle	Omaha	Kentucky	Georgia	Southern Plains
	--------$ per cwt and ($ per cwt)^2--------			
Choice Steers				
Mean	-0.52	-0.53	0.02	-0.65
Variance[1/]	.39	.56*	.62*	.51
Good Steers				
Mean	-2.96	-3.43	-3.01	-2.57
Variance	.33	.95	.56	.35
Choice Heifers				
Mean	-1.42	-1.44	-1.72	-2.00
Variance	.39	.50	.70	.46
Good Heifers				
Mean	-4.05	-4.60	-4.24	-3.12
Variance	.36	.73	.53	.43

[1/] Bartlett's test statistic was 2.95, which is significant at the 5% level, indicating variances of realized basis were different among markets.

* Indicates significance of the 5% level of individual F-ratios relative to Omaha.

Table 10.--Ratios of Realized Basis Variances to Cash Market Price Variances, by Grades, Four Markets, January 1969 - June 1972.

Grade and Class of Fed Cattle	Omaha	Kentucky	Georgia	Southern Plains
	-------percent of cash market price variances-------			
Choice Steer	53	64	82	54
Good Steer	58	95	182	56
Choice Heifer	51	61	142	67
Good Heifer	64	81	181	74

Source: Data from Table 5 and 9.

ratios, shown in Table 8, as hedges were shortened. For these reasons, the effect of length of hedge on hedging effectiveness was studied in more detail. A set of long (30 weeks), medium-length (21 weeks) and short (13 weeks) hedges were postulated for the four study markets. Despite appearances, timing of the 21-week hedge was very close to that assumed by Heifner. Heifner assumed that hedges were lifted prior to the beginning of a delivery month, while in this study hedges were allowed to run for another 3 weeks, until the expiration of the contract. Thus, the timing of hedge placements in the two studies were within a week of one another.

Hedging revenue results and tests of equality of variances for the three hedging periods are shown in Table 11. Results for cash market prices and for the 30-week hedge are the same as in Table 6. The hypothesis of equality of hedging revenue variances was rejected for all hedging periods. Individual F-ratio tests were conducted, with Omaha as the basis of comparison. Results of these tests are shown in Table 12. Hedging revenue variance ratios were significant for all but the 21-week hedge in the Southern Plains. These results support Heifner's findings, but they also suggest that his conclusion with respect to location basis variability in the Southern Plains market holds only for medium-length hedging periods.

Examination of covariances between cash and futures prices provides insight into the origin of differences in hedging revenue variances. As shown in equation (2), there are two such covariances. One of these terms $CV(P_{ig}, H_{jm})$, relates cash prices with futures prices at the time hedges are placed. Its effect on hedging revenue is direct, as shown by the positive sign in the equation. The other term, $CV(P_{ig}, C_m)$, relates cash and futures prices when hedges are covered and has an inverse effect on hedging revenue variance. Table 13 presents these covariances and their constituent correlation coefficients for the choice steer hedges under study. Hedging covariances for the Southern Plains were consistently larger in absolute terms than for Omaha. Where the signs were positive, in the long- and short-term hedges, the effect was to increase variance relative to Omaha. The negative value of the 21-week hedging covariance had the opposite effect, reducing hedging revenue variance to a level approximating that at Omaha.

It is a curious fact that the higher the correlation between the prices at which hedges are placed and ultimate cash prices the higher will be hedging revenue variance, and vice versa. It has already been noted that the covariance term through which this phenomenon acts is absent from the realized basis variance measure, and the convergence of the *ex ante* measures of location variability caused by its absence were described. Confinement of measures of hedging effectiveness to the *ex ante* point of view would avoid this troublesome covariance term. However, the portfoliotype analyses of hedging strategies now in use take a fundamentally *ex post* view of hedging outcomes. In respect to hedging analysis, therefore, the *ex post* measures on which this study has concentrated cannot be ignored.

Little is known about the behavior of choice ster futures contract prices over the life of a contract, but to the extent that contract prices reflect forecasts of eventual cash prices, correlations between the two prices should be positive or zero, depending on the quality of forecasts. For this reason, the negative correlation for the 21-week hedge, which implies a negative price forecast, seems very strange. If it is a statistical fluke, and the relationship would normally be positive or zero, then location basis variability could have been expected to be significant for all hedging periods in the Southern Plains. On the other hand, if it reflects some phenomenon of futures price behavior, then it

Table 11.-- 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[1/]
	------$ per cwt and ($ per cwt)^2------				
Cash Price					
Mean	31.13	31.12	31.75	31.01	
Variance	0.73	0.87	0.76	0.94	1.10
30-week Hedge					
Mean	28.65	28.63	29.15	28.49	
Variance	.41	.60	.67	.58	3.28*
21-week Hedge					
Mean	29.07	29.06	29.60	28.92	
Variance	.55	.73	.87	.56	4.96*
13-week Hedge					
Mean	29.64	29.62	30.20	29.49	
Variance	.54	.73	.86	.75	2.66*

1/* Indicates significance at the 5% level. The critical value of $F_{.05}$ is 2.60.

Table 12.--Individual F-Ratios of Choice Steer Cash Price and Hedging Revenue Variances, Three Markets Compared to Omaha, January 1969 - June 1972[1/].

Test Item	Kentucky	Georgia	Southern Plains
	----------F-Ratios----------		
Cash Price	1.20	1.03	1.29
30-week Hedge	1.47*	1.64*	1.42*
21-week Hedge	1.34*	1.60*	1.03
13-week Hedge	1.33*	1.57*	1.38*

[1/] Data are from Table 11. See Table 7 for test procedures.

* Indicates significance at the 5% level.

Table 13.--Covariances and Correlations of Choice Steer Prices with Hedging and Covering Futures Prices, Four Markets, January 1969 - June 1972.

Item	Omaha	Kentucky	Georgia	Southern Plains
	----------($ per cwt)^2----------			
Hedging Covariances				
30-week Hedge				
$CV(P_{ig}, H_{30})$	0.011	0.029	-0.007	0.034
$r(P_{ig}, H_{30})$	0.029	0.071	-0.019	0.082
21-week Hedge				
$CV(P_{ig}, H_{21})$	-0.021	-0.007	-0.006	-0.076
$r(P_{ig}, H_{21})$	-0.046	-0.015	-0.012	-0.146
13-week Hedge				
$CV(P_{ig}, H_{13})$	0.029	0.041	0.035	0.068
$r(P_{ig}, H_{13})$	0.058	0.077	0.069	0.122
Covering Covariances				
$CV(P_{ig}, C_m)$	0.588	0.586	0.471	0.632
$r(P_{ig}, C_m)$	0.760	0.687	0.576	0.718

is a factor to be considered in the timing of hedges.

Nothing has been said heretofore about the variances and covariances of futures prices themselves. Within-contract estimates of these are presented in Appendix Table 1 for all hedging periods considered. Variances for the various hedging periods indicated that futures price variance tended to rise gradually over the life of a contract. Of course, mean prices rose also. Covariances displayed a complex pattern. They never became negative but fell almost to zero in the 22-week hedge and rose thereafter. It is not known whether this represents a consistent pattern of price behavior.

Concluding Remarks

The significance or nonsignificance of location basis variability for hedges placed in one of the live animal futures markets does not by itself answer the question whether producers in distant markets ought, or ought not, to hedge. Rather, it establishes whether they have an equal opportunity to hedge compared with producers located elsewhere. Hedging is not necessarily ruled out even where location basis variability is significant. Hedging strategies may call for a certain proportion of the inventory of livestock on feed to be hedged, although the proportion will be reduced by location basis variability. From the point of view of feeders, location basis variability puts additional limits on the risk-shifting effectiveness of hedging. From the point of view of the futures markets themselves, location basis variability reduces the supply of hedges forthcoming from feeders. This study found that location basis variability was not significant for slaughter hogs in the Southern markets studied, but it was significant for fed cattle in the Southern and Southern Plains markets. If one takes into account the general growth in livestock hedging, these findings suggest that hedging of hogs in the South may grow in proportion to hedging in other areas, notably the Corn Belt, but that growth in hedging of fed cattle will be limited.

Since the conclusion of significant basis variability in the Southern and Southern Plains fed cattle markets has considerable potential impact, it is well to review the procedure by which this conclusion was reached. The formal analytical procedure had two phases. First, the hypothesis of equality of cash market price variances among markets for a given grade was tested. If the hypothesis was accepted, the second step was to test for the equality of hedging revenue variances. On the other hand, the test procedure stopped if price variances were found to be unequal. Inequality of price variances was taken as indication the spatial market was not sufficiently competitive to allow basis-free hedging.

There was a potential for making a type II error in this procedure. A type II error is committee when a hypothesis is accepted as true when it is actually false. Thus, a type II error could have been committed when hog price variances were accepted as being equal among markets, or when choice steer price variances were accepted as being equal. The probability of making a type II error is never known, but it is known that the probability decreases with increasing sample size. So, while type II errors might have been committed, the probability is low because the samples were comparatively large. Some 260 daily observations were used for hogs, and about 180 weekly observations were used for cattle. These samples were large as such analyses go. In statistical parlance, they provided large numbers of degrees of freedom and consequently made the tests quite powerful.

The potential for making a type I error, rejecting a true hypothesis, is always present in statistical analysis, but its probability can

be controlled. Otherwise known as the level of significance, this probability was set at 5%. The 5% level of significance is a very conventional level, but higher or lower levels might have been adopted. At a higher level of significance, say 1%, several hypotheses that were rejected in this study would have been accepted, namely most of the hypotheses concerning location basis variability for choice steers.

This seeming digression on statistical procedures has been presented to show that the relatively small degree of location basis variability which seems to be present for choice steers in the Southern Plains, a very important cattle feeding area, could be covered up by judicious cooking of the statistical procedures. This would be unwise. The equivalence of price variances between it and Omaha indicate a fundamentally healthy state of spatial competition. What is needed is to eliminate the lags in price adjustment which cause basis variability. Perhaps establishment of the Guymon, Okla. delivery point may be sufficient to accomplish this, particularly if the delivery discount is adjusted to accurately reflect price differentials. However, more resources may have to be invested in price formation and reporting to eliminate the problem. Location basis variability was more serious in the Kentucky and Georgia markets. In view of the small numbers of cattle fed in these areas and the westward shift of the center of gravity of cattle feeding, it is doubtful if their location basis variability problems can be surmounted.

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Appendix Table 1. Means, Variances, and Covariances of Choice Steer Futures, by Length of Hedge, January 1969-June 1972.

Hedging Period	Mean	Variance	Covariance, With Cover Price
	$ per cwt	-----($ per cwt)^2-----	
Cover Price	31.64	0.83	----
31-week Hedge	29.11	0.15	0.056
30-week Hedge	29.15	0.19	0.086
29-week Hedge	29.19	0.21	0.097
27-week Hedge	29.28	0.25	0.115
25-week Hedge	29.35	0.21	0.091
22-week Hedge	29.52	0.20	0.004
21-week Hedge	29.58	0.28	0.035
19-week Hedge	29.73	0.34	0.065
17-week Hedge	29.87	0.32	0.133
16-week Hedge	29.93	0.26	0.139
13-week Hedge	30.15	0.33	0.112