NCCC-134
APPLIED COMMODITY PRICE ANALYSIS, FORECASTING AND MARKET RISK MANAGEMENT

Methods for Selecting Delivery or Cash Settlement Arrangements for Agricultural Futures Contracts: The Case of Live Cattle

by

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METHODS FOR SELECTING DELIVERY OR CASH SETTLEMENT ARRANGEMENTS FOR AGRICULTURAL FUTURES CONTRACTS: THE CASE OF LIVE CATTLE[1]

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If we accept Holbrook Working's argument (p. 433) that futures markets "depend for their existence primarily on hedging," then it is reasonable to ask how futures contracts can be designed to better serve hedgers' needs. In a previous paper on soybeans we addressed this question by estimating the effects of alternative final settlement arrangements on aggregate basis risk from locational price differences (Heifner, Plato, and Wright). Our soybean results illustrated the gains from locating delivery or cash settlement points within the Cornbelt, but showed quite small differences between locations there. This paper evaluates final settlement arrangements for live cattle futures from a somewhat broader perspective that includes pricing imprecisions induced by the contracts themselves as well as spatial price variation.

Most agricultural futures contracts ensure the necessary convergence of futures and cash prices at contract maturity by allowing for physical delivery. However, the decline of central cash markets has reduced the concentrations of commodities at points where they can be conveniently diverted to futures delivery and led to increased potential for delivery period squeezes. To deal with this problem the exchanges have introduced multiple delivery points for most agricultural futures contracts and turned to cash settlement in a few cases.

Our primary objective is to develop procedures for choosing among alternative futures final settlement arrangements for commodities that are costly to transport and produced and consumed over space. A second objective is to evaluate specific final settlement arrangements for live cattle futures. We believe the paper is among the first to consider both the basis risks that arise from underlying spatial differences in supply and demand and the basis risks that arise from pricing imprecisions induced by the futures contracts themselves.

Sources of Hedgers' Basis Risks

Hedging generally does not completely eliminate the hedger's revenue uncertainty because of variability in end-of-period basis. The hedger's end-of-period basis is uncertain because of (1) randomness in price differences associated with location, quality, and delivery times, and (2) contract-induced pricing imprecisions at individual delivery or cash settlement points. Basis risks generally cannot be estimated by experimenting with alternative futures final settlement arrangements. We must instead estimate from historical observations the risks arising from various sources and put these together to estimate the risks associated with each settlement arrangement.

The risks associated with spatial price variations are the main focus of this paper because they are important and can be estimated with available data. We apply the model developed for soybeans in our 1992 paper. Our

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[1] The authors are economist with the Economic Research Service, U.S. Department of Agriculture. They are indebted to Ron Gustafson, Ken Mathews, Kenneth Nelson, Steve Reed, John Van Dyke, Michael O'Connor, Fred Linse, and Bill Lindamood for advice and assistance with the data.

empirical analysis uses historical prices of slaughter cattle, feeder cattle, and grain for successive 4-month feeding periods in leading cattle feeding states.

The risks associated with pricing imprecisions induced by futures contracts at delivery or cash settlement points are more difficult to quantify. Each different final settlement arrangement introduces it own pricing imprecisions. For example, futures and cash prices at contract maturity tend to differ by the cost of making or taking delivery which depend upon specific contract provisions. Delivery period squeezes may introduce additional pricing imprecisions. Similarly, price reporting errors and possible price manipulation may introduce imprecisions in prices for cash-settled contracts. Because data limitations preclude direct measurement, we report indicators of potential contract-induced pricing imprecisions.

Basis Risk Resulting from Uncertainties About Price Differences Over Space, Time, and Form

Price differences over space, time of delivery, and product quality exhibit uncertainty due to unanticipated shifts in supply and demand for specific product attributes. Such uncertainty can be measured in terms of mean squared deviations from expectations. Two closely related performance measures are used. Both are calculated by simulating futures prices historically for alternative final settlement arrangements and using the simulated futures prices in combination with observed cash prices to calculate minimum-risk hedge ratios and hedging effectiveness at the various locations. The first performance measure is a weighted sum of revenue variances or certainty equivalent losses. This approach seeks a socially optimal solution--one that minimizes total certainty equivalent loss. The second approach involves maximizing the total of hedgers' positions in the contract under the assumption that hedgers at all locations use risk-minimizing hedges. Since open interest and the amount of commissions generated are positively related, this approach should be of interest to exchange members who wish to increase commissions generated.

Measuring Risk

In measuring risk in terms of deviations from expectations this study follows the spirit of Myers and Thompson's proposal to calculate optimal hedge ratios using conditional variances and covariances. This approach forces us to make explicit assumptions about how expectations are generated.

Let

$$\Delta P_{it}=P_{it}-E_t(P_{it}),\ i=1,2,\dots n,\ t=1,2,\dots T \qquad (1)$$

be the deviation in end-of-period cash price from its beginning-of-period expectation where P_{it} is the end-of-period cash price at location i for feeding period t, E_t indicates expectation at the beginning of the period, n is the number of locations, and T is the number of feeding periods observed per location. Similarly, let

$$\Delta F_{mt}=F_{mt}-E_t(F_{mt}),\ m\in M,\ t=1,2,\dots T \qquad (2)$$

be the deviation in the futures price from its expectation where F_{mt} is the maturing futures price for settlement method m at the end of period t and M is the set of settlement methods. A measure of aggregate hedging effectiveness is,

$$\overline{R}_m^2=\frac{\sum_{i=1}^{n} W_i R_{im}^2}{\sum_{i=1}^{n} W_i},\ m\in M. \tag{3}$$

where the weights W_i are calculated as follows,

$$W_i=w_i\lambda_i Var(\Delta P_i),\ i=1,2,\ldots n. \tag{4}$$

and w_i represents total hedgeable positions at location i, $\lambda_i<0$ is the coefficient of risk aversion at location i, and R_{im}^2 is hedging effectiveness (proportion of the revenue variance eliminated by hedging) at location i under settlement method m. Maximizing (3) is equivalent to minimizing aggregate certainty equivalent loss.[3] In the empirical analysis that follows we assume that all the λ_i are equal so that they can be omitted.

Alternatively, to calculate the proportion of total supplies that would be hedged by risk-minimizing hedgers we use

$$\overline{H}_m=-\frac{\sum_{i=1}^{n} w_i h_{im}}{\sum_{i=1}^{n} w_i},\ m\in M \tag{5}$$

where w_i is as defined above and h_{im} is the minimum-risk hedge ratio at location i under settlement method m.

Basis Risk Due to Contract-Induced Pricing Imprecisions

Each futures final settlement arrangement introduces its own set of pricing imprecisions. These may arise from: (1) the tendency of the futures to price the cheapest deliverable product; (2) the failure of futures and cash prices to fully converge due to delivery costs; (3) possible delivery period squeezes, or (4) reporting errors or manipulation of prices used for cash settlement. Our model takes (1) into account, but not (2), (3), and (4). The latter generally cannot be observed and compared for the alternative futures contracts being considered and can only be evaluated indirectly.

Pricing of the Cheapest Deliverable Product

Under delivery settlement the futures price tends to converge to the price for the cheapest deliverable product. If the cash price happens to be very low at one delivery point, the futures price will be unexpectedly low relative to cash prices at other locations to the disadvantage of long hedgers

[3] See Heifner, Plato, and Wright.

at the other locations. This problem reflects a fundamental weakness of delivery settlement and it worsens as the number of delivery points increases. Cash settlement avoids the problem by using an average price across locations. We might therefore expect that cash settlement would reduce basis risks, particularly for long hedgers. However, the empirical evidence suggests that the problem is not very severe for live cattle futures. For example, Kahl, Hudson, and Ward show some reduction in basis variability from using cash settlement with Cattle-Fax prices, but not with other price indexes. Our results for cattle feeding reported below show only a slight advantage for cash settlement over delivery settlement.

Incomplete Convergence of Futures and Cash Prices Due to Delivery Costs

Even hedgers who are positioned to deliver or take delivery on a futures contract with a single delivery point are subject to basis risk. Delivery assures that the futures price will not exceed the cash price by more than the cost of making delivery nor will it be less than the cash price by more than the cost of taking delivery. This leaves a range of indeterminacy for the futures price (Garbade and Silber, pp. 454-459). During each delivery period the longs would like to sell out their futures positions at the upper end of the range of price indeterminacy and the shorts would like to buy out their positions at the lower end of the range. The resulting futures price depends on the abilities of the longs and shorts to effectively threaten delivery. Since neither party gains from delivery, delivery normally occurs only when one party misjudges the price at which the opposite party will make or take delivery.[4]

The costs of delivery include a constant component for grading and certification and lot fees plus a hauling cost which tends to increase with the amount of deliveries because of the need to haul longer distances. The constant component is probably about the same at the different locations. The hauling cost component depends on the number of cattle and the amount of slaughter capacity that is available in the vicinity of the delivery point.

Possible Price Distortions Due to Delivery Period Squeezes

As a futures contract approaches maturity and the numbers of position holders decline, one or more of the remaining long or short position holders may be tempted to squeeze the market. A long squeeze occurs when one or a few large longs gain some control of the deliverable supply and force shorts to buy at an inflated price to fulfill contract obligations. Similarly, a short squeeze may occur when one or a few large shorts threaten delivery to longs who cannot dispose of the commodity and must sell out at a depressed price. The squeezer gains only to the extent that he/she manages to sell to or buy from opposite position holders at a distorted price. Product delivered on the futures market during a squeeze must be obtained from and returned to normal commercial channels which generally results in added costs for both parties.

Susceptibility to manipulation generally can be lowered by making delivery more convenient, by limiting the size of traders' positions as contracts near maturity, or in the case of cash settlement, by increasing the number of cash prices used in determining final settlement prices. The

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[4] The exception is when one party prefers futures delivery to cash delivery which amounts to a negative delivery cost for that party.

potential for manipulation generally declines as the volume of cash trading at or near deliverable locations increases. This calls for substantial slaughter capacity near delivery points to make short squeezes difficult as well as large numbers of cattle on feed nearby to make long squeezes difficult.

Long position holders frequently have an advantage in squeezing agricultural futures markets because they are larger and fewer in number than the shorts. This advantage is lessened or reversed by multiple delivery point arrangements which increase deliverable supplies and allow the shorts to determine where deliveries are made.

Unlike the would-be long squeezer, who must be prepared to take delivery at any delivery point where shorts might want to deliver, the would-be short squeezer can choose where he/she wants to threaten delivery. Suppose, for example, that one firm dominates slaughter at one of the delivery points. Then that firm, although normally a long position holder, might occasionally attempt a short squeeze by taking a large short position, lowering the price at which it will buy cattle at the delivery point it dominates, and threatening to make deliveries there. This might force the longs to sell out their positions at a depressed price to avoid having to take delivery. Thus, more than one potential buyer is needed at each delivery point to prevent short squeezes.

Reporting Errors and Possible Manipulation of Prices Used for Cash Settlement

Cash settlement eliminates the pricing imprecisions associated with futures delivery costs, but introduces another source of pricing imprecision--errors in observing the prices used for settlement. In addition to random sampling errors, response bias may be a problem. Such imprecisions can be reduced by increasing the number of persons contacted about prices and by obtaining responses from both buyers and sellers.

Cash settlement removes the futures delivery requirement that would-be squeezers can use to force opposite position holders to trade out of their positions at distorted prices. Cash settlement prices might nonetheless be manipulated by selling or buying in extraordinarily large quantities on the cash market as price quotations are being collected for use in futures settlement. Leuthold has argued that delivery brings more information to the market in the form of arbitrage opportunities than does cash settlement. Paul (1985, pp. 307-8) suggests that the amount of capital required to manipulate prices would be about the same under cash settlement as under delivery.

Estimates of Basis Risk Due to Location

Our empirical analysis consists of two parts: (1) estimation of aggregate basis risks and potential hedging volume arising from spatial price variation and (2) estimation of the number of cattle within different distances of selected delivery or cash reporting points. The delivery and cash pricing points were selected based on the availability of AMS price data. These are listed in table 1 along with the weights assigned to each for each feeding period. The analysis was performed for three 4-month feeding periods beginning and ending in January, May, and September.

Table 1--Cattle feeding locations included in the analysis and weights assigned to each location by feeding period1/

Location	Weight by feeding period		
	Jan.-May	May-Sept.	Sept.-Jan.
Kansas	0.180	0.183	0.179
Nebraska	.227	.208	.219
Texas, Okla.	.266	.290	.276
Iowa, Minn., S.Dak.	.164	.152	.147
Colorado	.097	.099	.099
California	.040	.048	.052
Arizona	.027	.022	.027
Total	1.001	1.002	0.999

1/ Weights are based on numbers of cattle on feed by feeding period averaged over the 5-year period, 1988-1992. April 1 estimates were used for the January-May feeding period, July 1 estimates were used for the May-September feeding period, and an average of October 1 and January 1 estimates were used for the September-January feeding period. Totals differ slightly from 1 due to rounding.

Data

The weights, w_{ip}, for each location and feeding period are proportional to numbers of cattle fed by feeding area during the 5-year period 1988 to 1992,

$$w_{ip}=\frac{1}{5}\sum_{t=1988}^{1992} N_{itp},\ i=1,2,\ldots n \qquad (6)$$

where N_{itp} is the average number of cattle on feed in area i during feeding period p in year t. The location weights differ little between the three feeding periods.

Table 2 shows the final settlement arrangements evaluated. These fall into three categories: single-point delivery or cash settlement; multiple point delivery; and multiple point cash settlement.

The analysis requires data on end-of-period prices for slaughter cattle and beginning-of-period prices for feeder cattle and feed. The prices used are weekly averages prices for feeder and slaughter steers and Wednesday prices for grain for the last week in January, May, and September for each year from 1980 to 1992 (table 3). We assume that feeder steers are purchased at 720 pounds, fed 121 days, and sold as fed steers at 1060 pounds. Further, we assume that 6.6 pounds of grain are fed per pound of gain giving a total grain requirement of 2244 pounds per animal.

Table 2--Final settlement arrangements evaluated

No.	Locations included
Single point delivery or cash settlement	
1.	Kansas
2.	Nebraska
3.	Texas-Oklahoma
4.	Iowa, So. Minn., S. Dak.
5.	Colorado
6.	California
7.	Arizona
Multiple point delivery	
8.	Kansas, Nebraska, Texas-Oklahoma, Iowa-So. Minn., Colorado with average price differentials.
9.	Kansas, Nebraska, Texas-Oklahoma, Iowa-So. Minn., Colorado with zero price differentials.
10.	Kansas, Texas-Oklahoma, Colorado with average price differentials.
11.	Kansas, Texas-Oklahoma, Colorado with zero price differentials.
Multiple point cash settlement	
12.	All seven states with weights proportional to inventory.
13.	All seven states with equal weights.

Table 3--AMS Market News price quotations used in study

Fed cattle, Choice steers, 2-4, 1000-1100 lb. (weekly ave.)	Feeder cattle, Medium steers Frame No. 1 700-800 (weekly ave.)	Grain (Wednesday prices)
Kansas	Dodge City auct.	Sorghum, Kansas City
Nebraska	Sioux City	Corn, Omaha
Texas-Okla.	Amarillo	Sorghum, Tex. High Pln.
Iowa, S. Minn.	Sioux City	Corn, Omaha
Colorado	Dodge City auct.	Corn, Omaha
California	California	Sorghum, Los Angeles
Arizona	California	Sorghum, Los Angeles

Computational Steps

Application of the model involves five steps:

1. Simulate beginning-of-period expectations for end-of-period slaughter cattle prices at each location for each feeding period in the sample.

2. Calculate for each settlement method simulated beginning and ending slaughter cattle futures prices for each feeding period in the sample.

3. Calculate the covariance matrix of price deviations from expectations for all cash and simulated futures price series.

4. Calculate minimum-risk hedges for each location and each final settlement method using the covariance matrix of price deviations from expectations.

5. Calculate the weighted average hedging effectiveness and total open interest for risk-minimizing hedgers.

Simulating Price Expectations

We simulated beginning-of-period expectations of end-of-period slaughter cattle prices at each location by two different methods:

Method 1: Observed futures plus lagged basis. This method involves adding a basis calculated from previous years' experience to the current futures price,

$$E_t(P_{it})=F_t^o+\hat{B}_{it} \tag{7}$$

where P_{it} is defined specifically as the price for slaughter steers at location i at the end of period t, F_t^o is the futures price observed at the beginning of period t for the live cattle futures contract that matures at the end of the period, and $\hat{B}_{it}$ is the projected end-of-period basis at location i. The projected basis is calculated from lagged differences between cash and futures prices,

$$\hat{B}_{it}=\frac{1}{k}\sum_{s=t-k}^{t-1}(P_{is}-F_s) \tag{8}$$

where k is the number of lagged observations used and F_s is the observed end-of-period price of the maturing futures. The results reported here are based on a 3-year lag, k=3.

This method for simulating price expectations is patterned on the procedures used by hedgers to forecast local prices. However, the method is not ideal for comparing alternative futures final settlement arrangements because the results depend in part on the settlement arrangement that has been used historically. We cannot be sure that expectations so constructed are equally appropriate for all possible settlement methods being evaluated. Moreover, using the same futures price to simulate price expectations at all locations may bias upward the estimated correlations and estimates of hedging effectiveness. Thus, we also calculate price expectations using a second method which avoids use of observed futures prices.

Method 2: Cost plus lagged return. The cost plus lagged return method is based on the assumption that the expected end-of-period price of slaughter cattle at each location equals the local cost of the feeders and the grain at the beginning of the period plus a projected return above feeder and grain costs,

$$E_t(P_{it}) = (1+\frac{I_t}{3})(c_iC_{it}+g_iG_{it})+\hat{R}_{it} \tag{9}$$

where I_t is the interest rate, c_i and g_i constants representing, respectively, the pounds of feeder cattle and the pounds of grain required per pound of slaughter cattle sold at location i, C_{it} and G_{it} are the prices per pound for feeder cattle and for grain at the beginning of the feeding period, and $\hat{R}_{it}$ is projected return above the costs of feeders and grain. $\hat{R}_{it}$ is calculated from lagged observations as follows:

$$\hat{R}_{it}=\frac{1}{k}\sum_{s=t-k}^{t-1}[P_{is}-(1+\frac{I_s}{3})(c_iC_{is}+g_iG_{is})] \tag{10}$$

Shortcomings of this method include errors in estimating costs and disregard of information contained in futures prices about prospective profits above costs. This method generates lower estimates of price correlations and hedging effectiveness than does the first method.

Simulating Futures Prices under Alternative Final Settlement Methods

Simulated beginning and ending futures prices were calculated from observed cash prices and simulated cash price expectations for each different final settlement arrangement. Three types of final settlement are evaluated here: single point delivery or cash settlement; multiple point delivery; and multiple point cash settlement. With single point delivery or cash settlement the futures price equals the spot price at the delivery point

$$F_{mt}=P_{jt},\ m\in M_1,\ t=1,2,\ldots T \tag{11}$$

where F_{mt} is the simulated futures price for settlement method m at the end of feeding period t, and P_{jt} is price at the delivery point for settlement method m and M_1 is the set of single point delivery arrangements.

With multiple delivery points we assume that delivery occurs at the point where the commodity can be acquired by shorts at the lowest price, after adjusting for the locational discount or premium. This gives a futures price of

$$F_{mt}=\underset{j}{Min}(P_{jt}-d_{mj}),\ m\in M_2,\ j\in J_m,\ t=1,2,\ldots T \tag{12}$$

where M_2 is the set of multiple point delivery arrangements, J_m is the set of delivery points allowed under settlement method m, d_{mj} is the premium(+) or discount(-) for delivery at point j under final settlement method m.

For cash settlement, the futures price is a weighted average of prices at one or more locations

$$F_{mt}=\sum_{j\in J_m} a_j P_{jt},\ m\in M_3,\ t=1,2,\ldots T \qquad (13)$$

where J_m is the set of pricing points contained in m and a_j is the weight assigned to point j in the final settlement formula such that $\sum_j a_j = 1$. Note that if only one point is used for determining the cash settlement price the result is the same as for delivery at that point.

Results

Estimates of weighted average hedging effectiveness calculated for alternative final settlement arrangements using observed futures plus lagged basis price expectations are reported in table 4. Corresponding estimates of the percent of cattle hedged by risk-minimizing hedgers are shown in table 5. Estimated hedging effectiveness was near 1 for all locations and all final

Table 4--Weighted average hedging effectiveness for alternative final settlement methods, price expectations based on futures prices and lagged basis.

Settlement method	Feeding period			
	Jan.-May	May-Sept.	Sept.-Jan.	Average
Single point				
1. Kansas	0.990	0.990	0.934	0.971
2. Nebraska	.988	.989	.882	.953
3. Tex.-Okla.	.993	.991	.945	.976
4. Ia., So. Minn.	.989	.986	.944	.973
5. Colorado	.989	.990	.948	.976
6. California	.987	.944	.865	.932
7. Arizona	.977	.943	.879	.933
Multiple point delivery				
8. 5 points, ave. diff.1/	.992	.991	.924	.969
9. 5 points, zero diff.1/	.990	.990	.896	.958
10. 3 points, ave. diff.2/	.989	.991	.943	.975
11. 3 points. zero diff.2/	.989	.992	.948	.976
Cash settlement				
12. 7 points, prop. wts.	.995	.993	.961	.983
13. 7 points, equal wts.	.994	.991	.958	.981

1/ Includes Kansas, Nebraska, Texas-Oklahoma, Iowa-Southern Minnesota, and Colorado.
2/ Includes Kansas, Texas-Oklahoma, and Colorado.

Table 5--Weighted average risk-minimizing hedge ratios for alternative final settlement methods, price expectations based on observed futures prices and lagged basis.

Settlement method	Feeding period			
	Jan.-May	May-Sept.	Sept.-Jan.	Average
	Percent			
Single point				
1. Kansas	104.8	101.6	93.4	100.3
2. Nebraska	92.3	100.2	90.0	94.3
3. Tex.-Okla.	101.6	105.8	98.0	101.9
4. Ia., So. Minn.	90.2	98.8	91.0	93.3
5. Colorado	101.7	95.8	89.3	96.0
6. California	106.5	102.6	109.3	106.1
7. Arizona	116.6	102.5	92.3	104.7
Multiple point delivery				
8. 5 points, ave. diff.1/	93.0	97.9	93.9	94.9
9. 5 points, zero diff.1/	92.2	100.8	92.1	95.1
10. 3 points, ave. diff.2/	103.2	98.5	91.3	98.1
11. 3 points, zero diff.2/	101.4	97.6	89.3	96.5
Cash settlement				
12. 7 points, prop. wts.	100.3	100.2	99.7	100.1
13. 7 points, equal wts.	102.8	101.9	100.8	101.9

1/ Includes Kansas, Nebraska, Texas-Oklahoma, Iowa-Southern Minnesota, and Colorado.
2/ Includes Kansas, Texas-Oklahoma, and Colorado settlement points for Table

settlement arrangements for feeding periods beginning in January and May, except that having delivery only in California or Arizona would reduce effectiveness to about 94 percent for the May period. Estimated hedging effectiveness was lower for the September-January feeding period than for the other two periods. The highest risk-shifting effectiveness for the September-January period was under cash settlement, but the advantage over the best delivery arrangements is only about 1 percent. The last column in each table shows the results from pooling the data for the three feeding periods.

Corresponding estimates of aggregate hedging effectiveness and percentages hedged are reported in tables 6 and 7 for price expectations based on costs plus lagged returns. The hedging effectiveness estimates in table 6 are considerably lower than those in table 4, but the differences between the alternative final settlement arrangements are small in both tables. We conclude that risk-shifting effectiveness is not very sensitive to the location of delivery or cash settlement points, except that delivery only in Arizona or California would be less satisfactory than the other arrangements.

Table 6--Weighted average hedging effectiveness for alternative final settlement methods, price expectations based on costs plus lagged return.

Settlement method	Feeding period			
	Jan.-May	May-Sept.	Sept.-Jan.	Average
Single point				
1. Kansas	0.770	0.804	0.855	0.810
2. Nebraska	.433	.856	.765	.685
3. Tex.-Okla.	.730	.894	.833	.819
4. Ia., So. Minn.	.572	.799	.841	.737
5. Colorado	.771	.830	.841	.814
6. California	.340	.673	.693	.568
7. Arizona	-.032	.686	.500	.384
Multiple point delivery				
8. 5 points, ave. diff.1/	.744	.807	.835	.795
9. 5 points, zero diff.1/	.681	.828	.812	.774
10. 3 points, ave. diff.2/	.740	.823	.853	.805
11. 3 points. zero diff.2/	.743	.832	.854	.810
Cash settlement				
12. 7 points, prop. wts.	.797	.915	.909	.874
13. 7 points, equal wts.	.793	.905	.890	.863

1/ Includes Kansas, Nebraska, Texas-Oklahoma, Iowa-Southern Minnesota, and Colorado.
2/ Includes Kansas, Texas-Oklahoma, and Colorado.

Supply and Demand for Slaughter Cattle At Potential Delivery or Cash Settlement Points

Pricing precision at futures delivery or cash settlement points can be expected to increase as the numbers of cattle fed and slaughtered nearby increase. As indicators of potential cattle supplies we calculated the numbers of cattle fed within 50, 75, and 100 miles of the locations included in each final settlement arrangement. Road distances were approximated by rectangular distances between the designated delivery or cash settlement points and county centers. County estimates of cattle fed concentrates and sold were obtained from the 1987 Census of Agriculture. Estimates for counties not reported in the Census due to disclosure problems were constructed by multiplying Census county estimates of the numbers of feedlots in each size category by the corresponding state average numbers of cattle in each size feedlot and summing over size categories.

Table 7--Weighted average risk-minimizing hedge ratios for alternative final settlement methods, price expectations based on costs plus lagged return.

Settlement method	Feeding period			
	Jan.-May	May-Sept.	Sept.-Jan.	Average
	Percent			
Single point				
1. Kansas	89.7	105.6	87.9	94.5
2. Nebraska	71.6	108.0	91.4	89.7
3. Tex.-Okla.	98.7	82.9	82.9	88.7
4. Ia., So. Minn.	72.8	90.4	99.9	86.7
5. Colorado	100.0	84.2	87.7	91.0
6. California	80.0	72.7	92.2	81.2
7. Arizona	65.0	70.8	69.2	68.2
Multiple point delivery				
8. 5 points, ave. diff.1/	88.7	113.3	82.7	95.2
9. 5 points, zero diff.1/	89.9	120.3	84.6	98.5
10. 3 points, ave. diff.2/	97.6	105.8	79.7	95.0
11. 3 points, zero diff.2/	97.7	99.4	79.8	92.9
Cash settlement				
12. 7 points, prop. wts.	100.6	100.5	99.9	101.4
13. 7 points, equal wts.	106.3	97.5	99.3	101.3

1/ Includes Kansas, Nebraska, Texas-Oklahoma, Iowa-Southern Minnesota, and Colorado.
2/ Includes Kansas, Texas-Oklahoma, and Colorado settlement points for Table

The actual numbers of cattle available for futures delivery would be only a small fraction of the estimated numbers fed during 1987 shown in table 8. First, only cattle ready for slaughter during a futures delivery period would be available for delivery. Moreover, a large portion of the cattle ready for slaughter at any time are not of the proper sex, grade, or weight to meet delivery requirements. However, the correlation between the 1987 totals by location and the amount of cattle available for delivery at any time is believed to be high.

Evaluating delivery points for short squeeze potential would require data on location and ownership of cattle slaughtering capacity which we lack. We report in table 8 estimates of total numbers of cattle slaughtered during 1992 in the states involved.

The main conclusion to be drawn from table 8 is that each of the five leading states adds substantially to the total numbers of cattle available for delivery or represented by cash settlement prices.

Table 8--Number of cattle fed and slaughtered near delivery or cash settlement points for alternative final settlement methods

Settlement method	Cattle fed within specific distances from a pricing point1/			Cattle slaughtered in included states2/
	50 mi.	75 mi.	100 mil.	
	-----------------	Thousands	-----------------	
Single point				
1. Kan. (Dodge City)	701	1,705	2,644	6,027
2. Neb. (Grand Island)	422	787	1,647	6,310
3. Tex.-Ok. (Amarillo)	489	1,927	2,219	5,652
4. Ia., Minn., S.D. (Sioux City)	899	1,500	2,427	3,224
5. Col. (Greeley)	853	1,214	1,215	2,236
6. Cal. (Imperial)	490	490	546	1,082
7. Ariz. (Phoenix)	357	357	370	350
Multiple point delivery				
8, 9. Kan., Neb., Tex., Ia., and Col.	3,364	7,133	9,982	23,449
10, 11. Kan., Tex. and Ia.	2,089	5,132	7,290	14,903
Cash settlement				
12, 13. 7 points	4,211	7,980	10,898	24,881

1/ Calculated from 1987 Census of Agriculture estimates of cattle fed grains and concentrates and sold using rectangular distances from the city shown in parentheses.
2/ Estimates for 1992 reported in Agricultural Statistics.

Summary and Conclusions

Because revenue deviations from expectations are highly correlated among the major cattle feeding areas, overall hedging effectiveness is relatively insensitive to the location of futures delivery or cash settlement points. For the same reason, neither adding or eliminating delivery points nor switching to cash settlement would affect hedging effectiveness by much. These results suggest that a relatively large number of delivery points, such as we now have, might limit the potential for long squeezes without introducing other sources of basis uncertainty for hedgers. However, competition among slaughtering firms is needed at each delivery point to limit the potential for short squeezes.

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