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APPLIED COMMODITY PRICE ANALYSIS, FORECASTING AND MARKET RISK MANAGEMENT

## **Short-Term Variability in Grid Prices for Fed Cattle**

by

Clement E. Ward and Jong-In Lee

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## Short-Term Variability in Grid Prices for Fed Cattle

Clement E. Ward and Jong-In Lee\*

This research examined variability in grid prices that can occur within a given day or week for a given set of cattle. Data for one day's slaughter from four plants revealed considerable variation in cattle brought to slaughter by cattle feeders. Several sources of variation were found. Base prices varied \$2/dressed cwt., or \$15/head, whether using plant averages or formulas tied to reported cash-market prices. Prices across grids added another \$2-4/cwt. of variation, another \$15 to \$30/head. Variation in carcass characteristics contributed significantly to the variation in grid pricing, especially discounted characteristics such as Select and Standard carcasses, Yield Grade 4-5 carcasses, light and heavy carcasses, and non-conforming or "out" carcasses.

### Introduction

Numerous formula and grid pricing arrangements exist for fed cattle. Formula pricing refers to establishing a transaction price using a formula that includes some other price as a reference (Ward, Feuz, and Schroeder 1999). Grid pricing consists of a base price with specified premiums and discounts for carcasses above and below a set of quality specifications. Grid pricing may involve using a formula for establishing the base price or the base price may be a negotiated price.

There are several potential sources of price variability in conjunction with grid pricing, including:

- Alternative base prices
- Alternative premium-discount grids
- Packing plant where cattle are slaughtered
- Cattle quality
- Time of slaughter.

More specifically, at any given time for any given sale lot of cattle, producers can price their fed cattle using a grid from several packers. How much difference is there in net price for alternative grids and base prices? The objective of the research reported here was to examine this short-term variability in grid prices. Short-term refers to the variability that can arise on any given day from pricing fed cattle with alternative formula or negotiated base prices and alternative premium-discount grids.

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\* Professor and Extension Economist, and Graduate Research Assistant, respectively, Department of Agricultural Economics, Oklahoma State University.

## Data Sources and Procedure

This study took a cross-section approach unlike other grid pricing research, thus grid prices were examined at a given point in time. Data were provided from several industry sources. Carcass data were obtained on 140 sale lots of cattle of at least 25,000 pounds (i.e., about 20 head or more) slaughtered on the same day in four plants from Nebraska to Texas. Number of head totaled 19,426. Plants are referred to as Northern Plains 1 and 2 and Southern Plains 1 and 2. Not all packers keep records in the same manner. Therefore, some assumptions were necessary regarding the categories of carcass information kept by packers for the sake of data consistency. These assumptions affected selected results and will be mentioned in a later section. Premium-discount grids were collected for the week of November 17, 1997, and were believed to closely represent premium-discount grids reported to the Agricultural Marketing Service (AMS), U.S. Department of Agriculture (USDA) and summarized in the weekly *National Carcass Premiums and Discounts for Slaughter Steers and Heifers* report. Table 1 shows a sample grid as if might be given to a producer by a packer. Table 2 shows the same grid in a matrix format, thus leading to the term "grid."

**Table 1. Example Grid, as Presented by a Packer (\$/dressed cwt)**

Choice YG3 600-900 lb	Base Price (\$/dressed cwt)
Prime-Choice Price Spread	6.00
Choice-Select Price Spread	-6.00
Select-Standard Price Spread	-10.00
Dark cutters	-20.00
Light Carcasses (<600 lb)	-10.00
Heavy Carcasses (>900 lb)	-20.00
Yield Grade 1	5.00
Yield Grade 2	3.00
Yield Grade 4	-20.00
Yield Grade 5	-25.00

**Table 2. Example Grid in a Matrix Format (\$/dressed cwt.)**

Quality Grade	Yield Grade			
	2	3	4	5
Prime		6.00		
Choice		BASE		
Select	5.00	3.00	-6.00	-20.00
Standard			-16.00	-25.00
Dark Cutters		-20.00		
Light Carcasses (<600 lb)		-10.00		
Heavy Carcasses (>900 lb)		-20.00		

Reported premium-discount grids for any single week can vary significantly. For the week chosen, premiums for Prime grade carcasses ranged from \$3.00 to \$10.00/cwt. Discounts for Standard grade carcasses ranged from -\$9.00 to -\$30.00/cwt. and for yield grade 4 carcasses, -\$10.00 to -\$20.00/cwt. Other premiums-discounts also varied across reported grids.

Base prices use in this study were selected from reported live weight and dressed weight prices from AMS for the week ending November 15, 1997. Mean dressed weight prices across quality groups in the five-state weighted-average report (*Livestock, Meat and Wool Weekly Summary and Statistics*) ranged from \$106 to \$107.58/cwt. and mean live weight prices (converted to dressed weight prices by dividing by an average 63.3% dressing percentage) ranged from \$105.67 to 107.33/cwt. In addition, an estimate was made of fed cattle prices based on the process followed by packers to estimate fed cattle prices and using summary data for the four plants (Ward, Schroeder, and Feuz 1998). The estimated break-even dressed weight price was \$107.05/cwt. Selected base prices chosen were: low, \$106.00; medium, \$107.00; and high, \$108.00/cwt. In addition, a plant-average price was estimated following the example in Ward, Feuz, and Schroeder 1999).

Several alternative prices were simulated for each of the 140 sale lots of carcass data. Actual prices paid by packers were not known for each sale lot. Prices assigned to each lot included a live weight and dressed weight price based on the appropriate quality category for reported prices. In addition, 21 grid prices were estimated using three base prices and seven premium-discount grids. Each base price was assumed to be for Choice, Yield Grade 3 carcasses. Simulated prices were summarized across alternative base prices and premium-discount grids, both across sale lots and plants. Prices also were summarized across premium-discount grids within each sale lot.

Seven grid prices were estimated for each of the 140 sale lots using a common base price. Therefore, to aid in summarizing the effects of carcass attributes on prices and price variability across premium-discount grids, three regression models were estimated. The three models were intended to identify the relative importance of carcass attributes that receive premiums and those that are discounted on prices and price variability. Models of the following form were estimated by OLS regression:

- (1) Std Dev of Mean Price =  $f(\%Prime, \%Select, \%Standard, \%YG1, \%YG2, \%YG4-5, \%Light, \%Heavy, \%Outs)$
- (2) Mean Price =  $f(\%Premium\ attributes, \%Discount\ attributes)$ , and
- (3) Std Dev of Mean Price =  $f(\%Premium\ attributes, \%Discount\ attributes)$ .

Variables were defined as follows:

- Std Dev of Mean Price is the standard deviation of prices across seven grids for the same sale lot of cattle
- Each “%” variable is the percentage of the sale lot which consisted of those attributes, i.e., Prime, Select, Standard quality grades, Yield Grades 1, 2, and 4-5, Light carcasses (< 550 lbs.), Heavy carcasses (> 900 lbs.), and “Out” or non-specification carcasses such as dark cutters, heiferettes, hard bones, dairy breeds, etc.

- Mean Price is the average of prices across seven grids, assuming a common base price, for each sale lot of cattle
- % Premium attributes is the sum of carcass attributes in the sale lot which receive premiums in most grids, i.e., %Prime, %YG1, and %YG2
- % Discount attributes is the sum of carcass attributes in the sale lot which receive discounts in most grids, i.e., %Select, %Standard, %YG4-5, %Light, %Heavy, and %Outs.

### Carcass Data Summary

Table 3 summarizes selected carcass data collected from the four packing plants. These data were for one day's slaughter. Variation attributable to seasonality and other factors is not reflected in these data.

The percentage of carcasses grading Prime was estimated from the percentage of Choice or above in each sale lot. The mean %Prime carcasses from three independent data sets of cattle were used to estimate the %Prime carcasses consistently across all plants for this set of carcass data. Thus, as %Choice increased, so did %Prime. Note that the percentage of %Choice carcasses differed significantly between the two Northern Plains plants and two Southern Plains plants. Some cattle feeders assert that Northern Plains cattle are higher quality than Southern Plains cattle and thus a higher percentage are marketed on a carcasses weight or grid basis (Schroeder et al. 1997). The percentage of %Standard carcasses varied widely, in part due to the way in which data were provided and interpreted. Included in %Standard carcasses were no roll or ungraded Select carcasses as well as Standard carcasses. Thus, the range of %Standard in the 140 lots was wide, and wider than would be expected if *only* carcasses grading Standard were included. Heavier carcasses were assumed to be greater than 900 lb and lighter carcasses were those less than 550 lb. The percentage of "out" carcasses, those not meeting desired carcass specifications of packers, included dark cutters, heiferettes, condemned carcasses, and dairy breeds. Thus, the range of %Out carcasses in this set of carcass data was wider than would be expected if dairy carcasses had been excluded.

### Price Variation Summary

*Base Prices* - The focus of this project was on the variation across premium-discount grids at a given point in time. However, it should be noted that significant variation occurs in the base price as well. Plant average base prices were calculated from the one-day slaughter data according to the procedure described in Ward, Feuz, and Schoreder (1999). The estimated plant average base price for Choice, Yield Grade 3 cattle ranged from \$112.91 to \$110.74/dressed cwt., a variation of \$2.17/cwt. or over \$16/head. Thus, cattle feeders may experience a significant difference in the base price when the base price is tied to a plant average cost of cattle. The plant average base price depends on the quality of a given pen of cattle relative to the quality slaughtered in that plant for the period in which the plant average is calculated, usually the preceding week or a three to four week moving average.

**Table 3. Selected Carcass Data Summary Statistics, by Plants and Total Plant**

Variable	Statistic	Northern Plains 1	Northern Plains 2	Southern Plains 1	Southern Plains 2	Total
Lot Size (head)	N	52	22	25	41	140
	Mean	92	196	199	131	139
	Std Dev	95.9	147.1	107.7	92.4	114.4
Average Live Weight (lb.)	Mean	1242	1252	1225	1155	1215
	Std Dev	96.1	98.3	98.2	101.1	105.0
Average Dressing Percentage (%)	Mean	63.5	63.1	63.4	63.2	63.3
	Std Dev	2.0	1.2	1.2	2.5	1.9
% Prime	Mean	2.3	1.7	0.8	0.8	1.5
	Std Dev	2.1	1.3	1.3	1.1	1.7
% Choice	Mean	59.6	58.7	45.1	45.0	52.6
	Std Dev	17.4	11.2	15.4	15.7	17.1
% Select	Mean	30.7	37.9	40.6	45.0	37.8
	Std Dev	17.7	12.3	13.0	13.9	16.0
% Standard	Mean	7.4	1.7	13.6	9.2	8.2
	Std Dev	7.7	2.3	10.6	8.4	8.6
% YG1	Mean	11.9	12.0	24.1	14.8	14.9
	Std Dev	10.3	8.8	15.7	10.8	12.1
% YG 2	Mean	42.9	49.0	46.9	51.4	47.1
	Std Dev	14.6	11.7	10.2	12.2	13.1
% YG3	Mean	41.1	36.2	27.1	30.8	34.7
	Std Dev	16.3	15.1	11.2	14.4	15.6
% YG4/5	Mean	4.2	2.8	1.8	3.2	3.3
	Std Dev	5.1	4.9	2.6	3.9	4.4
% Light Carcasses	Mean	0.1	1.1	0.4	1.0	0.6
	Std Dev	0.4	3.9	1.0	1.3	1.8
% Heavy Carcasses	Mean	3.3	4.5	3.2	2.2	3.2
	Std Dev	5.0	4.8	5.6	5.1	5.1
% "Out" Carcasses	Mean	3.5	0.9	7.1	3.6	3.8
	Std Dev	7.2	2.0	16.8	15.1	1.7

When the base price is tied to a reported market price, the base price may also vary significantly. For the week chosen for this study, the base price varied over \$2/cwt. or over \$15/head. These variations in the base price occur before considering any variation from the premium-discount grids and variation in cattle quality.

*Prices and Price Grids* – Compared with estimated average live weight and dressed weight prices, grid price variation is significantly higher. Average pricing on a live weight or dressed weight basis results in little price variation within and between plants and among sale lots. This finding supports previous work by Feuz, Fausti, and Wagner (1993). Price variation with all grids exceeded the variation with “average” pricing. Mean grid prices varied across grids by \$2.38, \$2.35, \$2.92, and \$2.61/cwt. (or \$18 to \$22/head) for the four plants (Northern Plains 1 to Southern Plains 2, respectively). Thus, the variation from different grids exceeded the variation from the base price. However, together, the variation could exceed \$5/cwt. on a dressed weight basis or over \$38/head.

The variation in mean prices across plants within a single grid also varied, ranging from \$2.94/dressed cwt. for grid 7 to \$5.76/cwt. for grid 2 or \$22 to \$45/head. Quality of the cattle slaughtered varies from plant to plant which, when combined with alternative premium-discount grids, results in substantial variation.

Thus far, only mean prices have been discussed, not the full range of estimated prices (maximum less minimum price). Much less variation can be expected in mean prices than prices for individual sale lots, yet the variation in mean prices across grids and plants is considerable. Recall, also, this is for a single day’s slaughter. Additional variation would occur had data been collected for several slaughter days.

Quality variation and the variation in grid prices can be shown better for one plant in Table 4. Sale lots were sorted into similar groups based on the percentage of Choice carcasses in the sale lot. Then, prices were summarized within like groups of cattle for each grid and each plant. Number of observations in some quality groups was small, especially in the lowest and highest quality groups for each plant. In general and as expected, mean prices increased with higher quality groups of cattle (i.e., sale lots with a higher percentage of Choice carcasses) within all grids. In general, the standard deviation or variation in prices also increased with higher quality groups of cattle within all grids.

In some cases within a quality group and grid for each plant, relatively little variation in the range of prices for individual sale lots was found. For example, there were six sale lots in the Northern Plains 1 plant that had 20-39 percent Choice carcasses in the sale lots. The range in price across the six lots ranged from \$1.37 for grid 4 to \$2.74/cwt. for grid 7. While that variation is important, over \$10/head, it is small compared with most other quality groups. In the adjacent quality group (40-59 percent Choice), among the 17 sale lots, prices ranged from \$9.91 to \$18.23/cwt. for grids 4 and 2, respectively, a difference exceeding \$65/head.

**Table 4. Summary Statistics, Seven Grids, Medium Base Price, by Quality Group and Plant (in \$/dressed cwt.)**

Price	Statistic	Plant – Northern Plains 1				
		0-19	20-39	40-59	60-79	80-100
Grid One	N		6	17	23	5
	Mean	96.87	99.15	99.78	101.75	101.38
	Std Dev	--	0.56	2.79	2.94	3.95
	Range	0.00	1.46	11.36	12.44	10.27
Grid Two	Mean	96.01	98.39	98.82	101.80	101.48
	Std Dev	--	0.79	4.66	4.10	7.01
	Range	0.00	2.02	18.23	17.51	17.08
Grid Three	Mean	94.41	97.27	98.07	100.53	100.46
	Std Dev	--	0.66	3.30	3.54	4.39
	Range	0.00	1.51	12.77	14.77	11.27
Grid Four	Mean	97.18	99.39	100.48	102.86	103.16
	Std Dev	--	0.53	2.42	2.46	3.39
	Range	0.00	1.37	9.92	10.14	8.76
Grid Five	Mean	96.56	99.27	99.71	101.66	100.71
	Std Dev	--	0.80	3.46	3.74	5.51
	Range	0.00	2.12	14.02	15.74	14.06
Grid Six	Mean	96.81	99.23	99.97	102.05	101.78
	Std Dev	--	0.75	3.02	3.20	4.94
	Range	0.00	1.96	12.02	13.58	12.39
Grid Seven	Mean	98.18	100.58	100.94	102.11	100.74
	Std Dev	--	1.11	2.90	3.54	5.33
	Range	0.00	2.74	11.92	15.05	13.65

*Variation within Sale Lots* - Marketing fed cattle with a premium-discount grid involves two strategies, one long-run and one short-run. True value-based marketing means changing cattle to meet consumer preferences for beef products from those animals. This takes time, genetic improvements, feeding to correct end points, etc. In the short-run, a given set of cattle with given attributes can be priced with one of several alternative grids. This section discusses how much variation there is for the same cattle on the same day with alternative grid prices. This variation does not consider the significant variation arising from alternative base prices as discussed earlier which must be added to the variation discussed below to fully recognize and appreciate the true amount of variation with grid pricing.

Recall each sale lot was priced with seven alternative grids for each base price. The following assumes a constant base price. Therefore, variation is attributable for each sale lot to alternative grids and to cattle attributes. Table 5 shows a frequency distribution of the range in prices across the seven grids within each plant for all sale lots. The price range for over half the sale lots (55.7%) ranged from \$2.00 to \$3.99/dressed cwt. or \$15 to \$31/head. Those sale lots which ranged in excess of \$8.00/cwt. may have included dairy animals or had other carcass characteristics that were discounted severely. While readers might discount the results for these lots as being unrepresentative of most cattle sold with grids, sale lots in the \$4.00 to \$7.99/cwt. range (or \$31 to \$62/head) are not likely data anomalies. These lots, 17.9 percent of the total, contained sufficient numbers of carcasses that were discounted to widen the range in mean prices across grids. Thus, marketing a given sale lot of cattle on any given day can result in wide differences in prices due to the premium-discount grid used and cattle quality.

**Table 5. Frequency Distribution of the Range in Prices Across Seven Grids within Each Plant**

Price Range (\$/dressed cwt)	Northern Plains 1	Northern Plains 2	Southern Plains 1	Southern Plains 2	Total
	(Number of Sale Lots)				
Less than 2.00	12	7		11	31
2.00-3.99	31	14	14	19	78
4.00-5.99	4	1	6	7	18
6.00-7.99	3	0		3	7
8.00 or More	2	0	3	1	6
Total	52	22	25	41	140

Regression results emphasize the importance of cattle quality on mean prices and price variation across premium-discount grids. Note for this analysis, the base price was associated with Choice YG 3 carcasses. Average premiums and discounts are given here (in round numbers/dressed cwt.). Premiums were associated with %Prime (\$0.06), %YG1 (\$0.02), and %YG2 (\$0.01) carcasses. Thus, premiums were relatively small. Discounts were more important. Discounts were associated with %Select (\$0.10), %Standard (\$0.20), %YG4-5 (\$0.19), %Light (\$0.20), %Heavy (\$0.20), and %Out (\$0.32) carcasses. Discounts clearly exceeded premiums.

Results in Table 6 are for the regression model in which carcass characteristics were included to explain the variation in standard deviation of prices for each sale lot across the seven grids. Overall, the model explained 94% of the variation in the standard deviation of grid prices for each sale lot across seven grids. All carcass characteristics except %Light carcasses significantly added variability to grid prices. Since there were relatively few %Light carcasses, these results are not surprising. Characteristics contributing the most to variability were %Prime and %Out carcasses. As the percentage of those characteristics increase in a sale lot, more variability can be expected across grids. Thus, the two most extreme carcass characteristics

(%Prime and %Out) contributed most to the variability of grid prices for a given sale lot across the seven grids.

**Table 6. Regression Results on Standard Deviation of Grid Prices from Carcass Characteristics and Alternative Grids**

Independent Variable	Dependent Variable	
	Standard Deviation of Mean Price	Coefficient (\$/dressed cwt)
Intercept		0.031 (0.19)
%Prime		0.086* (3.77)
% Choice	Base	
%Select		0.010* (4.25)
%Standard		0.033* (12.73)
%YG1		0.005* (3.14)
%YG2		0.004* (2.64)
%YG3	Base	
%YG4-5		0.018* (3.60)
% Light		0.007 (0.78)
%Heavy		0.026* (8.48)
%Out		0.047* (30.99)
n	140	
R <sup>2</sup>	0.94	

<sup>a</sup>Absolute value of calculated t statistics are given in parentheses;

\*Indicates 0.01 significance level.

The other two models attempted to group together all carcass characteristics that typically receive premiums and all characteristics that are discounted. Results in Table 7 show that all carcass characteristics typically receiving premiums contribute far less to variation in the price level and to variability (standard deviation) across grids than do all the carcass characteristics that are discounted.

**Table 7. Regression Results on Mean Grid Prices and Standard Deviation of Grid Prices from Groups of Carcass Characteristics and Alternative Grids**

Independent Variable	Mean Price Coefficient <sup>a</sup> (\$/dressed cwt)	Dependent Variable	
		Independent Variable	Standard Deviation of Mean Price Coefficient (\$/dressed cwt)
Intercept	109.31* (137.34)	Intercept	-0.054 (0.30)
%Premiums	0.025 (2.02)	%Premiums	0.002 (0.92)
%Discounts	-0.194* (18.32)	%Discounts	0.023* (9.46)
n	140	n	140
R <sup>2</sup>	0.72	R <sup>2</sup>	0.45

<sup>a</sup> Absolute value of calculated t statistics are given in parentheses; asterisk indicates 0.01 significance level.

The contribution to mean price from positive carcass characteristics was \$0.02/dressed cwt., while the negative contribution from carcass characteristics that are discounted was \$0.19/cwt. Discounted characteristics also contributed significantly to variability, while characteristics that receive premiums did not.

Recall that Choice YG 3 carcasses were the base for this analysis and that some packers use other carcass specifications as the base or standard. Coefficient signs and magnitudes would differ with another set of base specifications, such as Select YG 2 or a floating base between Choice and Select.

*Summary* - Grid prices vary considerably more than the variation in live weight or dressed weight prices. However, such variation is essential in a value-based marketing system. All carcasses should not receive the same price because they are not of the same value to packers, retailers, and consumers. To achieve pricing accuracy and send clearer signals to producers, better quality cattle should be rewarded and poorer quality cattle should be discounted. Combined, that means increased price variation. Thus, price variation of this type is positive and essential to industry progress, not a negative result of grid pricing. However, cattlemen must be aware that greater variation exists with grid pricing.

With grid pricing, cattlemen must be aware of the variation in base price, whether from using plant averages or reported prices. From both base price sources *on the same day*, prices

may vary \$2/dressed cwt. or more or about \$15/head. Considerable variation also exists across premium-discount grids. *For the same cattle, on the same day, with the same base price*, the variation was \$2 to \$4/cwt. (\$15 to \$30/head) over half the time in the sale lots studied here. For sale lots with a high percentage of cattle whose carcass characteristics were severely discounted (Standard, YG 4-5, Heavy, and Out carcasses), the variation was considerably more than \$4/cwt. These lower quality carcass characteristics need to be avoided if producers want to experience higher overall prices with grid pricing compared with live weight or dressed weight pricing. From an industry standpoint, these lower quality groups of cattle need to be eliminated from the market mix, through genetic selection, feeding practices, improved handling, or other methods.

## Conclusions

This research examined the variability in grid pricing that can occur within a given day or week for a given set of cattle. Data for one day's slaughter from four plants revealed considerable variation in cattle brought to slaughter by cattle feeders. Within-day, within-plant and between-plant variation is likely not appreciated fully by cattle producers. This variability is only one element of the broader problem the industry faces regarding quality and consistency of final products for consumers.

Examining live weight and dressed weight pricing reveals one reason both feeders and packers continue to use them. Price variability is low and poorer quality cattle bring almost as much as better quality cattle, even across sale lots.

Several sources of variation exist in grid pricing. These sources were known *a priori* but not measured. For the sole data period in this study, base prices varied \$2/dressed cwt., or \$15/head, whether using plant averages or formulas tied to reported cash-market prices. Prices across grids added another \$2-4/cwt. of variation, another \$15 to \$30/head. In addition, variation in carcass characteristics contributed significantly to the variation in grid pricing, especially discounted characteristics such as Select and Standard carcasses, Yield Grade 4-5 carcasses, light and heavy carcasses, and non-conforming or "out" carcasses. Relatively large numbers of carcasses with discounted characteristics alone doubled the amount of variation arising from grid pricing. While only a single day's slaughter data were available for this study, there is no reason to expect the quality variation to be significantly different for any other randomly selected day.

Grid pricing is a step towards value-based pricing when used correctly. Cattlemen can learn much about the cattle they market with grid pricing and can then use the information to make genetic and management improvements. However, simply trying to match a given sale lot of cattle to the best grid, while potentially beneficial from a short-run perspective, is not moving the industry to value-based marketing. Only when genetic and management changes result from grid pricing information can long-term value-based marketing be achieved.

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