Grid Pricing: Valuing Cattle Quality Information

By

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Presented at Western Agricultural Economics Association Annual Meeting
July 11-14, 1999
Fargo, ND

1999 WAEA Selected Paper Submission Sheet

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Paper Title: Grid Pricing: Valuing Cattle Quality Information

Abstract: (50 words or less)

Grid pricing is increasingly prominent in cattle markets. This study compares selling 11,703 head of fed cattle using grid, live, and dressed weight pricing. Cattle sold on a grid had price variability twice that of live or dressed. Average pricing inefficiency by not selling cattle on a grid exceeded $30/head.

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03 Primary Area _____ Secondary Area (if any)

Grid Pricing:
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March 6, 1999

Selected Paper Submission: *Western Agricultural Economics Association*

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Grid pricing is increasingly prominent in cattle markets. This study compares selling 11,703 head of fed cattle using grid, live, and dressed weight pricing. Cattle sold on a grid had price variability twice that of live or dressed. Average pricing inefficiency by not selling cattle on a grid exceeded $30/head.

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Beef demand has declined substantially over the past several decades. Purcell (1998) estimated that after accounting for changes in quantities of substitutes and consumer income, beef demand declined by as much as 72% from 1960 to 1997. Relative prices of beef to competing meats are widely recognized as important demand determinants. However, numerous non-price factors have contributed to the decline in beef demand since 1980 including health/nutrition concerns, changes in consumer lifestyles, product quality, and product convenience problems (Capps and Schmitz 1991; Kinnucan et al. 1997; Purcell 1998).

Problems associated with beef product quality and consistency have been thoroughly documented (Smith et al. 1992, 1995). Much of the beef product quality problem has resulted from poor coordination of the vertical beef production and marketing system (Lamb and Beshear 1998). Schroeder, et al. (1998) concluded that a considerable amount of beef system coordination problems rest in poor information transmission between cattle feeders and beef packers. They argued that live weight average pricing of fed cattle inhibits information flow from beef consumers to cattle producers. Several have argued that for the beef industry to revitalize demand it must improve information flow and value-based price discovery of fed cattle (Fausti et al. 1998; Lamb and Beshear 1998; Schroeder et al. 1998). Such sentiments have increased interest in moving away from average live (or dressed) weight cattle pricing and more towards value-based grid (or grade and yield) pricing.

The objectives of this study are to compare revenues associated with live weight,

dressed weight, and grid pricing. In particular, the value of information on cattle quality attributes under the three pricing methods is estimated, the magnitude of pricing inefficiency associated with live and dressed weight relative to grid pricing is estimated, and the determinants of price variability across the three pricing methods are compared.

Previous Research

A few studies have examined various issues related to grid pricing. Feuz, Fausti, and Wagner (1993) examined price distributions associated with selling fed cattle using four different methods, live, dressed, grade and yield, and a specific firm's muscle scoring system. They concluded that under live weight pricing, profit variability was most explained by average daily gain and second by days on feed. For grade and yield and the muscle scoring cattle pricing methods profit variability was most influenced by quality grade and secondly average daily gain.

Feuz (1999) examined the implications of pricing cattle on show list, pen level, and individual animal pricing methods (using two different packer grids) for 85 pens of 5,520 head of fed cattle. He conducted this analysis for three different time periods with differing market prices and Choice to Select price spreads. He concluded that mean price level tended to increase in going from live weight to dressed weight to grid pricing. In addition, revenue variability on an individual head level increased with grid pricing.

Ward and Lee (1999) compared prices across seven different packer grids and live weight and dressed weight pricing by simulating selling 140 lots of 19,426 head of cattle obtained from a particular beef packer for a particular slaughter day. Premium/discount variation across grids alone typically constituted a $2/cwt to $4/cwt range in cattle prices. They concluded (p. 55), "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."

These previous studies provide important information to increase understanding of the magnitude of price variability and price differences associated with live weight, dressed weight, and grid pricing. The present study compliments the earlier research in several ways. First, this is the first study to estimate the magnitude of market inefficiency associated with live and dressed weight cattle pricing. Second, this study calculates the value of information for cattle producers as they consider the various pricing methods. Finally, this study identifies and compares sources of price and revenue variability across different pricing methods.

Data and Procedures

The primary data set used consists of 71 pens of cattle, comprising 11,703 head, obtained from a large midwestern cattle feeding operation. The cattle were produced and marketed under a grid pricing formula marketing agreement with a large midwestern beef packer. The cattle were marketed during 1997 and just over one pen per week spread throughout the year was provided by the cattle feeder. For each pen of cattle, the data consisted of packer kill sheets indicating the slaughter date, overall revenue, individual price received, carcass weight, quality grade, yield grade, and "out" grades for each carcass. In addition, a pen-average dressing percentage and total pen live weight were also available.

A simulation of selling the 71 pens of cattle using four different pricing methods over the time period is completed to determine differences in prices received by the various methods. The cattle were priced using live weight fed cattle prices, dressed

weight prices, and the actual grid prices received. Each carcass was also priced assuming the cattle feeder could have sorted the cattle and sold them individually using the method among live weight, dressed weight, or grid, providing the highest price.

The live weight and dressed weight prices were obtained from the United States Department of Agriculture (USDA) WH LS725 *Weekly 5-Area Weighted Average Direct Slaughter Cattle Prices*. The price from this report was weighted-average data from Texas-Oklahoma, Kansas, Colorado, Nebraska, and Iowa-South Minnesota market regions. The live weight and dressed weight prices used for each pen were determined, based on the percentage of Choice or higher and Select or lower quality grade cattle contained in the pen.

To determine the relative importance of various factors affecting price variability across carcasses when pricing on a grid basis, the following regression model is estimated twice with only the dependent variable changing each time:

$$(1)\quad s_{price} = b_0 + b_1 HEAVY + b_2 LIGHT + b_3 s_{Weight} + b_4 s_{Quality} + b_5 s_{YieldGrade} + b_6 SPREAD + e$$

where σ_{price} is the standard deviation of price per cwt. or revenue per head in each pen of cattle, *HEAVY* is the percentage of carcasses in the pen that weigh more than 950 lbs., *LIGHT* is the percentage of carcasses that weigh less than 525 lbs., σ_{Weight} is the standard deviation of carcass weight in the pen, $\sigma_{Quality}$ is the standard deviation of quality grade of cattle in the pen (quality grade coded as Prime=1, Choice=2, Select=3, No Roll=4, Miscellaneous=5, Hieferette=6), $\sigma_{YieldGrade}$ is the standard deviation of yield grade in the

pen, and *SPREAD* is the weekly Choice-to-Select wholesale boxed beef cutout price spread during the week the cattle were sold.

Variability in price within a pen is expected to be positively associated with each variable in the model. As any of the right-hand-side variables increase, price variability within the pen should also increase because variability in these factors will lead to variability in grid discounts and/or premiums being applied.

Comparative Prices

This section analyzes selling the 11,703 fed cattle using three different methods; live weight, dressed weight, and an actual packer's grid. Summary statistics of the cattle are presented in Table 1. The cattle graded 65% Choice or higher and had a few heiferettes and other miscellaneous "out" quality types of cattle. The cattle were 40% yield grades 1 and 2 and 43% yield grade 3, with a few yield grade 4 and 5 carcasses. A small number of the cattle were either excessively heavy or light weight; 14 head had carcasses weighing less than 525 lbs. and 219 weighed more than 950 lbs. The carcasses had average weight of 798 lbs. and an average dressing of 63.6%.

Summary statistics of the prices for the cattle when sold under the different pricing methods are presented in Table 2. Although the cattle were from 71 pens, for the analysis completed here all cattle are priced as if they were sorted and sold individually. When the cattle were sold on a live weight basis the average price was $65.60/cwt. with a standard deviation of $1.78/cwt. If all cattle were sold on a dressed weight basis, they would have brought an average price of $67.16/cwt. (on a live weight basis) with a standard deviation of $1.84/cwt. When the cattle were priced using the packer grid, the

average was $66.90/cwt. (live weight basis) with a much larger standard deviation than either live or dressed weight pricing of $3.91/cwt.

To determine the value of information on cattle quality attributes to the cattle feeder, each carcass was priced using the method that resulted in the highest price among the three methods. The average price under each of these scenarios is reported in Table 2. If the cattle were sold using the method that resulted in the highest price for each carcass, the overall average price would have been $68.37/cwt, gaining a $1.21/cwt over just selling all cattle on the next highest average pricing method (dressed weight basis). Interestingly, selling the cattle using the method with the highest price resulted in 198 (2%) head being sold on a live weight basis, 5,401 (46%) on a dressed weight basis, and 6,104 (52%) head using the grid pricing system.

Summary statistics of cattle having each of the respective highest pricing opportunities reveal important differences across the types of cattle that fit each pricing method best relative to the other three (Table 1). It is difficult to make broad generalizations about the type of cattle that will get the highest price under each method primarily because so many different characteristics jointly impact price when using a grid. However, a few generalizations can be gleaned from these results. First, cattle with a low dressing percentage received the highest price when sold on a live weight basis. This is simply because when cattle having a low dressing percentage are sold on a dressed basis fewer pounds are being sold (after adjusting the carcass back to a live-weight equivalent) than if they were sold on a live weight basis. In other words, the dressing percent implied in the live weight relative to the dressed weight market prices

Table 1. Summary Statistics for Marketing 11,703 Head of Cattle Overall and for Three Highest Pricing Methods, Marketed Weekly During 1997

		Method with Highest Price		
Pricing Attribute	Overall	Live Weight	Dressed Weight	Grid
Quality Grade:				
Prime (%)	1.48	0.00	0.41	2.47
Choice (%)	63.49	42.42	25.83	97.49
Select (%)	27.47	46.97	57.77	0.03
No Roll (%)	5.84	8.08	12.37	0.00
Miscellaneous (%)	1.49	2.53	3.13	0.00
Heiferette (%)	0.23	0.00	0.50	0.00
Yield Grade:				
Yield Grade 1 (%)	17.97	21.21	26.14	10.63
Yield Grade 2 (%)	32.85	23.74	30.83	34.94
Yield Grade 3 (%)	43.47	52.53	30.88	54.31
Yield Grade 4 (%)	5.23	2.53	11.11	0.11
Yield Grade 5 (%)	0.48	0.00	1.04	0.00
Carcass Weight & Dressing:				
Less than 525 lbs. (%)	0.12	0.00	0.26	0.00
Greater than 950 lbs. (%)	2.73	1.01	5.81	0.07
Carcass Weight (lbs.)	798.29	769.37	798.22	799.29
Dressing (%)	63.62	62.27	63.62	63.67
Prices & Revenues:				
Live Price ($/cwt – live weight)	$65.60	$68.49	$65.70	$65.42
Dressed Price ($/cwt – live weight)	$67.16	$68.01	$67.33	$66.98
Grid Price ($/cwt – live weight)	$66.90	$66.42	$64.20	$69.29
Live Revenue ($/head)	$823.00	$845.79	$824.17	$821.22
Dressed Revenue ($/head)	$842.60	$839.97	$844.66	$840.87
Grid Revenue ($/head)	$839.07	$820.12	$805.15	$869.71
Number of Head (head)	11,703	198	5,401	6,104
Percent of Cattle (%)	100%	2%	46%	52%

was greater than the actual dressing percent of the carcass. Similarly, lower quality grade cattle generally receive the highest price on a live weight basis. Of the 198 carcasses with live weight price the highest, 58% were Select and lower quality grade. This indicates that higher quality cattle will often receive higher prices under a method other than live weight pricing.

Table 2. Summary Statistics of Price and Revenue for Various Pricing Methods, 11,703 Head of Cattle Marketed Weekly During 1997

Pricing Method	Average	Standard Deviation	Minimum	Maximum
	- - - - - - - - - - - - - - - ($/cwt.) Live Weight - - - - - - - - - - - - - - - - - -			
Live Weight	$65.60	$1.78	$61.89	$69.96
Dressed Weight	$67.16	$1.84	$63.07	$71.22
Grid	$66.90	$3.91	$44.46	$80.69
Highest Price	$68.37	$2.39	$63.07	$80.69
	- ($/head) -			
Live Weight	$823.00	$82.38	$478.73	$1200.33
Dressed Weight	$842.60	$84.92	$486.19	$1247.19
Grid	$839.07	$91.60	$357.49	$1251.85
Highest Revenue	$857.74	$87.29	$486.19	$1251.85

About half of the cattle would have brought the highest price when sold on either a dressed (46%) or grid (52%) basis (Table 1). Comparing the quality of the cattle that would have realized the highest price under grid vs. dressed pricing indicates the higher quality cattle typically are highest priced using the grid. Only 4 of the carcasses with a quality grade worse than Choice would have received the highest price using the grid. In contrast, the dressed priced cattle had more than 70% quality grades of Select or below. This demonstrates the need for cattle producers to know the quality grade of their cattle.

Value of Information and Price Error

Table 3 reports the total value of selling the cattle under the highest price method relative to each of the alternative methods. Selling all carcasses using the pricing method having the highest price increased revenue by $34.74/head relative to selling all cattle using live weight pricing, by $15.14/head compared to selling all on a dressed weight basis, and $18.67/head compared to selling all on the grid. Thus, there are considerable values for having a better understanding of the cattle quality and properly marketing by

the particular method returning the highest price compared to selling all cattle using the same method, whether it be live weight, dressed weight, or grid.

Table 3. Revenue Comparisons and Value of Information Selling 11,703 Head of Cattle Weekly During 1997 using Three Pricing Methods

Pricing Method	Total Revenue ($)	Highest Pricing Revenue ($)	Value of Information ($)	($/head)	(%)
Live Weight	$9,631,541	$10,038,131	$406,590	$34.74	4.22%
Dressed Weight	$9,860,960	$10,038,131	$177,171	$15.14	1.80%
Grid	$9,819,676	$10,038,131	$218,455	$18.67	2.22%

To determine from a producer welfare perspective the value of pricing cattle on a grid instead of live weight or dressed weight pricing, the differences in revenue received for the carcasses by pricing method were compared. Assume the grid price paid for these cattle is an efficient price in the sense that it fully reflects the market value of the carcass. Then any carcass that sells for a higher price brings more than the efficient price and any carcass selling for less brings less. To determine the amount that cattle were "over-priced" or "under-priced" relative to the assumed efficient actual grid price, the difference in the revenue from selling the cattle on the grid relative to live or dressed weight was computed.

For the 11,703 cattle in this data set, Table 4 presents the amounts of "over-" or "under-pricing" that would have been present had the cattle been sold live or dressed weight instead of on a grid. For 3,650 of the cattle, the grid price was less than the live weight price by an average of $2.90/cwt. or $36.80/head. This means that if these cattle were sold on a live weight basis, they would have received $134,335 more than they were worth. For the remaining 8,053 head, the grid price exceeded the live weight price and if

these cattle were sold live instead of on the grid they would have received $322,442 ($40.04/head) less than they were worth. Similar magnitudes of pricing errors are present for dressed pricing relative to grid pricing. The conclusion is that if these cattle were sold via live or dressed weight pricing, assuming the grid pricing system is efficient, this would have resulted in typical "pricing error"(positive or negative) of $30/head or more.

Table 4. Magnitude of Pricing Error from Selling Cattle on a Live Weight or Dressed Weight Basis Instead of a Grid, 11,703 Head of Cattle Marketed Weekly During 1997

Revenue Comparison	Number of Cattle (head)	Average Price Difference ($/cwt live weight)	Average Revenue Difference ($/head)	Total Revenue Difference ($)
Grid Less than Live Weight Revenue	3,650	-$2.90	-$36.80	-$134,335
Grid Exceeds Live Weight Revenue	8,053	$3.20	$40.04	$322,442
Grid Less than Dressed Weight Revenue	5,521	-$3.11	-$39.38	-$217,435
Grid Exceeds Dressed Weight Revenue	6,182	$2.28	$28.49	$176,150

Explaining Grid Price Variability

The results of this regression estimation are reported in Table 5. Two models are estimated, one with the dependent variable measured on a price per cwt. and the second with the dependent variable on a revenue per head basis. All of the signs on the parameters, except one, conform to expectations. The one sign that is not consistent with expectations is the parameter on the percent of heavy carcasses on revenue per head. This could simply be an anomaly of this set of cattle. These models explained the majority of price (68%) and revenue per head (88%) variability. Statistical problems caused by autocorrelation, multicollinearity, and/or heteroskedasticity were tested for and none were generally present in either model.

To aid in the interpretation of the regression results, the standardized parameter estimates of each factor are also reported. These estimates provide a measure of the relative importance of each variable in the model. On a price per cwt. basis, the USDA Choice-to-Select wholesale boxed beef price spread has the largest impact on price variability in a pen. This is because as the Choice-to-Select price spread increases, Choice cattle receive an increasingly divergent price relative to Select carcasses which increases the range of prices in a pen of cattle sold on a grid. The next most important factor is standard deviation in the quality grade of the cattle in the pen. This is expected because quality grade premiums/discounts tend to be larger than yield grade differentials (except for yield grade 4 and 5 carcasses which this data set has very few of).

Table 5. Regression Results for Models Estimating the Influence of Carcass Quality Characteristics on Variability in Price per cwt. and Revenue per Head

	Dependent Variable			
	σ_{Price} (Price per cwt.)		σ_{Price} (Revenue per head)	
Independent Variable	β	Standardized β	β	Standardized β
Intercept	-2.810**		-10.851	
HEAVY	0.059*	0.146	-1.154**	-0.331
LIGHT	0.490	0.111	3.466*	0.092
σ_{Weight}	0.004	0.037	0.922**	0.973
$\sigma_{Quality}$	3.497**	0.348	11.055**	0.129
$\sigma_{Yield\ Grade}$	1.319	0.084	6.881	0.051
SPREAD	0.609**	0.689	2.793**	0.370
R^2	0.68		0.88	
Observations	71		71	
Breusch-Pagan test				
χ^2 Value	18.017		25.300	
Probability	0.903		0.878	
Durbin-Watson test				
Test statistic	1.960		1.907	
1st Order Autocorr.	0.016		0.045	

**Denotes significance at the 5% level.
*Denotes significance at the 10% level.

Conclusions and Implications

Grid pricing resulted in more than twice the variability in price received per cwt. (live weight basis) across carcasses compared to live- and dressed-weight pricing. This indicates that grid pricing is more discriminating in terms of pricing signals conveyed to producers. If cattle could have been sorted and sold using the pricing option offering the highest price, approximately $15/head to $35/head more could have been made relative to selling the cattle using a single pricing method. This indicates substantial value of information for producers to understand the kind of cattle they market and target the cattle to the best pricing opportunity.

If grid pricing is efficient at sending appropriate pricing signals, large pricing errors exist in both under-pricing and over-pricing carcasses on live and dressed weight selling methods compared to grid pricing. High-quality cattle subsidized low-quality cattle by an average of more than $30/head. This quantifies how poorly average live or dressed weight pricing is at conveying appropriate pricing signals to cattle feeders. Cattle feeders that want to get paid for the quality of cattle they produce will only if cattle are sold using something method other than live or dressed weight average pricing.

The Choice-to-Select boxed beef wholesale cutout price spread had the most impact on variability of price per hundredweight for carcasses sold on a grid followed by variability in quality grade of carcasses in a pen. Carcass weight variability followed by the Choice-to-Select price spread had the largest influence on variability of revenue per head. Producers trying to manage the increased price risk associated with grid pricing will find most benefit from managing cattle quality grade, carcass weights, and monitoring the Choice-to-Select price spread.

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