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Valuing Fed Cattle Using Slice Shear Force Measurements

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Valuing Fed Cattle Using Slice Shear Force Tenderness Measures

Introduction

Value-based marketing, and particularly "grid pricing", has become a popular way to value fed cattle. Schroeder et al. (2002) found from a survey of cattle feeders that 45% of cattle marketed in 2001 were sold on a grid and respondents indicated that they expected grid sales to increase to 62% of fed cattle sales by 2006. Prior to grid pricing, the dominant method of selling fed cattle was on an average price of the live animal or dressed carcass weight basis. Through this method, all cattle in the pen receive the same price. What separates grid pricing from average pricing is that each animal is assigned an individual price with grid valuation. This is achieved by assigning premiums or discounts to each carcass according to the carcass characteristics.

Grid values are calculated by starting with a base price ($/dressed cwt.) and adding (subtracting) premiums (discounts) that reward (penalize) carcass attributes. Currently, the primary mechanisms used to assess value per pound for beef carcasses sold using grids are USDA yield grades and quality grades which are applied by USDA graders at the processing facility at the time of slaughter. Quality grades are intended to serve as a proxy for meat palatability. USDA graders assess this attribute by examining marbling (measure of intra-muscular fat) and skeletal maturity. The most common quality grades for fed steers and heifers are Prime, Choice, Select, or Standard. Yield grades are intended to approximate carcass meat yield (the percentage of boneless, closely trimmed retail cuts from the chuck, rib, loin, and round). Yield grades range from 1 to 5, where 1 is the most desirable and 5 the least desirable.

The reason for grid pricing is to increase beef supply chain coordination. Grid pricing evolved because the beef industry was experiencing a sustained decline in demand and the industry was searching for a way to better send consumer preference signals back to producers in the form of price incentives. The beef industry audit that was conducted as grid pricing was being launched indicated that consumers desire a tender beef cut (Smith et al., 1995) and grid pricing attempts to reward carcasses that are tender. Grid pricing currently relies on use of USDA quality grades to estimate meat tenderness attributes. However, USDA quality grades are poor predictors of beef tenderness (Wheeler, Cundiff, and Koch, 1994; Wulf et al., 1997). Wheeler, Cundiff, and Koch (1994) found that shear force as well as tenderness and juiciness ratings increased only slightly as marbling (the primary visual measure used to assess quality grades) increases. Furthermore, they state that marbling explained only 5% of the variation in palatability. Wulf et al. (1997) not only found the relationship of marbling and shear force value to be low, reporting a correlation of -0.12, they also found that the correlation between marbling and consumer panel tenderness ratings to be 0.11.

A significant number of Choice carcasses produce tough steaks and many Select carcasses yield tender steak cuts (see Figure 1). Therefore, using USDA quality grades to value carcasses results in over-valuing some carcasses and under-valuing others relative to tenderness valuation.

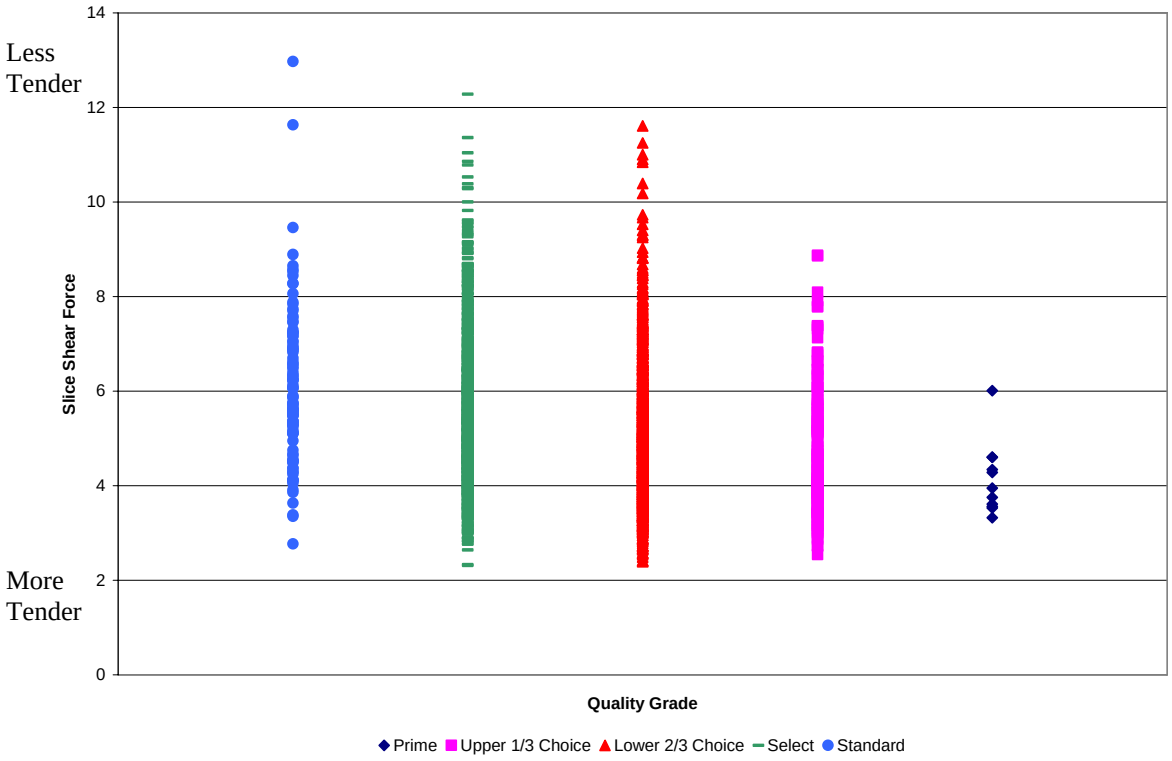

Figure 1. Slice Shear Force Values By Quality Grade

The current grid pricing method has been effective at increasing coordination along the supply chain by rewarding higher quality carcasses and discounting lower quality carcasses. However, the USDA quality grading system does not accurately quantify carcass tenderness. Kovanda, Schroeder, and Wheeler (2004) investigated the accuracy of grid pricing by comparing a carcass' grid value to its wholesale boxed beef cut out value. They determined that grid pricing undervalues carcasses as compared to its wholesale boxed beef cutout value by $136/cwt. They suggest that grid values should be more closely tied to consumer preferences, which (according to Smith et al.) is most often tenderness. The purpose of this study is to develop a new fed cattle valuation method

that builds on the current grid structure with emphasis on valuing carcasses based upon tenderness (as measured by SSF) rather than USDA quality grades.

Tenderness Value Background

The most common objective mechanized method used to assess beef tenderness is slice shear force (SSF) and the Warner-Bratzler shear force (WBS) tests (see Huffman et al, 1996; Boleman et al., 1997; Shakelford et al., 2001; Wheeler, Shackelford, and Koohmaraie, 2004). SSF technology involves removing a core from the strip loin of the beef carcass that is approximately 1.25 centimeters in diameter (Wheeler, Cundiff, and Koch, 1994). The core is cooked and sliced using one of the previously mentioned instruments. The amount of force required to slice the meat determines its tenderness. A lower value indicates less force required to slice the meat and thus a more tender piece of meat.

Studies have shown that SSF and WBS measures accurately predict consumer evaluation of tenderness. Wulf et al. (1997) reported that the correlation between shear force and consumer rated tenderness to be -0.76. Shackelford et al. (1999) found a correlation of -0.77 and -0.82 between consumer sensory evaluation of tenderness and SSF and WBS, respectively. Wheeler, Shackelford, and Koohmaraie (2004) found an R^2 between SSF and consumer valuation of 0.85.

Consumers consider tenderness the most important factor for beef palatability (Savell et al., 1987; Smith et al., 1987, 1995). Research has shown that consumers are willing to pay more for tender beef. Recently, Feldkamp, Schroeder, and Lusk (2005) conducted a consumer evaluation study where participants were given a generic 12 oz. rib

eye steak and asked to place bids to exchange the generic cut for a "guaranteed tender" steak. Consumers were willing to pay $0.95 (per 12 oz. steak) more for the guaranteed tender cut. Lusk et al. (2001) found that consumers are willing to pay $1.84 more per pound for tender steaks through a similar consumer evaluation study. Miller et al. (2001) found, through a nation wide consumer evaluation study, that 78% of participants were willing to pay more for steaks that were guaranteed tender by the retailer. In another study Shackelford et al. (2001) found that 50% of consumers would "definitely pay" or "probably pay" $0.50[1] more per pound for a steak that registered a low shear force value (i.e., was tender). Lusk and Fox conducted a survey of consumers to examine willingness to pay (WTP) for beef steak attributes. One of the attributes studied was that of "guaranteed tender", which was described through tenderness ratings in the survey. As the tenderness of a cut increased one unit, the WTP increased $1.13

Data and Methods

Data from the Meat Animal Research Center (MARC) was used for this study. MARC collected 3,563 carcasses. On all carcasses, traditional fed cattle valuation measures (e.g., USDA quality and yield grades) and slice shear force values for each carcass were collected by MARC. Those carcasses with weights above or below the acceptable range as defined by the grid (those weights receiving discounts included carcasses weighing less than 600 lbs or more than 900 lbs) were excluded from the data, which reduced the number of carcasses to 3,154. These data were used to assess how these cattle would have been valued under traditional dressed and grid pricing systems

[1] Consumers in this study were asked how willing they would be to pay $0.50 per pound more to purchase the tender steak.

and compared these to valuations based upon actual meat tenderness as assessed by a slice shear force instrument. Table 1 displays the summary statistics of the carcass data obtained from MARC.

Table 1. Summary Statistics of MARC Carcass Data

	Count (%)	Mean	Std. Dev.	Minimum	Maximum
Live Weight (lbs.)		1,199.48	114.54	892.00	1,544.00
Hot Carcass Weight (lbs.)		736.43	73.27	600.00	900.00
Dressing Percentage		61.41%	2.11%	50.25%	72.38%
Marbling Score		504.17	67.60	280.00	890.00
Quality Grade		1.56	0.67	0.00	4.00
No. of Prime	11 (0.3%)				
No. of Upper 1/3 Choice	182 (5.8%)				
No. of Lower 2/3 Choice	1460 (46.3%)				
No. of Select	1397 (44.3%)				
No. of Standard	104 (3.3%)				
Yield Grade		2.94	0.85	0.40	6.92
No. of Yield Grade 1	14 (0.4%)				
No. of Yield Grade 2	401 (12.7%)				
No. of Yield Grade 3	1299 (41.2%)				
No. of Yield Grade 4	1097 (34.8%)				
No. of Yield Grade 5	343 (10.9%)				
Slice Shear Force		5.26	1.41	2.31	12.97
Number of Observations	3,154				

[a]200=Practically Devoid, 300=Traces, 400=Slight, 500=Small, 600=Modest, 700=Moderate, 800=Slightly Abundant, 900=Moderately Abundant

[b]4=Prime, 3=Upper 1/3 Choice, 2=Lower 2/3 Choice, 1=Select, 0=Standard

Dressed steer prices were obtained from the USDA-AMS *5 Area Weekly Weighted Average Direct Slaughter Cattle* report. USDA-AMS *National Weekly Direct Slaughter Cattle – Premiums and Discounts* reported prices were used for grid premiums/discounts. The dressed steer price was used as the base price for grid and tenderness values. Grid premiums/discounts were adjusted due to the fact that the dressed steer price takes into account a mix of both Choice and Select cattle. For example, assuming a pen is composed of 50% Choice and 50% Select cattle; the base

price (i.e. dressed steer price) would then be a 50% Choice and 50% Select carcass. Premiums/discounts obtained from USDA-AMS reported the base quality grade as lower two-thirds Choice (this grade received a premium of $0). To correct for this the Select discount was evenly divided so that lower two-thirds Choice carcasses received a premium of one-half the Select discount and Select carcasses received a discount of one-half the Select discount.

Price and premium/discount data for 430 weeks were available, however only two time periods are examined for this study because the results are similar over time. The first time period examined encompasses when grid premium/discounts were first reported by USDA which occurred in late 1996. At this time grid pricing was relatively new and not widely adopted (Schroeder et al. 2001). The second time period consists of mid 2004. The purpose of this is two fold. Grids have been in existence for a number of years at this point and had gained increased use. Also, a significant event occurred in the beef industry in December of 2003 when a Holstein cow was found to have Bovine Spongiform Encephalopathy in Washington which had enormous market implications.

Within these two periods of time three market scenarios were examined. The Choice to Select spread is the difference between Choice and Select beef (in terms of carcass boxed beef cut out value) and is an indicator of the relevant demand for Choice cattle. Therefore, an average market situation was studied which is when the Choice to Select spread was around its mean value for the 430 weeks. Also, two other market environments were examined encompassing one standard deviation on each side of the mean.

The first value calculated for each carcass was a dressed value:

$$DressVal_{n,t} = HCW_n \times DressP_t \quad (1)$$

where $DressVal_{n,t}$ is the total dressed value of carcass *n* at time period *t*, HCW_n is the hot carcass weight of each carcass and $DressP_t$ is the dressed price ($/dressed cwt).

Next, grid values were formulated. Individual grid values for each carcass are:

$$GridVal_{n,t} = HCW_n * (Base_t + QGprem_{n,t} + YGprem_{n,t}) \quad (2)$$

where $GridVal_{n,t}$ is the total grid value of carcass *n* at time period *t*. $Base_t$ is the base price of the grid, $QGprem_{n,t}$ is the quality grade premium/discount, and $YGprem_{n,t}$ is the yield grade premium/discount associated with each carcass.

Tenderness-based values for each carcass were estimated as follows. We calculated each carcass' value in terms of its tenderness score as measured by SSF by estimating premiums and discounts for each SSF measure. Shear force tenderness value was estimated by first assuming that on average carcasses quality grade is related to SSF and thus the premium/discount different quality grades of carcasses receive is a function of its SSF. Figure 1 illustrates slice shear force values by carcass quality grade measures. Two important issues are revealed in this graph. First, the better the quality grade, the lower the average shear force or the more tender on average is the carcass. However, considerable variability in tenderness is present within each carcass quality grade. For example, numerous Select grade carcasses are more tender than Choice. This suggests that USDA quality grades will do a poor job of valuing each carcass based on tenderness. Assuming wholesale premiums/discounts reported by USDA on average reflect similar patterns in premiums/discounts at the retail level and thus consumer preferences; then quality grade premiums and discounts can be used to obtain a value for tenderness. This is done by linear OLS regression:

$$Tend\,\mathrm{Pr}\,em_{n,t} = \alpha + \beta\, SSF_n + \varepsilon_{n,t} \qquad (3)$$

where $Tend\,\mathrm{Pr}\,em_{n,t}$ is the tenderness premium for carcass n (measured here as the USDA grid-based quality grade premiums and discounts) at time t and SSF_n is the slice shear force measure for carcass n. Table 2 reports the results of this regression at different points in time having different Choice to Select price spreads. Because of the way they are estimated, tenderness premiums vary with different quality grade premiums, especially the Choice to Select price spread. This would be expected given seasonal factors affecting the demand and supply of Choice and Select beef (Lusk et al., 2001). We would expect tenderness premiums to have similar seasonality. Given the way that we have estimated tenderness premiums, they likely represent conservatively smaller premiums than what we would expect to be present in the marketplace. This is because given the amount of noise or errors present in quality grades relative to tenderness.

Once a premium/discount for tenderness is determined, tenderness value can be derived:

$$TendVal_{n,t} = HCW_{n,t} * (Base_t + Tend\,\mathrm{Pr}\,em_{n,t} + YGprem_{n,t}) \qquad (4)$$

where $TendVal_{n,t}$ is the total value of carcass n at time period t. Equations (1), (2), and (4) were reduced to $/dressed cwt for reporting purposes and is found by dividing each equation by the HCW of each carcass.

Table 2. Regression Results Quality Grade Premiums/Discounts on Slice Shear Force Tenderness Measures (Standard Errors in Parentheses)

Choice/Select Spread	Intercept	Beta	R^2	No. of Observations
$13.01	70.08**	-13.55**	0.937	5
	(8.05)	*(1.57)*		
$8.59	61.69**	-11.96**	0.952	5
	(6.17)	*(1.20)*		
$3.59	48.82**	-9.55**	0.959	5
	(4.51)	*(0.88)*		
$14.12	86.67**	-16.56**	0.941	5
	(9.51)	*(1.85)*		
$8.07	73.52**	-14.20**	0.969	5
	(5.83)	*(1.13)*		
$3.17	62.31**	-12.26**	0.943	5
	(6.94)	*(1.35)*		

** denotes significance at 0.01 level

Results

Tenderness values (equation 4) were calculated and compared to that of dressed pricing and grid pricing (equation 2). Table 3 presents a comparison of dressed, grid, and tenderness values ($/dressed cwt) for selected market price situations. The mean dressed price across different market scenarios is greater than that of grid pricing which is greater than pricing using tenderness measures. This is simply a result of the distribution of the quality grade of the carcass data used in this study (i.e., 53% Choice and 47% Select and 45.7% yield grade 4 or worse). Despite the fact that the mean value of the yield grades for the cattle were above the base values (see Table 1), the discount for lower cutability (higher yield grade) carcasses is much greater than the premium for carcasses of higher cutability (lower yield grade). Table 3 shows that the penalty for poor yield grade is higher than rewards for quality grade and thus grid pricing results in lower average prices for these carcasses as a whole than dressed pricing. Furthermore, the average discount

for tenderness exceeds the discount for quality grades, which explains the reason why valuing cattle on tenderness in this study has a lower average price than grid pricing. An interesting result shown in Table 3 is that the tenderness premium/discount's standard deviation is below that of grid pricing at the average and high Choice to Select spread, but when the Choice to Select spread is low the standard deviation of tenderness premium/discounts are higher than grid pricing.

Table 3. Results of Valuing Cattle Using Three Different Marketing Methods and the Premiums/Discounts for Grid and Tenderness

Choice/Select Spread		Dressed ($/dressed cwt)	Grid ($/dressed cwt)	Tenderness ($/dressed cwt)	Quality Grade premium/discount ($/dressed cwt)	Yield Grade premium/discount ($/dressed cwt)	Tenderness premium/discount ($/dressed cwt)
$13.01	Mean	$108.00	$107.27	$105.96	$0.12	($0.85)	($1.19)
	Std Dev		$6.59	$19.55	$6.39	$4.21	$19.16
	Minimum		$84.12	$3.16	($13.59)	($18.00)	($105.73)
	Maximum		$121.30	$147.66	$11.59	$1.71	$38.76
$8.59	Mean	$108.60	$107.81	$106.59	$0.06	($0.85)	($1.16)
	Std Dev		$5.67	$17.36	$5.16	$4.21	$16.91
	Minimum		$85.99	$16.08	($12.33)	($18.00)	($93.41)
	Maximum		$120.63	$143.56	$10.32	$1.71	$34.06
$3.59	Mean	$103.55	$102.68	$101.39	($0.08)	($0.79)	($1.37)
	Std Dev		$4.42	$14.03	$3.22	$4.04	$13.50
	Minimum		$84.22	$29.40	($10.89)	($16.86)	($75.04)
	Maximum		$113.44	$131.20	$8.18	$1.71	$26.76
$14.12	Mean	$144.95	$144.68	$143.97	$0.34	($0.61)	($0.38)
	Std Dev		$7.89	$23.82	$7.88	$4.81	$23.42
	Minimum		$119.78	$18.44	($14.65)	($17.92)	($128.14)
	Maximum		$163.07	$194.99	$15.29	$2.83	$48.41
$8.07	Mean	$137.49	$136.98	$135.79	$0.10	($0.61)	($1.09)
	Std Dev		$6.14	$20.55	$5.56	$4.81	$20.08
	Minimum		$114.82	$28.51	($14.25)	($17.92)	($110.61)
	Maximum		$153.11	$179.85	$12.79	$2.83	$40.73
$3.17	Mean	$137.68	$136.88	$134.94	($0.18)	($0.62)	($2.12)
	Std Dev		$5.20	$17.91	$3.62	$4.85	$17.34
	Minimum		$117.54	$42.61	($14.93)	($17.92)	($96.70)
	Maximum		$150.69	$173.30	$10.18	$2.83	$33.99

Table 4 shows the mean, standard deviation, minimum and maximum of the difference between tenderness and grid premium/discount ($/dressed cwt) as well as the percentage of times that the tenderness premium/discount was more desirable than that offered by the grid. As was suggested in Figure 1, considerable pricing error is present when valuing carcasses using a quality grade grid relative to a tenderness-based value measure. For example, the standard deviation of the difference between tenderness-based value less grid value ranges from $7 to $23/cwt depending upon market conditions and quality grade of the carcass. Further, the range in value differential between tenderness- and grid-based valuation typically exceeds $30/cwt and in certain market conditions in certain quality grade categories, exceeds $100/cwt. This indicates that some very tough carcasses are present in even upper Choice grade.

Although lower two-thirds Choice carcasses received a higher premium/discount on the grid more often than the tenderness-based value, both higher quality (Prime and upper two-thirds Choice) and lower quality (Select and Standard) cattle received a more desirable premium/discount on over half of the carcasses (excluding only one time where the grid was more often desirable for Select carcasses at a Choice/Select spread of $3.17). On average Prime and Standard carcasses were undervalued using a grid as compared to SSF measurement value. Upper two-thirds Choice and Select carcasses were mixed in their results of grid and tenderness valuation.

Table 4. Differences Between Calculated Tenderness Premiums/Discounts and Grid Premiums/Discounts ($/cwt dressed weight)

Choice/Select Spread	Mean of Absolute Value	Standard Deviation of Absolute Value	Mean	Standard Deviation	Minimum	Maximum	Tenderness > Grid
				Prime (11)			
$13.01	$8.00	$6.54	$2.36	$10.35	($22.98)	$13.48	63.6%
$8.59	$7.00	$5.77	$1.85	$9.13	($20.50)	$11.66	63.6%
$3.59	$5.53	$4.57	$1.09	$7.29	($16.75)	$8.93	54.5%
$14.12	$9.76	$7.99	$2.80	$12.65	($28.16)	$16.39	63.6%
$8.07	$8.24	$6.85	$1.94	$10.84	($24.59)	$13.60	54.5%
$3.17	$7.09	$5.86	$1.37	$9.36	($21.55)	$11.43	54.5%
				Upper Choice (182)			
$13.01	$13.93	$10.42	($0.80)	$17.41	($57.24)	$28.56	56.6%
$8.59	$12.33	$9.12	($0.40)	$15.36	($50.20)	$25.49	57.7%
$3.59	$9.96	$7.13	$0.34	$12.27	($39.43)	$21.02	59.9%
$14.12	$16.90	$13.03	($2.07)	$21.28	($71.05)	$33.79	54.4%
$8.07	$14.61	$10.89	($0.70)	$18.24	($59.83)	$30.04	56.6%
$3.17	$12.83	$9.11	$0.61	$15.75	($50.44)	$27.16	60.4%
				Lower Choice (1460)			
$13.01	$13.73	$12.03	($4.18)	$17.77	($93.17)	$31.80	44.3%
$8.59	$12.07	$10.52	($3.25)	$15.68	($81.76)	$28.50	45.6%
$3.59	$9.59	$8.25	($1.82)	$12.52	($64.52)	$23.53	47.9%
$14.12	$16.69	$14.49	($4.13)	$21.72	($112.87)	$39.84	46.1%
$8.07	$14.26	$12.29	($2.84)	$18.61	($96.05)	$34.84	47.6%
$3.17	$12.29	$10.50	($1.75)	$16.07	($82.25)	$30.79	49.7%
				Select (1397)			
$13.01	$15.62	$11.97	$1.47	$19.63	($90.50)	$44.64	58.6%
$8.59	$13.67	$10.64	$0.59	$17.32	($80.55)	$38.67	56.7%
$3.59	$10.77	$8.75	($1.19)	$13.83	($65.98)	$29.23	51.8%
$14.12	$19.29	$14.54	$2.91	$23.98	($109.46)	$55.66	60.2%
$8.07	$16.18	$12.69	$0.26	$20.56	($96.07)	$45.48	56.1%
$3.17	$13.83	$11.48	($2.83)	$17.75	($86.02)	$36.21	48.5%
				Standard (104)			
$13.01	$17.13	$14.23	$1.15	$22.31	($92.14)	$46.12	55.8%
$8.59	$15.14	$12.54	$1.22	$19.68	($81.08)	$40.89	55.8%
$3.59	$12.17	$10.00	$1.57	$15.72	($64.15)	$33.26	58.7%
$14.12	$20.84	$17.46	$0.49	$27.26	($113.49)	$55.44	54.8%
$8.07	$17.96	$14.90	$1.34	$23.36	($96.36)	$48.45	55.8%
$3.17	$15.73	$12.81	$2.61	$20.18	($81.77)	$43.28	59.6%

The distribution of the tenderness premiums/discounts as compared to that of grid premiums/discounts can be seen in Figures 2 and 3, as well as in further detail in Figures 4-8. Figure 2 represents a comparison of grid and tenderness in the first time period whereas Figure 3 depicts the second time period. Grids are rigid in their structure, only rewarding five different aggregate measures of palatability[2] (Prime, Upper Choice, Lower Choice, Select and Standard). Figures 2 and 3 show that if meat palatability were valued as measured by tenderness instead a more precise value message could be conveyed. Figures 4-8 show, in greater detail, the distribution of grid premium/discount error as compared to tenderness valuation. Figure 5 for example illustrates the distribution of the difference between the tenderness valued carcasses and the grid values for upper 1/3 Choice grade. The distribution illustrates the magnitude of pricing error in grid valuation relative to tenderness valuation. More than 61.5% of the upper 1/3 Choice carcasses are either under- or over-valued by more than $8/cwt when priced on a grid relative to a tenderness measure. Further, some upper 1/3 Choice carcasses are so tough; they are over-valued by more than $30/cwt when priced on a grid relative to a tenderness-based value. The distribution for lower 2/3 Choice (Figure 6) and Select (Figure 7) demonstrate even greater valuation error as a number of carcasses are under-valued or over-valued (16.8% and 24.0%, respectively) by more than $20/cwt using the grid value relative to a tenderness-based valuation.

[2] This does not take into account branded programs that are sometimes awarded in grid structures, such as Certified Angus Beef or Laura's Lean.

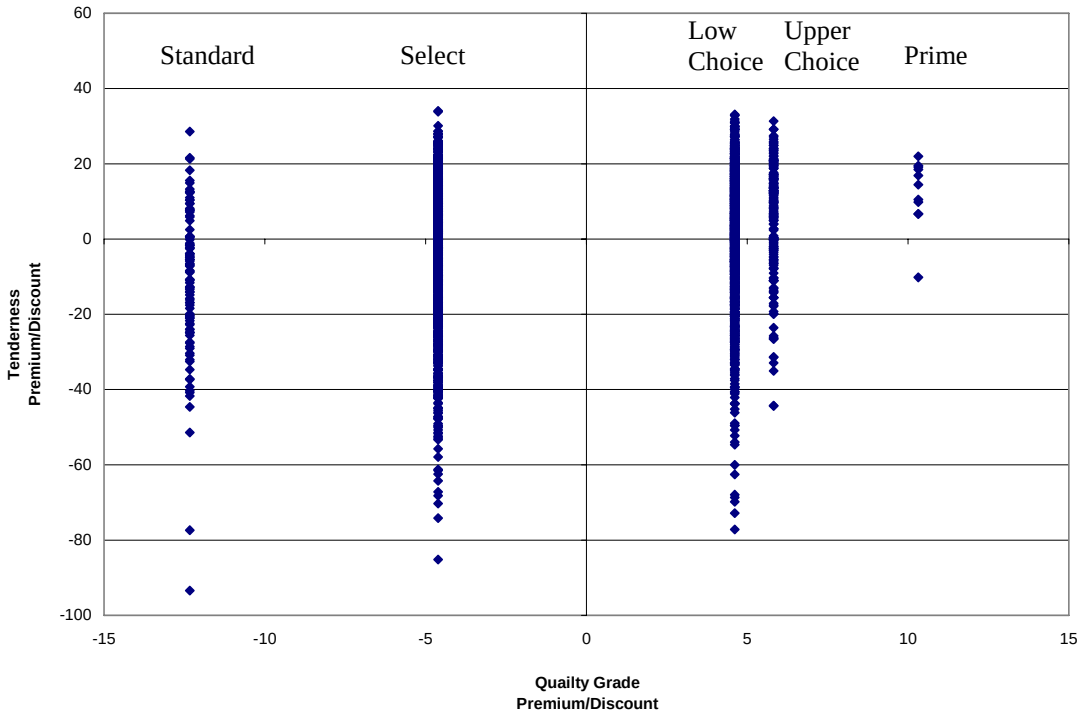

Figure 2. Scatter Plot of Tenderness and Grid Premiums/Discounts for the Time Period 1 at a Choice/Select Spread of $8.59 ($/cwt dressed)

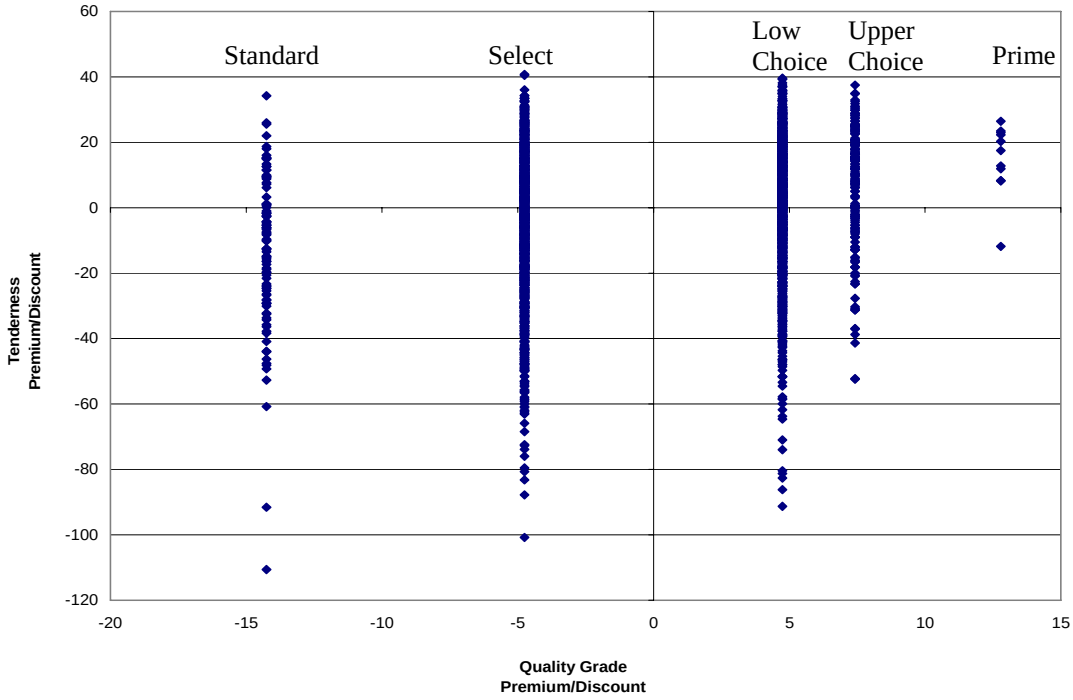

Figure 3. Scatter Plot of Tenderness and Grid Premiums/Discounts for Time Period 2 at a Choice/Select Spread of $8/07 ($/cwt dressed)

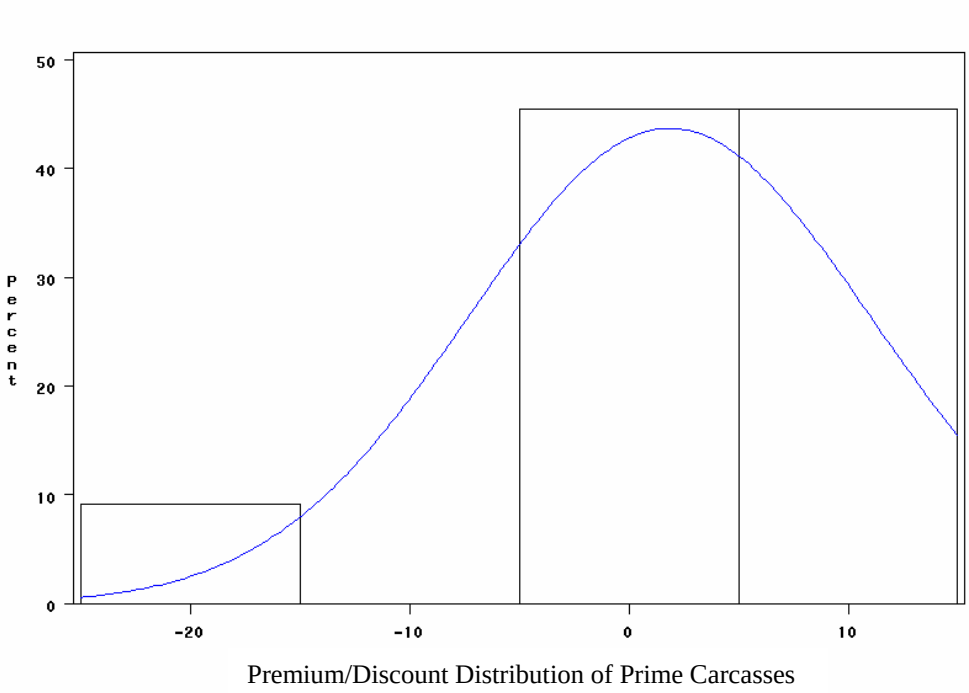

Figure 4. Distribution of the Difference of Tenderness Premiums/Discounts for Prime Carcasses when the Choice/Select Spread is 8.59

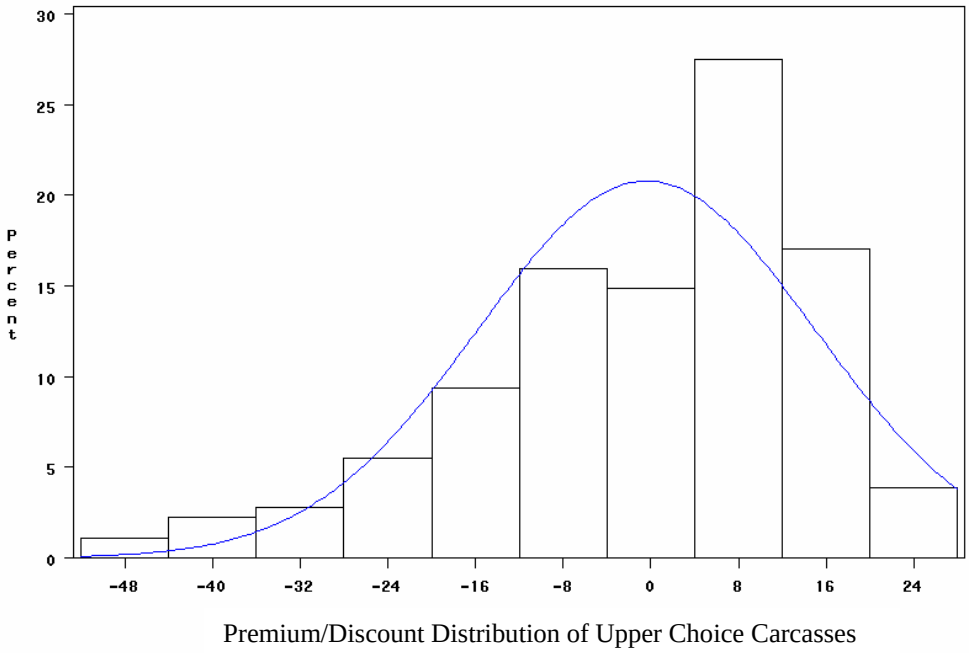

Figure 5. Distribution of the Difference of Tenderness Premiums/Discounts for Upper 1/3 Choice Carcasses when the Choice/Select Spread is 8.59 ($/cwt dressed)

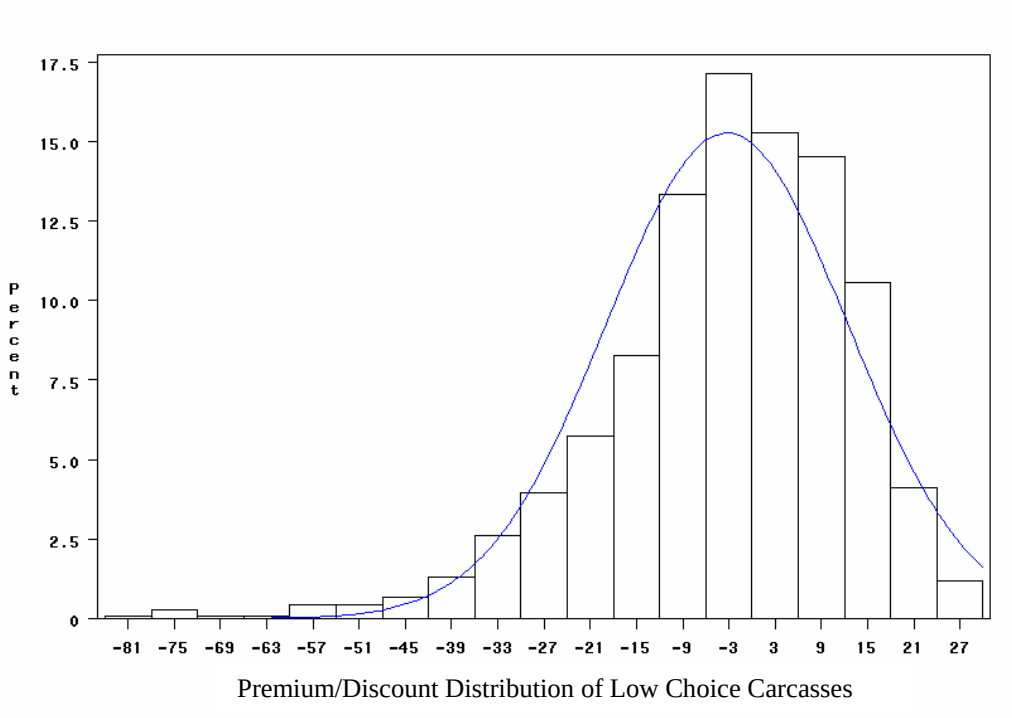

Figure 6. Distribution of the Difference of Tenderness Premiums/Discounts for Lower 2/3 Choice Carcasses when the Choice/Select Spread is 8.59 ($/cwt dressed)

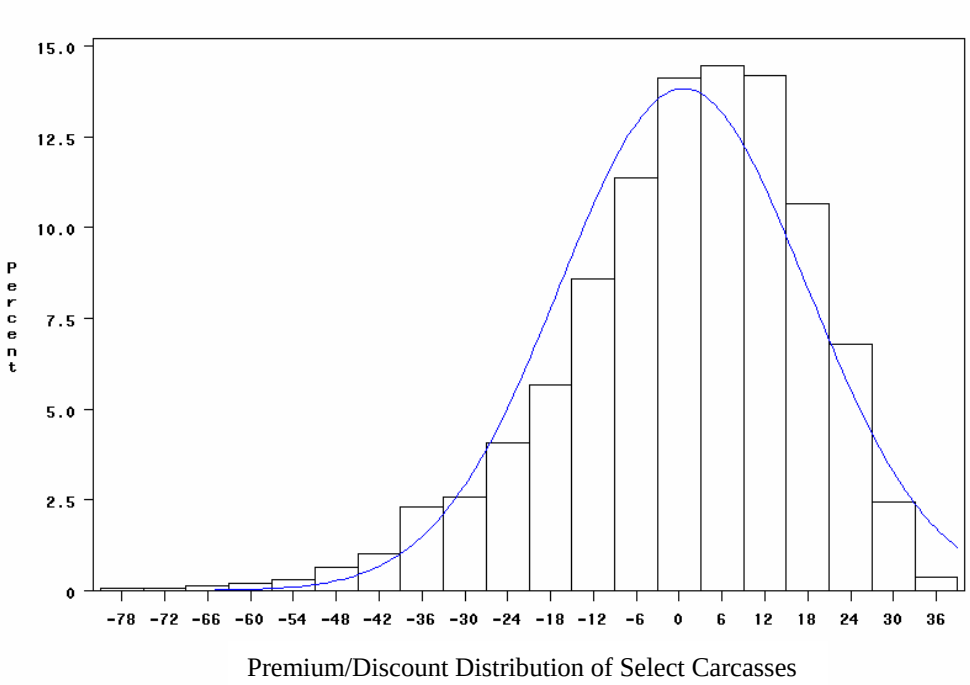

Figure 7. Distribution of the Difference of Tenderness Premiums/Discounts for Select Carcasses when the Choice/Select Spread is 8.59 ($/cwt dressed)

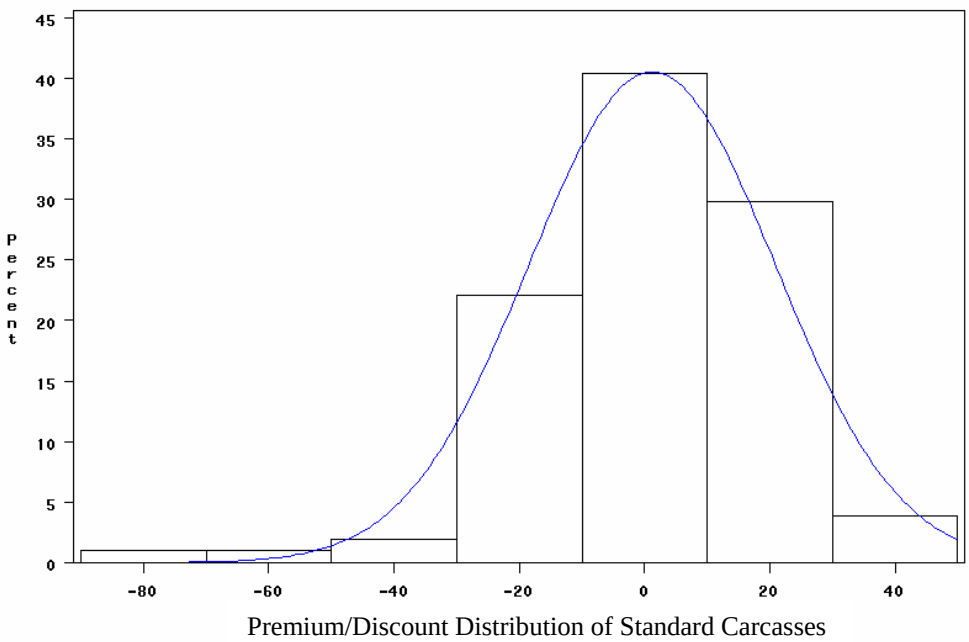

Figure 8. Distribution of the Difference of Tenderness Premiums/Discounts for Standard Carcasses when the Choice/Select Spread is 8.59 ($/cwt dressed)

Implications and Conclusions

Carcass data obtained from MARC were evaluated under three different marketing methods; dressed, grid, and tenderness valuation. Primary focus was given to the comparison of grid pricing and a hypothetical pricing system that awarded tenderness as measured by slice shear force. Prime and Standard carcasses were consistently undervalued in terms of their true palatability as compared to grid pricing and that lower two-thirds Choice carcasses (the current base for most grids) were overvalued. The average grid error across all carcasses and market scenarios was $13.11. Prime carcasses were over-valued as much as $13.60 but had the lowest grid error of $7.60. Upper Choice carcasses were over-valued as much as $71.05 with an average grid error of $13.43. Lower 2/3 Choice carcasses were consistently over-valued using grid marketing.

More importantly, the average grid error for lower Choice carcasses was $13.10 and many carcasses were over-valued as much as $50 or more. Select carcasses had an overall grid error of $14.89. As with lower Choice, many Select carcasses were over-valued as much as $50 or more. Standard carcasses had the largest grid error of $16.50. Many Standard carcasses are more tender than their USDA Quality Grade implies and should in some cases fetch a premium (as much as $40.79) rather than a discount.

Tenderness is one of the most important beef attributes (Smith et al.This study has shown that the current grid structure does not accurately reward/penalize carcasses in a manner that takes into account the end product use, which is the consumer's beef eating experience. More accurate measurements which reflect tenderness do have significant differences in overall carcass value and premiums/discounts rewarded to each carcass as compared to the grid.

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