GRID PRICING FOR FED CATTLE: AN EMPIRICAL ANALYSIS

BY

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ABSTRACT

The variability in the estimated weekly average carcass premium and/or discount for 2590 slaughter steers over a four year period is investigated. Individual weekly carcass premium or discount estimates are generated using AMS data on packer reported weekly slaughter cattle grid premiums and discounts. A three-stage recursive information structure is postulated to explain how a typical packer will determine weekly grid premiums and discounts. A three-stage recursive model is then estimated using an autoregressive procedure. The results of the empirical analysis indicate that among all grid premiums and discounts reported, it is the choice/select spread that explains the majority of the variability in the estimated carcass premium or discount from January of 1997 to December of 2000.

Key Words: slaughter cattle, grid pricing, average pricing, value-based-marketing.
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I. INTRODUCTION:

Grid pricing of fed cattle, which embodies the *value-based marketing* concept, has been touted as a solution to the problem of inconsistent beef quality and excess fat production. Today, all major packing companies offer producers the opportunity to sell their cattle on an individual carcass basis; however, grid pricing has not gained widespread producer acceptance. According to the *Packers and Stockyards Statistical Report (1998)*, 55% of all slaughter cattle were marketed live weight in 1994, and live weight marketings declined only slightly in 1996 to 53%. Ward et al. (1999) estimated that, at most, 20% of slaughter steers and heifers are marketed on a grid pricing system.

The evolution of grid pricing from a “dressed weight and grade” pricing system in the United States during the 1990s is consistent with the emergence of an industry consensus that an improved price incentive system for marketing high quality cattle is needed.\(^1\) Average pricing of slaughter cattle has been targeted as being a major contributor to inconsistent beef quality and excess fat production.\(^2\) However, average pricing continues to dominate the marketing channel for slaughter cattle.

The failure of grid pricing to become the dominate marketing channel for slaughter cattle has been debated in the literature (Fausti et al. 1998 and Ward et al. 1999). The incentive (disincentive) mechanism embodied in a grid pricing system is a function of the grid’s discount and premium structure. The general economic incentive structure embodied in packer grids has been pointed to as

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\(^1\) See Purcell (1998) for an informative discussion on how quality inconsistency has affected beef demand.

\(^2\) This view is articulated in the Value Based Marketing Task Force (VBMTF) final report (1990) published by the National Cattlemen's Beef Association (NCBA). Based on the report's findings, the task force recommended the development of a value-based marketing system to replace average pricing (live weight and dressed weight).
an obstacle preventing many slaughter cattle producers from selecting grid pricing as a marketing channel. The goal of this research is to identify which packer grid premium and discount categories explain weekly variation in carcass premiums or discounts over a four year period for a specific set of slaughter cattle.

II. THE GRID PRICING MECHANISM

The objective of a grid pricing system is to establish the true market value of fed cattle during the transaction period. Grid pricing is a superior price discovery mechanism relative to average pricing systems (live weight or dressed weight) because a grid pricing system eliminates estimation error from the transaction (Fausti et al. 1998, Ward et al. 1999).

In theory, a grid pricing system is designed to reward cattle that surpass minimum quality standards and penalize cattle failing to meet those minimum standards. The minimum standards (in general) are based on quality grade (choice), yield grade (3), and weight (550 to 950 lbs. dressed weight). Premiums are paid for carcasses grading prime and/or having a yield grade less than 3. Discounts are applied to lightweight/heavyweight carcasses, carcasses which quality grade select or less, and carcasses ascertainment to be yield grade 3.5 or greater.

A packing firm constructs its grid pricing system around a base price. The base price is a constructed price reflecting packer perceived market conditions (supply&demand). Base price formulation is not consistent across packers. An individual firm’s base price can be tied to the cash market (live or dressed weight), the futures market, or the boxed beef price. Plant averages for weight, yield grade, and quality grade can also play a role in determining the base price. Two

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3 Note that the phrase “grid premium or discount” refers to the price incentives (disincentives) a packer is paying for certain carcass characteristics. The phrase “carcass premium or discount” refers to the premium or discount levied on a carcass as an adjustment to the base price being paid for that carcass when the steer is being sold on a grid.

4 A general discussion of grid-base-price determination can be found in Ward et al. 1999.
common market elements used by firms in the packing industry to establish a weekly grid base price are the choice/select discount (SELECT) and the regional grading percentage (%CHOICE). Once a packing firm establishes a base price for its grid, then the firm applies discounts and premiums to the base price to determine the grid price of cattle purchased. However, no matter how the packer determines its base price, the packer’s goal when establishing its base price is to determine the market value of a yield grade 3, quality grade choice dressed carcass which falls in the weight class range of 550 pounds to 950 pounds. Accordingly, one would expect a strong correlation over time among base prices established by packers. Based on this premise, we argue that the way we calculate the base price in this study will be consistent and highly correlated with actual industry base prices over time.

To investigate the variability in the carcass premiums and discounts over time, the grid structure reported weekly by the AMS is utilized. The AMS grid is an additive grid, that is, the grid price per cwt. of a particular carcass is determined by the base price plus any carcass premiums and minus any carcass discounts. Base price, discounts, and premiums are in dollars per cwt. Grid price per cwt. is defined as:

1) \[
\text{GRID PRICE} = \text{BASE PRICE} + \text{PREMIUMS} - \text{DISCOUNTS}.
\]

As discussed above, the base price varies from firm to firm, and can change from week to week. Following the work of Fausti et al. 1998 and Feuz 1999, the base price for the AMS

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5 Ward et al. (1999) refer to this particular component used by a packer to determine a base price for its weekly grid as the “Choice-Select Price Spread Effect.” See Fausti et al. (1998) for a discussion of USDA quality grade and yield grade ratings. The regional grading percentage includes all prime and choice cattle which have a yield grade of less than 4 that were slaughtered in the reporting region. AMS data reported for region 7&8 includes: IA, KS, MO, NE, CO, MT, ND, SD, UT, and WY.

6 Grid pricing systems are not always additive. Ward et al. (1999), page 6, notes “.. some packers pay the same price for all Standard quality grade cattle regardless of the yield grade”. However, additive grids are commonplace.
grid is assumed to be a function of the regional reported hot carcass weight price (HCWP) and the “Choice-Select Price Spread Effect” as discussed in Ward et al. (1999): 7

2) BASE PRICE = HCWP + (SELECT) * (1 - %CHOICE).

The carcass premium or discount (CPD) for an individual animal is defined as:

3) CPD = GRID PRICE - BASE PRICE.

III. THE GRID PREMIUM/DISCOUNT DISCOVERY PROCESS: A RECURSIVE INFORMATION SYSTEM.

Holding carcass characteristics constant, the carcass premium or discount per cwt. for any individual steer carcass or for any particular group of steer carcasses will vary over time as packers adjust their grid premium and discount structure to changes in supply and demand conditions in the market. Therefore, grid premiums and discounts are packer-determined prices for particular carcass characteristics: 1) quality grade; 2) yield grade; and 3) carcass weight. It is assumed that packers calculate premiums and discounts for week t, based on USDA reported data on market conditions for week t-1. Widely reported data on market conditions include: 1) regional grading percentage (%CHOICE); 2) average regional slaughter weight (SLWT) for dressed weight sales; and 3) average price per cwt. for dressed weight sales (HCWP). Consequently, packer grid premiums and discounts are a function of a recursive process: USDA market data reported at time t for market conditions at time t-1 are used to determine grid premiums and discounts at time period t.

The recursive information structure is modeled as a three-stage recursive system which determines the average weekly CPD_t for the pen of 2590 carcasses over time:

7 One minus the regional grading percentage provides an estimate for the proportion grading select. Multiplying the regional percentage grading select by the choice/select spread and adding the product to the regional HCWP provides an estimate of the HCWP for slaughter steers grading 100% choice. Fausti et al. 1998 and Ward et al. (1999) use this approach to establish a base price in their analysis of grid pricing.
FIRST STAGE:
4) $\%\text{CHOICE}_{t-1} = f(\text{SLWT}_{t-1})$.  

SECOND STAGE:
5) $\text{PREMIUMS}_t = f(\%\text{CHOICE}_{t-1}, \text{HCWP}_{t-1})$.
6) $\text{DISCOUNTS}_t = f(\%\text{CHOICE}_{t-1}, \text{HCWP}_{t-1})$.

THIRD STAGE:
7) $\text{CPD}_t = F(\text{CARCASS TRAITS}, \text{PREMIUMS}_t, \text{DISCOUNTS}_t)$.

In the first stage, it is assumed that the $\%\text{CHOICE}_{t-1}$ for slaughter steers is a function of $\text{SLWT}_{t-1}$. An increase in the average slaughter weight will increase the percentage of steers grading choice.

In the second stage, it is assumed that grid premiums and discounts are a function of $\%\text{CHOICE}_{t-1}$ and $\text{HCWP}_{t-1}$. An increase in the regional grading percentage of slaughter steers grading choice or higher and yield grading 1,2, or 3 will reduce the quality grade and yield grade premiums and reduce discount levels as a result of an increase in the proportion of better quality cattle in the region. An increase in the $\text{HCWP}$ implies a change in the equilibrium price for slaughter steers. There are two plausible hypotheses on how a change in equilibrium price will affect premium and discount levels: 1) Packers will raise and lower premium and discount levels proportional to changes in $\text{HCWP}$; and 2) An increase in the equilibrium price implies slaughter steers have become relatively more scarce. In turn, packers will have to increase quality grade and yield grade premiums and reduce discounts across all categories to maintain purchase levels. The

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8 The predicted values of the first stage endogenous variables are used as explanatory variables in the second stage and so on. See Kennedy (1984) or Johnston (1972) for a discussion of the structure of a recursive system. The data indicate a strong positive correlation between weekly regional grading percentage and the weekly average regional slaughter weight ($r = .53$).
first hypothesis suggests a positive relationship between the HCWP level and the level of grid premiums and discounts. The second hypothesis suggests a positive relationship between the HCWP level and the grid premium level but a negative relationship between the HCWP level and the grid discount level.

In the third stage, carcass traits are held constant over time, but premiums and discounts change over time. Therefore, the individual carcass premium or discount (CPD) will vary over time. Accordingly, the weekly average carcass premium or discount for the pen of 2590 steers will also vary over time.

III. DATA DESCRIPTION:

The analysis is based on weekly market data collected over a 48-month period combined with carcass data on a set of 2590 South Dakota slaughter steers (42% grading choice, average yield grade of 2.68). Weekly market data were collected from USDA-AMS reports. The carcass data were collected by the Animal and Range Science Department at South Dakota State University.

The Animal and Range Science Department at South Dakota State University (SDSU) conducted a Retained Ownership Demonstration Program (RODP) for steer calves during the first half of the 1990s (Wagner et al. 1991-95). During this period 2590 steer calves were entered into the program by 250 beef producers and raised to slaughter weight. At slaughter weight, the animals were marketed under the dressed weight & grade pricing system. SDSU's animal scientists collected detailed carcass data at the time of slaughter.9

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9 The weekly proportion of fed cattle slaughtered in region 7&8 grading choice over the four-year period covered by this study ranged from 42% to 61%. Regional yield grade statistics were not collected.

10 The cattle in the RODP study were marketed on a dressed weight & grade basis when three steers of a group of five steers were estimated to have sufficient fat cover to grade low choice (.4 inches of fat over the 12th rib) or when continuing to feed the group of steers would result in excess fat cover and a yield grade 4. Only 42% of the 2590 animals slaughtered graded choice and the mean yield grade was 2.68.
The grid pricing system utilized here is three-dimensional (yield grade, quality grade, and dressed carcass weight) and was developed by the Agricultural Marketing Service (AMS 1997) division of the USDA for the purpose of price reporting. The AMS grid pricing system expands the yield grade categories from five under the dressed weight & grade system to seven. Carcass weight is divided into five weight class categories. Quality grade is divided into the four traditional categories: a) prime, b) choice, c) select, and d) standard.

All information provided on grid discounts and premiums was collected from the USDA-AMS grid pricing system on a weekly basis as reported in the AMS report, National Carcass Premiums and Discounts for Slaughter Steers and Heifers. Weekly data on the breakdown of quality grade for slaughter steers for region 7&8 were collected from the USDA National Steer & Heifer Estimated Grading Percent Report. The weekly average slaughter weight and the HCWP were collected from the USDA Livestock, Meat and Wool Weekly Summary and Statistics.

For each of the 2590 carcasses, a individual carcass price was calculated weekly by first deriving the weekly base price (constant across all carcasses for specific week), then applying the reported premiums and discounts according to the individual carcass's yield grade, quality grade, and weight classification. The next step was to subtract the weekly base price from the individual carcass’s calculated grid price. The final step was to derive the weekly average carcass premium or discount for the pen of 2590 carcasses. The result of the data collection process is a time-series data

11 The report’s price data are collected by the AMS through a survey of six regional packer grid pricing strategies for the previous week. The premiums and discounts reported by the AMS represent an average of those reported discounts and premiums. See Fausti et al. (1998) for an in-depth discussion of the structure of the AMS grid pricing system.

12 The HCWP is the USDA reported 5 area (Texas/Oklahoma, Kansas, Nebraska, Colorado, Iowa/So. MN) weekly weighted average price for dressed basis sales of slaughter steers grading 35% to 65% choice.

13 For each of the 2590 carcasses, a weekly carcass premium or discount value per cwt. was derived. Next, the weekly mean carcass premium or discount per cwt. was derived for the entire pen of 2590
set containing: 1) all premiums and discounts associated with the AMS grid; 2) regional supply side variables; 3) seasonal dummy variables; and 4) weekly price and revenue variables.

Diagnostics of the data indicated the possibility of serious multicollinearity. The major cause of the multicollinearity was determined to be the way premiums and discounts are set by the packing industry and reported by the AMS. The yield grade, quality grade, and carcass weight discounts and premiums move together within their respective groups. Highly correlated variables by group included: 1) quality grade standard and select discounts; 2) yield grade premiums; 3) yield grade discounts; 4) carcass weight discounts, 500 with 550, and 1000 with 1001. In addition, less than 1% of the carcasses in the SDSU RODP data set were: 1) lightweight or heavy weight carcasses; and 2) prime carcasses. Given these limiting constraints, it was decided to use the following grid variables as explanatory variables for the empirical model: yield grade less than 2 premium, yield grade 2 to 3 premium, yield grade 3.5 to 4 discount, yield grade 4 to 5 discount, and the quality grade select discount.

IV. THE EMPIRICAL MODEL:

The empirical analysis utilized a three-step recursive estimation procedure as described in Johnston (1972, pp.376-80) and Kennedy (1984, p.118). In the first stage, \( SLWT_{t-1} \) and seasonal monthly dummy variables were regressed on \( \%CHOICE_{t-1} \) (eq. 8). Predicted values from the first stage

carcasses. This process was repeated for each week over the four-year period. The data set contains 205 weekly observations of the average weekly premium (discount) calculated for the pen of 2590 carcasses.

The sample contained 349 (13.5%) carcasses that graded less than yield grade 2.0, 1407 (54%) carcasses yield graded between 2.0 and 3.0, and 769 (30%) carcasses that yield graded between 3.0 and 4.0. The sample contained 1090 (42%) quality grade choice carcasses and 1419 (55%) quality grade select carcasses. Severe discounts were applied to 134 animals which either quality graded standard (80 carcasses) or yield graded 4 or 5 (54 carcasses). The sample also contained 16 lightweight and 5 heavyweight carcasses. Only one carcass received a quality grade of prime.

December was selected as the reference month. Grid discounts were transformed into positive values. The hat symbol (^) denotes the predicted value of the independent variable.
analysis, along with $HCWP_{t-1}$ and a weekly time-trend variable, were regressed on $SELECT_t$, $YG2_t$, $YG2-3_t$, $YG35-4_t$, $YG4-5_t$, (eqs. 9, 10, 11, 12, 13, ). Predicted values from stages 1&2 were regressed on the $CPD_t$ (eq. 14).

**FIRST STAGE:**

8) $\%CHOICE_{t-1} = f(SLWT_{t-1}, \text{MONTHLY DUMMIES})$.

**SECOND STAGE:**

9) $SELECT_t = f(\%CHOICE_{t-1}, HCWP_{t-1}, \text{TIME-TREND})$.

10) $YG2_t = f(\%CHOICE_{t-1}, HCWP_{t-1}, \text{TIME-TREND})$.

11) $YG2-3_t = f(\%CHOICE_{t-1}, HCWP_{t-1}, \text{TIME-TREND})$.

12) $YG35-4_t = f(\%CHOICE_{t-1}, HCWP_{t-1}, \text{TIME-TREND})$.

13) $YG4-5_t = f(\%CHOICE_{t-1}, HCWP_{t-1}, \text{TIME-TREND})$.

**THIRD STAGE:**

14) $CPD_t = f(PREMIUMS_t, \text{DISCOUNTS}_t)$.

The recursive structure of the model allows OLS estimation of the three stages. The estimated equations in all three stages suffered from serious autocorrelation.

The results of the first stage equation (Table I) are consistent with the life cycle production pattern of the fed cattle industry in region 7&8. A preponderance of the calving in region 7&8 occurs in the early spring, resulting in a seasonal pattern of higher quality grade cattle coming to market the following spring, relative to the quality of slaughter cattle marketed in the fall. The analysis also indicates that an increase in the weekly average weight of a dressed carcass has a positive effect on

Stage 1&2 predicted values for the endogenous variables were generated using both the structural part of the model and the predicted values of the error process (SAS/ETS, 1990, p.181). It is assumed that the regression equation(s) in each stage have an associated error term, $V$, which is generated by an autoregressive process: $V_t = \gamma_t - \forall_1 V_{t-1} - ... - \forall_p V_{t-p}$, where $\gamma_t$ is a sequence of independent normally distributed error terms.
the weekly regional percentage of slaughter cattle grading choice. This result is also consistent with the biological pattern found in the cattle feeding industry.

**Table 1. Results of Stage I Regression Estimates.**

<table>
<thead>
<tr>
<th>Dependent Variable: %Choice&lt;sub&gt;t-1&lt;/sub&gt;</th>
<th>Coefficient</th>
<th>Std Error</th>
<th>t Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTERCEPT</td>
<td>9.333</td>
<td>13.186</td>
<td>0.708</td>
</tr>
<tr>
<td>SLWT&lt;sub&gt;t-1&lt;/sub&gt;</td>
<td>0.032 ***</td>
<td>0.0120</td>
<td>3.139</td>
</tr>
<tr>
<td>JAN</td>
<td>2.012 ***</td>
<td>0.6537</td>
<td>3.078</td>
</tr>
<tr>
<td>FEB</td>
<td>2.588 ***</td>
<td>0.7842</td>
<td>3.301</td>
</tr>
<tr>
<td>MAR</td>
<td>3.458 ***</td>
<td>0.8304</td>
<td>4.166</td>
</tr>
<tr>
<td>APR</td>
<td>2.036 **</td>
<td>0.8748</td>
<td>2.328</td>
</tr>
<tr>
<td>MAY</td>
<td>1.362</td>
<td>0.9266</td>
<td>1.470</td>
</tr>
<tr>
<td>JUN</td>
<td>1.395</td>
<td>0.9303</td>
<td>1.500</td>
</tr>
<tr>
<td>JUL</td>
<td>0.477</td>
<td>0.8970</td>
<td>0.532</td>
</tr>
<tr>
<td>AUG</td>
<td>-0.915 **</td>
<td>0.8607</td>
<td>-1.064</td>
</tr>
<tr>
<td>SEP</td>
<td>-1.945 **</td>
<td>0.8199</td>
<td>-2.373</td>
</tr>
<tr>
<td>OCT</td>
<td>-2.174 ***</td>
<td>0.7482</td>
<td>-2.906</td>
</tr>
<tr>
<td>NOV</td>
<td>-0.439</td>
<td>0.5983</td>
<td>-0.734</td>
</tr>
</tbody>
</table>

| SSE                                     | 415.178     | Reg Rsq   | 0.249   |
| MSE                                     | 2.173       | Total Rsq | 0.801   |
| DFE                                     | 191         | Durbin-Watson | 1.976 |
|                                         |             | Prob<DW   | 0.2529  |

*/ Significant at 0.10 , **/ Significant at 0.05 level, and ***/ Significant at 0.01 level.

Note. Autoregressive procedure was applied. The estimates of lag coefficients (and standard errors in parentheses) are as follows.
Lag 1 -0.457 (0.062), and Lag 4 -0.254 (0.062).

The statistical results generated by the second stage equations (Table II) indicate: 1) The best predictor of next week’s premium and discount levels are the current weekly premiums and discounts as indicated by the relatively large first-order autoregressive coefficient estimates; 2) The regional grading percentage has an inverse relationship with the select discount, and the yield grade 4-5

10
discount; 3) Changes in the regional grading percentage has no effect on the YG2, YG2-3 premiums and the YG35-4 discount; 4) The HCWP has a positive relationship with the select discount and the YG3.5-4 discount. Changes in the HCWP have no effect on YG2-3, YG4-5, and YG2; 5) The time-trend coefficients are significant and positive for all three discount variables, suggesting that grid discounts have increased over time; and 6) The time trend coefficient was insignificant for the YG2-3 premium, but positive for the YG2 premium indicating yield grade premiums were not declining during the four-year period of the study.

The implication of the general time-trend pattern observed in the stage II equations is that packers are increasing the yield grade premiums and discounts assessed on slaughter cattle sold on a grid independent of fluctuations in cattle prices. The exception is the YG2-3 premium, which has remained stationary. Statistical results indicate that packers have also been adjusting the YG35-4 discount as the HCWP fluctuates.

The trend in the market value of a quality grade choice carcass has been positive. For those producers who consistently produce choice cattle, the market for choice beef has improved over the last four-years. The time-trend coefficient estimated in the choice/select spread autoregressive model indicates the choice/select spread, on average, has increased by $3.56 \text{ cwt.}$ over the four-year period covered by this study. The results of the choice/select spread autoregressive model suggest that: 1) there is a positive relationship between the choice/select spread and the HCWP for slaughter cattle, indicating packers adjust choice/select spread to changes in the market price for slaughter cattle; and 2) there is a negative relationship between the choice/select spread and the supply of choice carcasses, indicating that cattle packers adjust the choice/select spread to fluctuations in the supply of choice carcasses.
Table 2. Results of Stage II Regression Estimates.

<table>
<thead>
<tr>
<th>INDEPENDENT VARIABLES:</th>
<th>SELECT(_t)</th>
<th>YG2(_t)</th>
<th>YG2-3(_t)</th>
<th>YG3.5-4(_t)</th>
<th>YG4-5(_t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>7.424***</td>
<td>1.001***</td>
<td>0.685***</td>
<td>0.019***</td>
<td>15.633***</td>
</tr>
<tr>
<td></td>
<td>(3.138)</td>
<td>(0.32)</td>
<td>(0.134)</td>
<td>(0.045)</td>
<td>(1.74)</td>
</tr>
<tr>
<td>%CHOICE(_{t-1})</td>
<td>-0.145***</td>
<td>0.004**</td>
<td>0.0018</td>
<td>0.0006</td>
<td>-0.048**</td>
</tr>
<tr>
<td></td>
<td>(0.042)</td>
<td>(0.0038)</td>
<td>(0.0009)</td>
<td>(0.0005)</td>
<td>(0.028)</td>
</tr>
<tr>
<td>HCWP(_{t-1})</td>
<td>0.054***</td>
<td>0.003</td>
<td>0.0006</td>
<td>0.0007**</td>
<td>-0.005</td>
</tr>
<tr>
<td></td>
<td>(0.021)</td>
<td>(0.002)</td>
<td>(0.0009)</td>
<td>(0.0003)</td>
<td>(0.0128)</td>
</tr>
<tr>
<td>TIMTREND</td>
<td>0.018***</td>
<td>0.003</td>
<td>0.003</td>
<td>0.0002***</td>
<td>0.025***</td>
</tr>
<tr>
<td></td>
<td>(0.004)</td>
<td>(0.001)</td>
<td>(0.0004)</td>
<td>(0.0000)</td>
<td>(0.003)</td>
</tr>
<tr>
<td>SSE</td>
<td>69.30</td>
<td>0.65</td>
<td>0.123</td>
<td>0.016</td>
<td>21.54</td>
</tr>
<tr>
<td>DFE</td>
<td>198</td>
<td>200</td>
<td>197</td>
<td>199</td>
<td>199</td>
</tr>
<tr>
<td>MSE</td>
<td>0.35</td>
<td>0.003</td>
<td>0.0006</td>
<td>0.00008</td>
<td>0.108</td>
</tr>
<tr>
<td>Reg Rsq</td>
<td>0.148</td>
<td>0.066</td>
<td>0.014</td>
<td>0.138</td>
<td>0.23</td>
</tr>
<tr>
<td>Total Rsq</td>
<td>0.967</td>
<td>0.964</td>
<td>0.927</td>
<td>0.869</td>
<td>0.97</td>
</tr>
<tr>
<td>Durbin-Watson</td>
<td>0.85</td>
<td>1.91</td>
<td>1.97</td>
<td>1.93</td>
<td>1.81</td>
</tr>
<tr>
<td>Prob&lt;DW</td>
<td>0.01</td>
<td>0.23</td>
<td>0.39</td>
<td>0.27</td>
<td>0.08</td>
</tr>
</tbody>
</table>

*/ Significant at 0.10, **/ Significant at 0.05 level, and ***/ Significant at 0.01 level.

Note: Auto regressive procedure was applied. The estimates for the lagged coefficients with the standard errors in parentheses are as follows:

- Model 1: Lag1 -0.839 (0.051), Lag3 -0.23 (0.068), Lag6 0.21 (0.043).
- Model 2: Lag1 -0.949 (0.022).
- Model 3: Lag1 -1.09 (0.067), Lag2 0.14 (0.07), Lag9 0.27 (0.07), Lag10 -0.26 (0.067).
- Model 4: Lag1 -0.89 (0.032), Lag8 0.13 (0.032).
- Model 5: Lag1 -1.01 (0.028), Lag6 0.124 (0.028).
Figure I displays a graph of the choice/select spread time series data. The data exhibits a strong seasonality component over the four years covered by this study. Consequently, the producer’s incentive to market on a grid system will be highly influenced by the seasonal pattern in the choice/select spread.

The implication is that the risk to reward tradeoff associated with marketing on a grid is not consistent over time.

The question that needs to be answered is: Will seasonal variation in the risk to reward tradeoff dissuade producers from marketing on a grid? Additional work is needed on this issue.

The predicted values of the grid premiums and grid discounts generated in the first and second stage were used as explanatory variables in the third stage equation. Regression diagnostics

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1 The data also indicates a possible cyclical component related to the cattle cycle.
were performed. Diagnostics of the model indicated that multicollinearity was not a problem.² A visual examination of the residuals against the predicted values of the price differential indicates that heteroscedasticity is not present.³ The parameter estimates, standard errors, p-values, and analysis of variance results from the autoregressive procedure are provided in table III.

² Regression diagnostics produced “Variance Inflation Factor (VIF)” estimates less than 9 for all independent variables (corrected for serial correlation) in the stage III equation (See Belsley et al. 1980).

³ The White test for heteroscedasticity, as suggested by Judge et al. (1985, p.447), was conducted, and it was concluded that heteroscedasticity was not present at a p-value of less than .01.
### Table 3. Estimated Model

Dependent Variable: CPD

#### Yule Walker Estimates

<table>
<thead>
<tr>
<th></th>
<th>SSE</th>
<th>DF</th>
<th>MSE</th>
<th>DFE</th>
<th>Root MSE</th>
<th>AIC</th>
<th>SBC</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>68.84</td>
<td>198</td>
<td>0.347</td>
<td>198</td>
<td>0.589</td>
<td>372.0</td>
<td>395.0</td>
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</table>

#### Reg Rsq

<table>
<thead>
<tr>
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<th>0.864</th>
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</thead>
</table>

#### Tot Rsq

<table>
<thead>
<tr>
<th></th>
<th>0.909</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Variable</th>
<th>DF</th>
<th>Parameter Estimate</th>
<th>Standard Error</th>
<th>Test</th>
<th>Prob &gt;</th>
<th>Standardized Beta Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>1</td>
<td>2.000</td>
<td>1.165</td>
<td>1.72</td>
<td>0.086</td>
<td></td>
</tr>
<tr>
<td>SELECTi</td>
<td>1</td>
<td>-0.604</td>
<td>0.021</td>
<td>-28.68</td>
<td>0.001</td>
<td>-0.931</td>
</tr>
<tr>
<td>YG4-5i</td>
<td>1</td>
<td>-0.079</td>
<td>0.038</td>
<td>-2.07</td>
<td>0.039</td>
<td>-0.077</td>
</tr>
<tr>
<td>YG35-4i</td>
<td>1</td>
<td>-4.923</td>
<td>2.997</td>
<td>-1.64</td>
<td>0.102</td>
<td>-0.058</td>
</tr>
<tr>
<td>YG2i</td>
<td>1</td>
<td>1.090</td>
<td>0.523</td>
<td>2.08</td>
<td>0.038</td>
<td>0.161</td>
</tr>
<tr>
<td>YG2-3i</td>
<td>1</td>
<td>-2.157</td>
<td>1.550</td>
<td>-1.392</td>
<td>0.165</td>
<td>-0.095</td>
</tr>
<tr>
<td>AR(1)</td>
<td>1</td>
<td>-0.203</td>
<td>0.069</td>
<td>-2.922</td>
<td>0.010</td>
<td></td>
</tr>
</tbody>
</table>

Durbin-Watson 2.02
Number of OBS 205
Prob < DW 0.4378

A first order autoregressive model was selected during the estimation procedure using the SAS “autoreg” procedure. The independent variables, corrected for autocorrelation, account for approximately 86% of the variability associated with the average weekly carcass premium/discount per cwt. for the 1-6-97 to 12-31-00 time period. The mean premium is -$3.55 per cwt. All significant premium and discount parameter estimates have the correct hypothesized sign.
Standardized Beta Coefficients were calculated to determine the influence of each independent variable on the weekly average carcass premium /discount.\(^4\) The standardized beta coefficient for SELECT demonstrates that a one standard deviation change in the choice/select spread results in a .93 standard deviation change in the average weekly carcass premium or discount. The yield grade premium \(YG2-3\) is insignificant. This result suggests that even though 55% of the carcasses in the data set were in the yield grade category of 2.0 to 3.0, the yield grade premium variable failed to contribute any information on the variability in the average carcass premium per cwt. during this time period. The yield grade premium for steers in the yield grade category of 2.0 or less is positive and significant. The standardized beta coefficient estimate indicates that the influence of yield grade 2.0 premium on carcass premium/discount variability is significantly less than the choice/select spread. The yield grade discount variables \(YG35-4\) and \(YG4-5\) were significant at the 10% and 5% levels respectively. The standardized beta coefficient estimates indicate that the variability in the yield grade discount variables has significantly less influence on carcass premium/discount variability than the choice/select spread.

The goal of the study is to identify which grid premium and discount prices have the greatest influence on the variability in the “average weekly carcass premium”, over a four-year period, for a specific set of 2590 slaughter cattle. Our results indicate that the AMS grid premium and discount structure, on average, would penalizes SDSU-RODP cattle -$3.55 per cwt. over the four-year period. The empirical analysis also reveals that week-to-week variability in the average weekly carcass premium or discount is due primarily to changes in the choice/select discount. A partial \(R^2\) ( \(R^2 = .85\) ) was calculated for the choice/select spread variable. The variability in the average carcass

\(^4\) Standardized beta coefficients are computed by dividing a parameter estimate by the ratio of the sample standard deviation of the dependent variable to the sample standard deviation of the regressor. Each beta coefficient reported in Table III indicates the number of standard deviation changes in the dependent variable associated with a standard deviation change in the independent variable, ceteris paribus. The magnitudes of the beta coefficients are not affected by the scales of measurements associated with the independent variables and thus can be used to ascertain the relative importance of the effects the independent variables on the dependent variable. See Pindyck and Rubinfeld (1998) for a complete discussion of this topic.
premium/discount over the four years can be almost entirely explained by changes in the choice/select spread.

V. SUMMARY:

A three-stage recursive regression model was developed to empirically investigate the variability in the average weekly carcass premium/discount for a set of 2590 steer carcasses over a four-year period. Our empirical results provide evidence that the variability in the weekly average carcass premium or discount is primarily due to changes in the choice/select discount. The implication for the producer who raised and sold pens of slaughter steers on a grid, with similar yield and quality grade characteristics as the group in this study, during this four year period is: 85% of the variability in carcass premiums and discounts for the average pen was the result of variability in the choice/select spread.

Examining the stage II and stage III results together, we observe that the yield grade discounts do contribute to the variability in the average weekly grid premium and the size of the yield grade discounts has been increasing over time. Changes in yield grade 2.0 premium does contribute to the variability in the average weekly carcass premium, and has the yield grade 2.0 premium has been increasing over time. The yield grade 2 to 3 premium has remained stationary over the four year period and does not contribute to explaining the variability in the average weekly carcass premium/discount.

In the third stage equation, the quality grade choice/select spread variable made the greatest contribution to explaining the variability in the average weekly grid premium over the four-year period. The second stage results indicate that the choice/select spread has been increasing over the period of the study and fluctuates positively with the general price level for slaughter cattle. These results, interpreted in light of the discussion found in the price discovery literature, indicate that the market incentives necessary to induce producers to switch from average pricing to a value based pricing system are weak at best. Given that cattle quality is held constant in this study, the upward
trend in grid discounts suggest that the price risk associated with marketing on a grid has been increasing. The grid price incentive mechanism needs further research.

REFERENCES:


USDA-AMS, *Livestock, Meat and Wool Weekly Summary and Statistics* weekly reports 1-1-97 to 3-1-99, Des Moines, IA.


USDA-AMS, *National Steer & Heifer Estimated Grading Percent Report* weekly reports 1-1-97 to 3-1-99, Des Moines, IA.


