GRID PRICING VERSUS AVERAGE PRICING FOR SLAUGHTER CATTLE:

AN EMPIRICAL ANALYSIS

By

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ABSTRACT

Weekly grid premium and discount price data for fed cattle have been collected over a 26 month period. The grid price data are combined with carcass data (2590 South Dakota slaughter steers) in order to investigate the variability in the price differential per cwt. when marketing fed cattle on a grid versus selling cattle at an average price (dressed weight). A three-stage recursive information structure is postulated. The theoretical model describes how the price differential is affected by changes in packer determined gird premiums and discounts on a weekly basis. The three-stage recursive model is then estimated using ordinary least squares. The results of the empirical analysis indicate that among all grid premiums and discounts, it is the choice/select discount playing the dominant role in determining weekly changes in the price differential.

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I. INTRODUCTION:

The advent of grid pricing for slaughter cattle in the United States during the 1990s is consistent

with the emergence of an industry consensus that average pricing of slaughter cattle is responsible for

inconsistent beef quality and excess fat production.[1] These two negative factors associated with average

pricing are cited as major contributing factors to the decline in the demand for beef over the last two

decades (VBMTF).[2]

Grid pricing, which embodies the *value-based marketing* concept, has been touted as a solution to

the average pricing dilemma facing the industry. 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 _1996 Packers and Stockyards Statistical Report_,

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) estimates that, at most, 20% of slaughter steers and heifers are

marketed on a grid pricing system.

The price discovery literature addresses the issue of why value-based marketing for fed cattle has

not come to dominate the cash market and supplant average pricing. The literature asserts that

informational disparities over carcass quality combined with risk averse behavior on the part of both the

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[1] 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).

[2] See Purcell (1998) for an informative discussion on the downward trend in beef demand over the last twenty years.

packer and the producer explain the continued use of average pricing in the cash market for slaughter cattle (Ward 1987, Fausti and Feuz 1995). The cited price discovery literature provides a theoretical framework and empirical evidence in support of the proposition that informational disparities result in price differentials between average carcass pricing and individual carcass pricing.   Within the context of the risk/return tradeoff discussion, Fausti et al. (1998) reviewed the price differential issue and the role the premium/discount structure plays in determining the magnitude of the differential.   Fausti et al. (1998) cautioned that if the increased return under a grid pricing system is **not** great enough to compensate producers for the additional risk, then producers will **not** sell their cattle on a grid system.

The incentive mechanism embodied in a grid pricing system is investigated in this study. Grid premiums and discounts reported weekly by Agricultural Marketing News Service (AMS) are used to conduct a weekly comparative price analysis study of South Dakota slaughter steers (2590 head, 42% grading choice, average yield grade of 2.68). The carcass data are evaluated on a weekly basis employing the AMS grid system and an average price system (dressed weight). The data indicate that on average, over a 114 week period, dressed weight price per cwt. is higher than grid price per cwt.[3]   The data also demonstrate that, over the last two years, the price differential has been trending downward (figure 1). In the context of the literature discussing the risk/return tradeoff, this negative trend indicates a **diminishing incentive** to market slaughter cattle through a grid pricing system during this time period..

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[3] A single set of slaughter cattle are evaluated weekly under the two pricing systems. The consequence of this approach is that weekly changes in the price differential are independent of carcass weight and carcass quality characteristics.

Fig 1. Price Differential
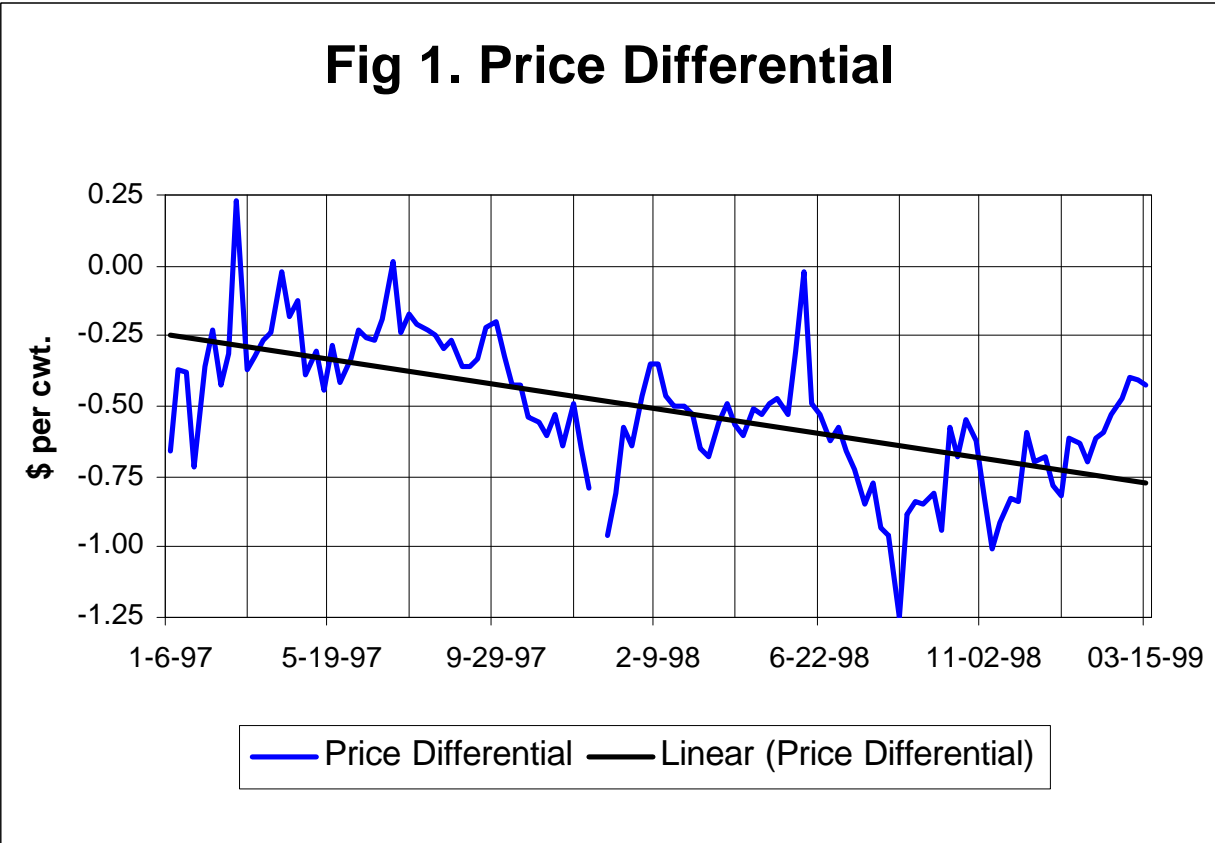
The contributions of this study are: 1) formalization of the theoretical structure of grid pricing, and 2) empirical identification of factors influencing the price differential (grid price per cwt. minus dressed weight price per cwt.). Grid premium and discount variables, market price, and supply side variables are included in the empirical model to determine which of these factors has significant explanatory power.

II. A THEORETICAL FRAMEWORK OF GRID PRICING FOR FED CATTLE

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 ascertained to be yield grade 4 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 factors (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.[4] Plant averages for weight, yield grade, and quality grade can also play a role in determining the base price. Two common market elements used by firms in the packing industry to establish a weekly grid base price are the choice/select discount (*SELECTd*) and the regional grading percentage (*%CHOICE*).[5] 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.[6]

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[4] A general discussion of grid-base-price determination can be found in Ward et al. 1999.

[5] Ward et al. refers 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. for a discussion of USDA quality grade and yield grade ratings.

[6] Grid pricing systems are not always additive. Ward et al., 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.

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To investigate the variability in the price differential, 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) GRID PRICE = BASE PRICE + PREMIUMS - 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 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.:[7]

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

The price differential (**PDIFF**) for any particular carcass is defined as the grid price per cwt. minus the hot carcass weight price per cwt:

3) PDIFF = GRID PRICE - HCWP.

Substituting equations 1&2 into equation 3 it is clear that the HCWP plays no *direct* role in determining the price differential. The price differential for any individual animal is solely a function of the choice/select spread effect and the grid's quality grade, yield grade, and weight premiums and discounts associated with the animal's carcass characteristics:

4) PDIFF = SELECTd * (1 -%CHOICE) + PREMIUMS - DISCOUNTS.

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[7] The regional grading percentage reflects the weekly proportion of slaughter steers grading choice in AMS reporting region 7&8. 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.

Holding carcass characteristics **constant**, the price differential per cwt. for any individual steer carcass or for any particular group of steer carcasses will vary over time as packers adjust the 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, the price differential is 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*. Grid premiums and discounts at time *t* determine the price differential at time *t*.

The recursive information structure is modeled as a three-stage recursive system which determines the price differential over time:

FIRST STAGE:

5) $\%CHOICE_{t-1} = f(SLWT_{t-1})$. [8]

SECOND STAGE:

6) $PREMIUMS_t = f(\%CHOICE_{t-1}, HCWP_{t-1})$.

7) $DISCOUNTS_t = f(\%CHOICE_{t-1}, HCWP_{t-1})$.

THIRD STAGE:

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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 indicates a strong positive correlation between regional grading percentage and average regional slaughter weight (r =.55).

8) $\text{PDIFF}_t = (1 - \%\text{CHOICE}_{t-1}) * \text{SELECTd}_t + \text{PREMIUMS}_t + \text{DISCOUNTS}_t.$ [9]

In the first stage, it is assumed that the **%CHOICE$_{t-1}$** for slaughter steers is a function of *SLWT$_{t-1}$*.[10] 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 **%CHOICE$_{t-1}$** and **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 **HCWP** implies a change in the equilibrium price for slaughter steers. 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.

In the third stage, an increase in **%CHOICE** will reduce the choice/select spread effect, resulting in a decline in the grid base price.[11] A decline in the base price will reduce the price differential. An increase in grid premiums will increase the price differential. An increase in grid discounts will decrease the price differential.

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[9] Predicted values of earlier stage endogenous variables denoted with the hat symbol(^).

[10] There is some controversy over the exact nature of the relationship between regional grading percentage and regional slaughter weight.

[11] An increase in the regional grading percentage will put downward pressure on the choice/select discount. Therefore, the overall effect of an increase in the regional grading percentage is a decline in the choice/select spread effect.

III. DATA DESCRIPTION:

The analysis is based on weekly market data collected over a 26 month period combined with carcass data on a set of 2590 South Dakota slaughter steers. 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.[12]

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

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[12] 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. While only 42% of the 2590 animals slaughtered graded choice, 68% of the cattle yield graded less than 3 and the mean yield grade was 2.68. The sample contained 360 carcasses rated less than yield grade 2. 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.

class categories. Quality grade is divided into the four traditional categories: a) prime, b) choice, c) select, and d) standard.[13]

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.[14] 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. [15]

For each of the 2590 carcasses, a grid carcass price was determined weekly by applying the reported premiums and discounts according to the carcass's yield grade, quality grade, and weight classification. Next, individual dressed weight carcass revenue, based on the USDA reported hot carcass weight price, was derived for each week. The final step was to derive the weekly average price differential.[16] The result of the data collection process is a time-series data set containing: 1) all premiums and discounts associated with the AMS grid; 2) regional supply side variables; 3) seasonal dummy

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[13]   See Fausti et al. 1998 for a in-depth discussion of the structure of the AMS grid pricing system.

[14] The report's price data are collected by the AMS through a survey of seven 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.

[15] The **HCW price** is the reported 5 area weekly weighted average price for dressed basis sales of slaughter steers grading **35% to 65% choice**.

[16] For each of the 2590 carcasses, the grid price per cwt. minus HCWP per cwt. was calculated. The weekly mean price differential per cwt. was then derived. This process was repeated for each week over the 26 month period.

variables; and 4) price and revenue variables. Summary statistics, excluding seasonal quarterly dummy variables, are reported in table 1.[17]

Diagnostics of the data indicated the possibility of serious multicollinearity. Grid premium and discount correlation coefficients are reported in appendix table 1a. 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) standard discount with select discount; 2) yield grade premiums; 3) yield grade discounts; 4) carcass weight discounts 500 with 550, and 1000 with 1001. It was decided to keep the following grid variables: yield grade 2 to 3 premium, yield grade 4 to 5 discount, choice /select discount, and weight discounts 550 & 1000.

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 quarterly dummy variables were regressed on $\%CHOICE_{t-1}$ (eq. 9).[18] Predicted values from the first stage analysis, along with $HCWP_{t-1}$ and a weekly time trend variable were regressed on $SELECTd_t$, $YG2\text{-}3p_t$, $YG4\text{-}5d_t$, $W550d_t$, $W1000d_t$ (eqs. 10, 11, 12, 13, 14). Predicted values from stages 1&2 were regressed on the $PDIFF_t$ (eq. 15).

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[17] All discounts were converted to positive values. Coefficient of Variation is reported as a measure of relative variability.

[18] Quarterly seasonal dummy variable MAM denotes March, April, May, etc.

Table I. Summary Statistics.

Variable	No.	Mean	Std. Dev.	Coef. of Var.	Min.	Max.
PDIFF	114	-0.508	0.246	48.4%	-1.246	0.235
PRIME	114	5.686	0.114	2.0%	5.290	5.860
SELECTd	114	6.424	2.693	41.9%	2.000	11.930
STANDARD	114	16.487	2.172	13.2%	11.870	20.800
YG2p	114	1.712	0.054	3.2%	1.670	1.890
YG2-3p	114	0.871	0.062	7.1%	0.710	1.000
YG3-35d	114	0.136	0.025	18.4%	0.080	0.170
YG35-4d	114	0.290	0.024	8.3%	0.250	0.330
YG4-5d	114	14.290	1.662	11.6%	11.290	16.500
YG5d	114	19.613	1.587	8.1%	16.710	21.330
W500d	114	21.066	0.505	2.4%	20.290	22.000
W550d	114	16.870	0.762	4.5%	14.170	17.570
W1000d	114	15.905	1.833	11.5%	12.570	18.500
W1001d	114	20.149	1.927	9.6%	16.710	23.500
%CHOICE	115	0.506	0.038	7.5%	0.424	0.602
HCWP	115	102.079	5.324	5.2%	90.710	111.840
SLWT	115	1275.40	25.58	2.0%	1210.00	1320.00

Where:

PDIFF = GRIDREV - HCWREV: $/cwt

PRIME = Quality grade, $/cwt, premium.

SELECT = choice/select, $/cwt, Discount.

STANDARD = quality grade select, $/cwt, Discount.

YG2p = yield grade 1.0-2.0, $/cwt, Premium.

YG2-3p = yield grade 2-3, $/cwt, Premium.

YG3-35d = yield grade 3.0-3.5, $/cwt, Discount.

YG35-4d = yield grade 3.5-4.0, $/cwt, Discount.

YG4-5d = yield grade 4.0-5.0, $/cwt, Discount.

YG5d = yield grade 5.0 or higher, $/cwt, Discount.

W500d = HCW less than 500, $/cwt, Discount.

W550d = HCW less than 550, $/cwt, Discount.

W1000d = HCW 950 -1000, $/cwt, Discount.

W1001d = HCW >1000, $/cwt, Discount.

%CHOICE = % slaughter grade at least choice YG3 in regions 7 and 8.

HCWP = AMS reported price, $/cwt.

SLWT = Slaughter weight of steers sold dressed weight in Lbs. (Weekly regional avg.).

FIRST STAGE:

9) %CHOICE$_{t-1}$ = f(SLWT$_{t-1}$, MAM, JJA, SON).

SECOND STAGE:

10) SELECTd$_t$ = f(%CHOICE $_{t-1}$, HCWP$_{t-1}$, time-trend).

11) YG2-3p$_t$ = f(%CHOICE$_{t-1}$, HCWP$_{t-1}$, time-trend).

12) YG4-5d$_t$ = f(%CHOICE$_{t-1}$, HCWP$_{t-1}$, time-trend).

13) W550d$_t$ = f(%CHOICE$_{t-1}$, HCWP$_{t-1}$, time-trend).

14) W1000d$_t$ = f(%CHOICE$_{t-1}$, HCWP$_{t-1}$, time-trend).

THIRD STAGE:

15) PDIFF$_t$ = f((1-%CHOICE$_{t-1}$ * SELECTd$_t$) , PREMIUMS$_t$, DISCOUNTS$_t$).

The recursive structure of the model allows OLS estimation of the three stages. The estimated

equations in both stages 1&2 suffered from serious autocorrelation. Equations 10, 12, 13 and 14 were

estimated using a first-order autoregressive model. Equations 9 and 11 were estimated with a second-order

autoregressive model.[19] First and second stage parameter estimates, standard error, and R^2 are provided

below:[20]

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[19]   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).

[20] The error term V is assumed to be generated by an autoregressive process: $V_t = \varepsilon_t - \alpha_1 v_{t-1} - ... - \alpha_p v_{t-p}$.
Where ε_t is a sequence of independent normally distributed error terms. Standard errors are in parentheses.
The autoregressive parameter estimates were generated using the Yule-Walker estimation procedure. The
symbol "***" denotes 1% level of significance, "**" 5%, and "*" 10% level of significance.

16) $\%\text{CHOICE}_{t-1} = -0.339^{**} + 0.0007\,\text{SLWT}_{t-1}^{***} + 0.0082\,\text{MAM}$
$\qquad\qquad\quad\ \ (0.178)\qquad\ (0.0001)\qquad\qquad (0.006)$
$\qquad\qquad\qquad\ \ -\,0.0067\,\text{JJA} - 0.0298\,\text{SON}^{***} + 0.4484\,\text{V}_{t-1}^{***} + 0.2019\,\text{V}_{t-2}^{***}.$
$\qquad\qquad\qquad\qquad (0.009)\qquad (.008)\qquad\qquad (0.094)\qquad\ \ (0.094)$

(ToT R$_{sq}$ = .83)

In the first stage equation, the intercept, **SLWT** , the Sept-Oct-Nov dummy variable, and the autoregressive coefficients are significant. The predicted value of **%CHOICE** is used as an explanatory variable in the second stage equations:

17) $\text{SELECTd}_t = 22.35^{***} - 28.37\,\%\widehat{\text{CHOICE}}_{t-1}^{***} - 0.0195\,\text{HCWP}_{t-1} + 0.005\,\text{TIMTREND} + 0.79\,\text{V}_{t-1}^{***}.$
$\qquad\qquad\qquad\quad (4.85)\qquad (5.84)\qquad\qquad\ \ (0.0353)\qquad\qquad (0.0098)\qquad\qquad (0.058)$

(ToT R$_{sq}$ = .93)

18) $\text{YG2-3p}_t = 0.85^{***} - 0.002\,\%\widehat{\text{CHOICE}}_{t-1} + 0.0005\,\text{HCWP}_{t-1} - .0006\,\text{TIMTREND}^{**}$
$\qquad\qquad\qquad (0.16)\qquad (0..186)\qquad\qquad\quad (0.0012)\qquad\qquad (0.003)$
$\qquad\qquad\qquad + 1.109\,\text{V}_{t-1}^{***} - 0.31\,\text{V}_{t-2}^{***}.$
$\qquad\qquad\qquad\quad (0.091)\qquad\quad (0.091)$

(ToT R$_{sq}$ =.86)

19) $\text{YG4-5d}_t = -15.21^{***} - 3.54\,\%\widehat{\text{CHOICE}}_{t-1} - 0.014\,\text{HCWP}_{t-1} + .0387\,\text{TIMTREND}^{***} + 0.91\,\text{V}_{t-1}^{***}.$
$\qquad\qquad\qquad\ \ (2.33)\qquad (2.82)\qquad\qquad (.0161)\qquad\qquad (0.0083)\qquad\qquad\ (0.039)$

(ToT R$_{sq}$ =.96)

20) $\text{W550d}_t = 13.24^{***} + 2.81\,\%\widehat{\text{CHOICE}}_{t-1} - 0.0117\,\text{HCWP}_{t-1} + 0.016\,\text{TIMTREND}^{***} + 0.85\,\text{V}_{t-1}^{***}.$
$\qquad\qquad\qquad (1.71)\qquad (2.09)\qquad\qquad\ (0.012)\qquad\qquad (0.004)\qquad\qquad\qquad (0.05)$

(ToTR$_{sq}$ =.90)

21) $\text{W1000d}_t = 10.26^{***} + 1.21\,\%\widehat{\text{CHOICE}}_{t-1} + 0.024\,\text{HCWP}_{t-1} + 0.038\,\text{TIMTREND}^{***} + 0.94\,\text{V}^{***}$
$\qquad\qquad\qquad\ \ (2.67)\qquad (3.15)\qquad\qquad\ (0.0178)\qquad\qquad (0.013)\qquad\qquad_{t-1}\qquad (0.315)^{t-1}$

(ToT R$_{sq}$ =.96)

The results of the second stage equations reveal an interesting pattern in the grid premium and discount structure. The intercept and autoregressive parameter estimates are significant in all second stage equations. With respect to the exogenous variables, only in the choice/select discount equation is the coefficient for *%CHOICE* significant and the time-trend variable insignificant. In all of the other second-stage equations, the coefficients for *HCWP and %CHOICE* are insignificant and the time-trend coefficient is highly significant. It is interesting to note that the cash market price for fed cattle has **no** explanatory power in predicting movements in grid premiums and discounts.

In equations 18-21, the first order autoregressive coefficients have values close to 1. The implication of this result is that last period's value of $YG2\text{-}3p_t$, $YG4\text{-}5d_t$, $W550d_t$, or $W1000d_t$ is the best predicator of the variable's value in the current period. One possible reason for this result is that packers are not using the most recent market information to adjust these premiums and discounts to changing market conditions. Instead packers are making adjustments only after grid premiums and discounts become seriously out of line with true market values. If this conjecture is indeed true, then this type of price setting behavior is counter to the concept of *value-based-marketing*.

Another interesting pattern emerging from the second-stage equations is revealed by examining the coefficients associated with the weekly time-trend variable. The time-trend variable was significant at the 5% level for *YG2-3* equation and at the 1% level for the *YG4-5*, *W550*, and *W1000* equations. The coefficients were positive for the discount equations and negative for the premium equation. This result indicates that the negative trend in the price differential (figure 1) is the result of increasing discounts and declining premiums over time. The one exception is the choice/select discount equation. The time-trend variable in this equation is extremely insignificant. In the data, the choice/select discount variable exhibited the greatest variability among the discount and premium variables (table 1). One possible explanation is

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that packers use weekly market information to alter only the choice/select discount level in order to adjust

grid price levels to changing market conditions. The implication of the general pattern is that packers are

increasing the penalty levied on below-average carcasses. However, there seems to also be a slight decline

in the reward structure for above-average carcasses. Regardless of the explanation, the risk/reward tradeoff

for producers did not improve. Consequently, the producer's incentive to market on a grid system has been

weakened during this time period.

The predicted values of *%CHOICE*, the grid premiums and grid discounts generated in the first

and second stage were used as explanatory variables in the third stage equation.[21] Regression diagnostics

were performed.   Diagnostics of the OLS results indicated serious multicollinearity between *YG4-5d* and

W1000d$_t$.[22] The Durbin-Watson test (dw=1.609) indicates that autocorrelation is not a serious diagnostic

problem. The correlation coefficient between adjacent error terms is less than .2, another indicator that

autocorrelation is not a serious problem.   A visual examination of the residuals against the predicted

values of the price differential indicate that heteroskedasticity is not present. The OLS parameter

estimates, standard errors, p-values, and analysis of variance results are provided in table II.

The global F test reported in table II indicates that the independent variables taken as a group are

highly significant with a p-value of less than 1%. The independent variables account for approximately

72% of the variability associated with the weekly price per cwt. differential for the 1-6-97 to 3-1-99 time

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[21] The variable *%CHOICE* was used instead of the "choice/select spread effect" variable. This was done
because the "choice/select spread effect" variable is a linear combination of the choice/select discount variable.

[22] "Variance Inflation Factor (VIF)" estimates of greater than 10 were generated for both YG4-5d and
W1000d$_t$, when both variables were included in the model (See Belsley et al. 1980). The heavyweight discount
was dropped and all VIF factors associated with the explanatory variables dropped below 6 when the model
was reestimated.

period.[23]

All parameter estimates have the correct hypothesized sign. The intercept is significant (p-value = .001) and indicates that when all independent variables are set to zero, the grid pricing system, on average, is $4.69 per cwt. higher than the dressed weight alternative.

Table II. Estimated Model.

Dependent Variable: PDIFF

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	5	4.888	0.977	54.592	0.0001
Error	107	1.916	0.018		
C Total	112	6.804			
				R-square	0.7184
				Adj R-sq	0.7052

Variable	DF	Parameter Estimate	Standard Error	Test→ HO $_i$=0	Prob > |T|
INTERCEPT	1	4.6944	0.8398	5.589	0.0001
W550d	1	-0.0276	0.0264	-0.937	0.3509
YG4-5d	1	-0.0192	0.0152	-1.260	0.2105
YG2-3p	1	0.0458	0.3099	0.148	0.8828
SELECTd	1	-0.1121	0.0131	-8.536	0.0001
%CHOICE	1	-7.4782	0.8819	-8.479	0.0001

Durbin-Watson D	1.609
Number of OBS	113
1st Order Autocorrelation	0.194

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[23] The predicted value of the variables listed in table II are used to generate the reported coefficients. It should be understood that each of the independent variables is the representative variable for its respective premium or discount category.

The negative parameter estimate for *SELECTd* has the highest level of significance in the model. The negative coefficient indicates that as the choice/select discount **increases**, the price differential between grid revenue and dressed weight revenue **declines**.

The negative parameter estimate for *%CHOICE* is significant. It is a proxy for the "choice/select spread effect." The highly significant negative parameter estimate indicates that as the percentage of choice steers marketed increases, the price differential between grid and dressed weight revenue declines. The *%CHOICE*, a supply side variable, affects the price differential directly and indirectly. The *%CHOICE* directly affects the base price, and thus the price differential. The indirect effect is through its affect on premium and discount levels. The indirect effect is accounted for through the second-stage equations.

The premium variable *YG2-3p* and the discount variables *W550d* and *YG4-5d* had the correct sign but were insignificant. This result is a consequence of a troubling feature associated with how grid discounts and premiums are determined: Packer price changes within these grid premium and discount price categories occur infrequently and prices move in lockstep within categories.[24] The data reveal that all grid premiums have a strong tendency to remain constant even as market conditions change.[25] Yield grade and heavyweight discounts, to a lesser extent, also tend to remain constant for extended periods of time. It is the quality grade discounts which exhibit the greatest variability, as the reported coefficients of variation confirm (table I).

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[24]For example, the **YG2-3** premium changed only 6 times during the 114 week period. The **W550** discount only changed 19 times.

[25] The quality grade premium "prime" was excluded from our analysis because only one steer out of 2590 graded prime. However, during the 114 week period the prime premium ranged from $5.29 cwt. to $5.86 cwt. and changed value only 11 times.

The goal of our analysis is to provide an explanation for the variability in the "Grid minus Hot Carcass Weight" price differential. Our results indicate that the AMS grid premium and discount structure, on average, penalizes SDSU-RODP cattle relative to selling them dressed weight over the 114 week period. The data also reveals the penalty increased over that time period. However, the empirical model revealed that the week-to-week variability in the price differential was due primarily to changes in the choice/select discount and changes in the base price resulting from changes in the regional grading percentage and its affect on the "choice/select spread effect." All other grid premiums and discounts affect only the level of the price differential and not its variability.

V. SUMMARY:

This study represents the first rigorous attempt at modeling a value-based pricing system for slaughter cattle. A formal theoretical framework for grid price determination was presented. A three-stage recursive regression model was developed to empirically investigate the determinants of the price differential between grid pricing and average pricing.

Our empirical results provide evidence that the variability in the price differential between grid pricing and average pricing is primarily due to changes in the choice/select discount. This particular result is troubling in light of the discussion found in the price discovery literature concerning market incentives necessary to induce producers to switch from average pricing to a value based pricing system.

Given that cattle quality is held constant in this analysis, the downward trend in the price differential raises an additional concern that the price incentive for marketing on a grid has been declining. The grid price incentive mechanism needs further research. If this negative trend continues, then grid pricing will not supplant average pricing as the dominant marketing alternative in the cash market.

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Table 1A. Pearson Correlation Between Selected Variables.

	PRIME	SELECTd	STANDARD	YG2p	YG2-3p	YG3-35d	YG35-4d	YG4-5d	YG5d	W500d	W550d	W1000d	W1001d
PRIME	1.00	0.01	-0.08	-0.56	-0.26	0.22	0.28	-0.28	-0.37	0.25	0.13	-0.43	-0.33
SELECTd	0.01	1.00	0.83	-0.21	-0.42	-0.17	-0.07	0.31	0.22	0.04	0.24	0.08	0.08
STANDARD	-0.08	0.83	1.00	-0.05	-0.25	-0.17	-0.14	0.48	0.46	0.29	0.46	0.41	0.23
YG2p	-0.56	-0.21	-0.05	1.00	0.75	-0.23	-0.46	-0.12	-0.01	0.28	-0.26	0.13	-0.11
YG2-3p	-0.26	-0.42	-0.25	0.75	1.00	-0.32	-0.57	-0.34	-0.23	0.40	-0.34	-0.11	-0.33
YG3-35d	0.22	-0.17	-0.17	-0.23	-0.32	1.00	0.95	-0.13	-0.13	0.01	0.01	-0.12	-0.21
YG35-4d	0.28	-0.07	-0.14	-0.46	-0.57	0.95	1.00	0.01	-0.04	-0.13	0.13	-0.07	-0.04
YG4-5d	-0.28	0.31	0.48	-0.12	-0.34	-0.13	0.01	1.00	0.98	-0.01	0.71	0.90	0.91
YG5d	-0.37	0.22	0.47	-0.01	-0.23	-0.13	-0.04	0.98	1.00	0.03	0.68	0.95	0.89
W500d	0.25	0.04	0.29	0.28	0.40	0.01	-0.13	-0.01	0.03	1.00	0.39	0.07	-0.14
W550d	0.13	0.24	0.46	-0.26	-0.34	0.01	0.13	0.71	0.68	0.39	1.00	0.60	0.63
W1000d	-0.43	0.08	0.41	0.12	-0.11	-0.12	-0.07	0.90	0.95	0.07	0.60	1.00	0.87
W1001d	-0.33	0.08	0.23	-0.11	-0.33	-0.21	-0.04	0.91	0.89	-0.14	0.63	0.87	1.00