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Grid Pricing Versus Average Pricing for Fed Cattle: Where is the Incentive

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ABSTRACT

A weekly comparative marketing study of above-average and below-average quality slaughter cattle was conducted over a 154 week time period (Jan 1997 to Dec 1999). Two data sets containing carcass information on 1500 head of fed cattle were randomly selected from a data set containing carcass information on 2590 steers. Weekly average price per cwt. was calculated for both pens using two different pricing systems: a) the dressed weight pricing system; and b) the Agricultural Marketing Service grid pricing system. The empirical evidence indicates that over the 154 week period: a) the above-average quality carcass data set received a higher average price per cwt. under the grid pricing system; b) the below-average quality carcass data set received a higher average price per cwt. under the hot carcass weight pricing system; and c) the weekly average grid price per cwt. decreased relative to the weekly average hot carcass weight price per cwt. for the below-average quality carcass data set during this time period.

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BACKGROUND

The issue of improving beef's competitive position against other domestic meat products and foreign imports has been discussed widely by groups associated with the beef industry. One possible strategy that has been seriously considered is a Value Based Marketing System (VBMS) for fed cattle. This strategy is articulated in the Value Based Marketing Task Force final report (1990), published by the National Cattlemen's Beef Association (NCBA). Based on the report's findings, the task force strongly recommended a new marketing system (application of discounts and premiums beyond dressed weight and grade) that will encourage producers to raise leaner cattle that still will grade at least USDA low choice. The industry has responded to the recommendations of the taskforce by developing individual carcass pricing systems commonly referred to as grid pricing systems (see Fausti et al. 1998).

The economic literature on price discovery (Ward 1987; Feuz et al. 1993) suggests that the implementation of a new premium and discount pricing system as an alternative to average pricing (live weight or dressed weight sales) will increase per-head revenue variability. Revenue variability will also increase from lot to lot, based on the carcass characteristics of the cattle in each lot. The base price may be the same for multiple lot sales, but the premiums and discounts applied will vary by lot as carcass quality varies from lot to lot. The increase in price variability will result from the packer being able to price discriminate to a greater degree with respect to overall cattle quality under a grid pricing system as compared to average pricing alternatives.

The price discovery literature on buyer and seller behavior in the market for slaughter cattle makes a strong case that varying degrees of incomplete information generate uncertainty over quality and quantity of cattle marketed via the live and dressed weight alternatives. This uncertainty, combined with risk averse behavior, creates price differentials between alternatives and sustains the demand by cattle producers for multiple pricing alternatives. If the conclusions in the recent literature are correct, then a grid pricing system will be successful only if the risk/return tradeoff for sellers is significantly superior to the other pricing alternatives. In other words, grid pricing will not receive broad producer support unless the new system raises the average price per cwt. enough to compensate producers for the increased price variability.

OBJECTIVES

The value based marketing literature and the price discovery literature discussing the issue of individual versus average pricing of fed cattle in the cash market suggest the risk to

reward structure of individual carcass based pricing systems must compensate producers for the increased price variability associated with grid pricing. When cattle are sold at an average price, above-average cattle in a pen receive an implicit discount and below-average cattle receive an implicit premium. The advent of grid pricing should eliminate these implicit discounts and premiums. The price differential (gird price minus hot carcass weight price per cwt.) reflects the implicit discount or premium associated with average pricing. If the differential is positive, then above average cattle receive an implicit discount if the producer sells dressed weight. If the differential is negative, then below average cattle receive an implicit premium if the producer sells dressed weight. The primary objective of this study is to analyze changes in the price differential to determine if the price incentives to market fed cattle through a grid pricing system have changed over time.

DATA DESCRIPTION

The analysis is based on weekly market data collected over a 154 week 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. Two data sets of 1500 randomly selected carcasses were constructed from the set of 2590 carcasses. The data selection procedure allows for the possibility that a particular carcass could be included in both data sets. One set was designed to be 67% choice and 33% select (above-average data set). The other was 33% choice and 67% select (below-average data set).

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. For each individual steer carcass, 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. See Fausti et al. (1998) for a detailed discussion of the AMS grid price reporting system.

Next, individual dressed weight carcass revenue, based on the USDA reported hot carcass weight price (HCWP) was derived for each week.[1] The next step was to derive the weekly price differential for each carcass (grid price per cwt. minus HCWP per cwt.). The average weekly

[1] The HCW price is the reported 5 area (Texas/Oklahoma, Kansas, Nebraska, Colorado, Iowa/So. Minn) weekly weighted average price for dressed weight sales of slaughter steers grading 35% to 65% choice (USDA Livestock, Meat and Wool Weekly Summary and Statistics).

price differential for the above-average and below-average data sets were then derived. An important feature of this approach is: *cattle quality characteristics are held constant over time*. Thus changes in the price differential are due solely to changes in market premiums and discounts.

GRID PRICE STRUCTURE: A DISCUSSION

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. Grid price per cwt. is defined as,

1) GRID PRICE = BASE PRICE + PREMIUMS - DISCOUNTS.

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 HCWP and the "Choice-Select Price Spread Effect" as discussed in Ward et al.(1999): Select discount multiplied by 1 minus the regional grading percentage:[2]

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

There are well over 25 fed cattle price grids being used by the beef packing industry (Feuz 1998). Base price formulas vary across grids. Many grids tie the base price to a market quote, such as East Nebraska direct, West Kansas top, etc. The goal of the packer when establishing the weekly base price for its grid is to discover the market value of a choice, yield grade 3 carcass that weighs between 550 and 950 pounds. On any given week the grid base price will vary from packer to packer. Over time, however, it is reasonable to postulate that there is a very strong positive correlation between packer weekly base prices. Accordingly, the computed base price used in this study should be a reasonable proxy for the base price of a typical packer over the period covered in this study. Figure 1 shows a plot of the regional grading percentage and the select discount over time. The HCWP and the computed base price are shown in figure 2. The fluctuation in the differential between the base price and the HCWP is highly correlated with changes in the select discount.

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[2] 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. At least one major packer uses the regional grading percentage when setting the grid base price.

Fig 1. Grade Percentage and Choice Select Spread

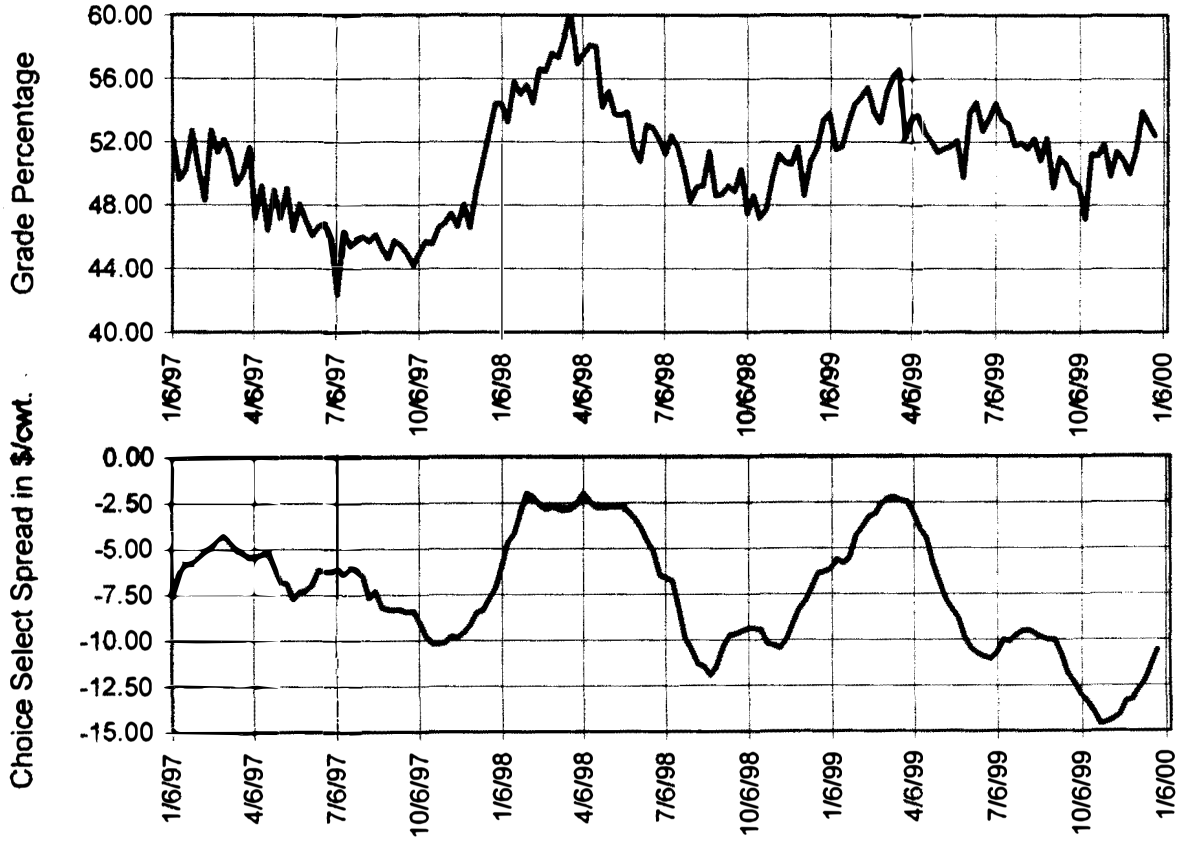
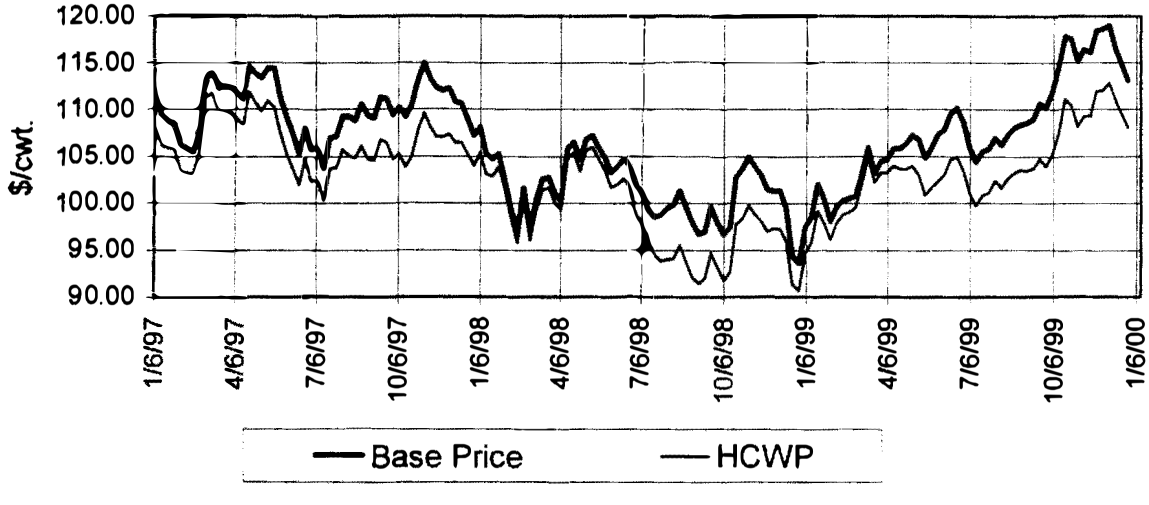


Fig 2. Base Price and HCWP



The price differential (***PDIFF***) for any particular carcass is defined as the grid price per cwt. minus the HCWP 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 = SELECTDISCOUNT * (1 -%CHOICE) + PREMIUMS - DISCOUNTS.

RESULTS AND DISCUSSION

Table I provides summary statistics for the weekly average price differential per cwt. for the above and below average carcass quality data set over a 154 week period. The summary statistics indicate, as expected, that the above-average (below-average) quality data set had a higher (lower) average price per cwt. when evaluated via the AMS grid.

TABLE I. Mean, standard deviation, and the 154 week range of the weekly average price differential per cwt. (PDIFF).

Price Difference	Mean	SD	Min	Max
Above-Average Pen	**1.117**	**0.601**	**0.01**	**2.40**
Below-Average Pen	**-1.257**	**0.611**	**-2.81**	**-0.09**

The mean value for the two price differentials reported in table I reflect the average weekly implicit discount and premium associated with selling fed cattle on a HCW basis.[3] For example, if the steers in the above-average carcass quality data set were sold at an average price, then the producer's implicit discount would be a minus $1.117 per cwt. The ranges of the two price differentials indicate that the implicit discounts and premiums associated with average pricing are persistent over time.

[3] A simple hypothesis test indicated that the mean price differential was non-zero at a level of significance of less than 1% for both the above and below quality data sets.

Our attention now turns to the issue of how the implicit discounts and premiums have been affected by adjustments in the premium and discount structure associated with the AMS grid. Equation 3 can be modified to reflect the implicit discount or premium when fed cattle are sold at an average price:

5) IMPLICIT DISCOUNT OR PREMIUM = HCWP - GRID PRICE.

The question of interest is: Has the risk to return tradeoff changed since the AMS began reporting weekly grid premium and discount information? To provide insight on this question, a weekly time trend variable and monthly seasonal dummy variables were regressed on the negative of the weekly average price differential (eq. 5) for both the above-average and below-average carcass quality data sets. Regression diagnostics revealed that the initial OLS regression equations had a serious problem with serial correlation. An autoregressive procedure was employed to estimate the model[4]:

$$6)\quad Y_t = a + b_1 Trend + b_2 Jan + b_2 Feb + b_3 Mar + b_4 Apr + b_5 May + b_6 June + b_7 July + b_8 Aug + b_9 Sept + b_{10} Oct + b_{11} Nov + V_t.$$

The variable Y_t denotes the weekly average implicit discount or premium for the above and below average pen. The variable *Trend* denotes the weekly time trend and the other eleven independent variables denote monthly seasonal dummy variables. The Yule-Walker correction procedure was used to estimate the autoregressive model. The results for the above-average data set are reported in table II and the results for the below-average data set are reported in table III.

The regression results in the Table II provide statistical evidence for the following conclusions: 1) On an average, the above-average carcass quality data set received an implicit discount ($1.35 cwt) when marketed dressed weight relative to being marketed on the grid; 2) These implicit discounts were significantly lower (as much as 28 to 67 cents per cwt.) during the months of January through May, and significantly higher (as much as 44 cents per cwt.) during the fall; and 3) During the 154 week period, the average implicit discount levied on the above average pen if marketed at an average price remained unchanged.[5]

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[4] The error term V is assumed to be generated by an autoregressive process: $V_t = \varepsilon_t - \alpha_1 v_{t-1} - \ldots - \alpha_p v_{t-p}$. Where ε_t is a sequence of independent normally distributed error terms. The autoregressive parameter estimates were generated using the Yule-Walker stepwise estimation procedure (SAS/ETS).

[5] To determine if the price differential (Pdiff) was influenced by the market price level for fed cattle over time we estimated eq.6 using "pdiff/hcwp" as the dependent variable. This defined the implicit premiums and discounts in terms of a percentage of the weekly HCWP. The results of the analysis remained unchanged.

The time trend result for the above-average carcass quality data set is interesting. The value based marketing literature suggests the risk to reward structure of a value based pricing system, like grid pricing, should reward producers for producing superior quality cattle. The insignificant time-trend variable suggests that the incentive structure of the grid system did not change over the study period. The decline in the grid price relative to dressed weight price during the spring is most likely driven by the seasonal variation in the choice/select spread.

Table II: Yule-Walker Estimates (above-average data set).

Dependent Variable: Y_t

REG RSQ = 0.2804 **Durbin-Watson D =1.97**
TOT RSQ = 0.9172 **Number of Obs. = 154**

Variable	DF	Parameter Estimate	Standard Error	T for HO: Param=0	Prob > |T|
INTERCEPT	1	-1.351	0.1963	-6.88	0.001
TREND	1	0.0009	0.0017	0.54	0.589
JAN	1	0.4336	0.109	3.99	0.001
FEB	1	0.6650	0.137	4.86	0.001
MAR	1	0.6650	0.155	4.30	0.001
APR	1	0.4960	0.157	3.15	0.002
MAY	1	0.2787	0.162	1.72	0.087
JUNE	1	0.1956	0.163	1.19	0.233
JULY	1	0.0499	0.158	0.315	0.752
AUG	1	-0.1557	0.155	-1.00	0.317
SEPT	1	-0.2267	0.144	-1.58	0.117
OCT	1	-0.4442	0.123	-3.62	0.001
NOV	1	-0.2896	0.093	-3.11	0.002
AR(1)	1	-0.6415	0.071	-9.03	0.001
AR(4)	1	-0.3763	0.083	-4.49	0.001
AR(5)	1	0.1803	0.083	2.15	0.020

The regression results in Table III provide statistical evidence for the following conclusions: 1) On average, the below-average carcass quality data set received an implicit premium ($0.92 cwt.) when marketed dressed weight relative to being marketed on the grid; 2) These implicit premiums were significantly smaller (as much as 39 to 60 cents per cwt.) during the months of February through May as the dressed weight price improved relative to the grid price for the below-average data set; and 3) During the154 week period, the trend in the implicit premium per cwt. for the below-average carcass quality data set increased at the rate of 0.75 cents a week (or $1.16 per cwt. over the 154 week period).

Table III: Yule-Walker Estimates (below-average data set).

Dependent Variable: Y_t

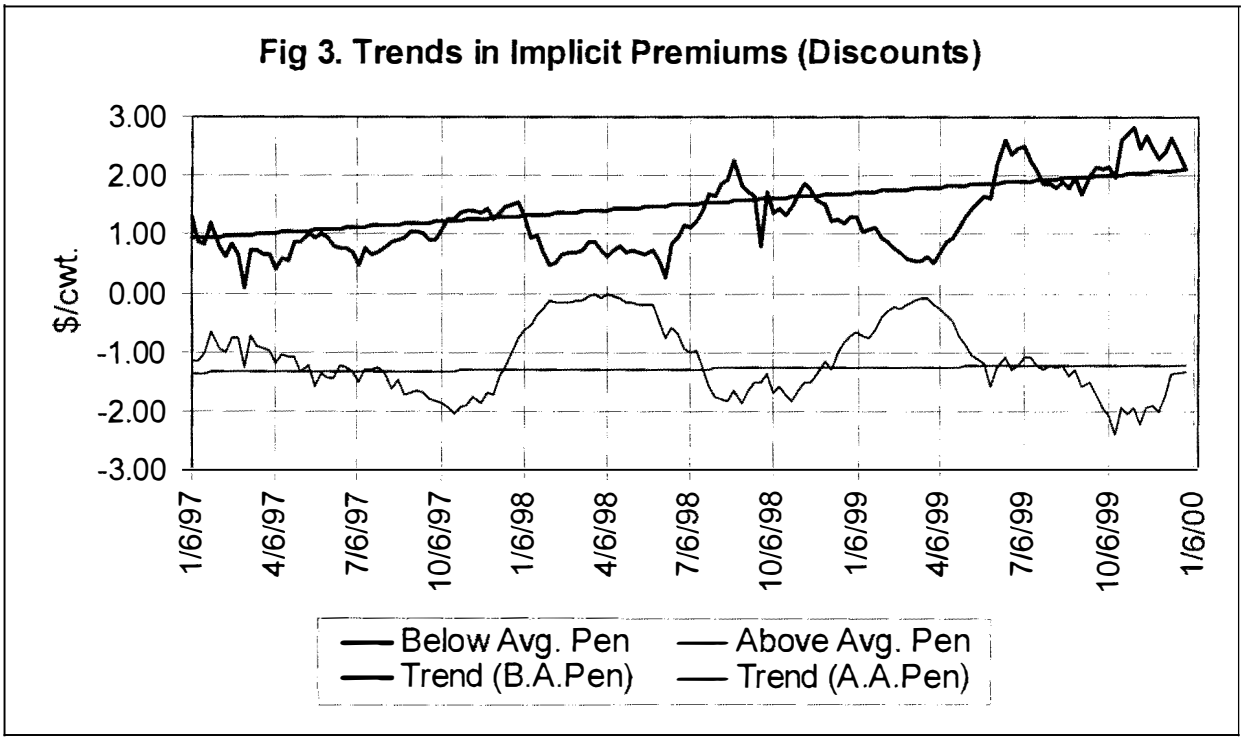
REG RSQ = 0.2317 **Durbin-Watson D =1.886**
TOT RSQ = 0.8897 **For Number of Obs. = 154**

Variable	DF	Parameter Estimate	Standard Error	T for HO: Param=0	Prob > |T|
INTERCEPT	1	0.9168	0.215	4.269	0.001
TREND	1	0.00757	0.0019	3.98	0.001
JAN	1	-0.1553	0.136	-1.14	0.256
FEB	1	-0.4284	0.1615	-2.65	0.008
MAR	1	-0.5968	0.174	-3.43	0.001
APR	1	-0.5841	0.182	-3.20	0.001
MAY	1	-0.3930	0.185	-2.12	0.035
JUNE	1	-0.2195	0.185	-1.18	0.238
JULY	1	-0.1852	0.183	-1.01	0.314
AUG	1	-0.0826	0.177	-0.46	0.641
SEPT	1	-0.133	0.167	-0.79	0.427
OCT	1	-0.0587	0.150	-0.39	0.695
NOV	1	0.0990	0.116	0.85	0.394
AR(1)	1	-0.6065	0.082	-7.30	0.001
AR(2)	1	-0.2067	0.082	-2.49	0.010

IMPLICATIONS FOR FED CATTLE PRODUCERS

A comparison of coefficients for the time trend in the Tables II and III provide additional insight into the process of adjustment in the grid premiums and discounts over time. Over time, the seasonally adjusted implicit discount for above-average data set has been stationary, and the seasonally adjusted implicit premium for below-average data set has been increasing. This implies, that the implicit premium producers receive when they sell below average cattle at a dressed weight price has increased and the seasonally adjusted implicit discount producers receive selling above average cattle at a dressed weight price has remained stationary. The ramification is that the incentive for producers to market their cattle on an individual pricing system, as opposed to selling at an average price, has eroded during the time period examined in this study. The implication is when there is uncertainty over carcass quality the incentive to sell at an average price has strengthened relative to selling on a grid.

The implicit premium and discount associated with selling at an average price also has a strong seasonal pattern (fig 3). The spread between the implicit discount and implicit premium for marketing above and below average cattle dressed weight, respectively, during the months of February, March, April, and May narrows. This implies a lower incentive to market on a grid as



the risk to reward ratio narrows. In the fall months, spread between the implicit discount and implicit premium for marketing above and below average cattle dressed weight, respectively, widens. In the fall, the implicit discount on above average cattle increases and the implicit premium for below average cattle is stationary (relative to December). This implies a greater incentive to market fed cattle on a grid as the risk to reward ratio widens. These results are consistent with the seasonal pattern in the choice-select spread.

SUMMARY

The results of the study support the conclusions arrived at in the earlier literature on the existence of implicit premiums and discounts when fed cattle are sold at an average price. The time series analysis concludes that there is a seasonal component to the fluctuations in the implicit premiums and discounts associated with selling fed cattle at an average price. The regression results also indicate that the seasonally adjusted implicit discounts for selling higher quality cattle are stationary and the seasonally adjusted implicit premiums for selling lower quality are increasing when producers sell cattle at an average price relative to selling on grid. Within the framework of the value based pricing concept for fed cattle, it is expected that the gird premium and discount structure would trend toward levying greater penalties on inferior cattle. However, stationary incentives for above average cattle reduces the incentive for producers to switch from average to individual pricing of their fed cattle and will hinder adoption of value based marketing by fed cattle producers.

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