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Does the producer have an incentive to sell fed cattle on a grid?

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Abstract

Barriers to the adoption of grid pricing by fed cattle producers are investigated over a 206-week period (January 1997 to December 2000). The empirical findings document the following potential barriers to adoption: (1) when fed cattle are evaluated on a grid pricing system versus a dressed weight pricing system, a price differential per cwt. and a per-head revenue differential exists over time, (2) the price differential per cwt. is subject to seasonal variation, resulting in variability in the monetary incentive to market-fed cattle on a grid relative to selling cattle at an average price, and (3) the variability in per-head grid revenue is consistently higher than per-head dressed weight revenue variability over time.

The marketing implications for fed cattle producers are (1) the incentive to market on a grid versus selling fed cattle dressed weight is lower in the spring relative to the fall; (2) marketing on a grid does reward producers selling high quality steers and the incentive to market higher quality cattle on a grid has been increasing over the 206-week period of the study; (3) grid discounts levied on lower quality cattle have also been increasing over time; (4) selling on a grid results in higher per-head revenue variability relative to selling fed cattle dressed-weight, indicating that while producers are rewarded when selling high quality cattle on a grid relative to selling at an average price, it is also a riskier marketing option relative to average pricing; and (5) the 4-year trend in the price differential per cwt. for above-average cattle has been positive but negative for the below-average quality cattle. This trend indicates that packers are providing monetary incentives and disincentives based on overall cattle quality when fed cattle are sold on a grid relative to purchasing fed cattle at an average price. Corresponding with this shift in the incentive structure of grid pricing, overall carcass quality has improved in the region from which data was collected. However, the

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empirical evidence supports the conclusion that the barriers to the adoption of grid pricing continue to exist.

1. Background

The decline in beef's comparative advantage in the domestic meat market relative to other domestic meat products and foreign imports began in the mid 1970s.[1] In 1990, the National Cattlemen's Beef Association (NCBA) released a final report on the status of value-based marketing in the beef industry (Value Based Marketing Task Force, 1990). The task force recommended that the industry seriously consider developing and adopting a Value Based Marketing System (VBMS) for fed cattle to replace the traditional average pricing systems of live weight and dressed weight pricing by the pen. This VBMS strategy called for the development of a new cash marketing system (application of discounts and premiums beyond dressed weight and grade) that would encourage producers to raise leaner cattle that still would 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. However, the published literature addressing the issues of price discovery in the slaughter cattle market and value-based marketing of slaughter cattle suggests that the widespread adoption of grid pricing as an alternative to average pricing (live or dressed weight) faces several hurdles: (1) the incentive to sell on a grid relative to selling live or dressed weight is variable over time, and (2) grid pricing is a riskier marketing alternative than average pricing.[2]

On the issue of variation in monetary incentive signals, Feuz (1999b) conducted a fed cattle marketing study on the relative economic efficiency of three grid pricing systems. Feuz presented evidence that monetary incentives paid for particular carcass quality traits were inconsistent (1) across the three grids at specific points in time, and (2) over six different marketing dates within the individual price grids.[3] Feuz concluded, "Present grid pricing practices are sending different price signals to producers across grids, and some signals may vary over time."

The literature focusing on uncertainty over carcass quality in the market for slaughter cattle makes a strong case that varying degrees of incomplete information on carcass quality during the transaction process generate uncertainty over the quality of cattle marketed via the live and dressed weight alternatives (Fausti & Feuz, 1995; Feuz, Fausti, & Wagner, 1993; Ward, 1987). This uncertainty, combined with risk averse behavior, creates price differentials and increases price variability between alternatives and sustains the demand by cattle producers for multiple pricing alternatives. Empirical evidence presented in the literature demonstrates that marketing fed cattle at an average price reduces per-head and per-cwt. revenue variability relative to marketing fed cattle through a value-based pricing system (Fausti, Feuz, & Wagner, 1998; Feuz et al., 1993, 1995). The literature surmises that selling fed cattle at an average price is preferred by risk averse producers over selling fed cattle on a value-based marketing alternative.

The Value Based Marketing literature documents the resistance to the widespread adoption of a VBMS by producers (Ward et al., 1999).[4] The literature also identifies the potential "barriers to adoption" of a value-based marketing system (Fausti et al., 1998). However, empirical verification of the persistence of these "barriers to adoption" over time has not been documented in the literature.[5]

The incentive structure of a grid pricing system is the key to empirically verifying the existence (or nonexistence) of these "barriers to adoption" over time. Grid premiums and discounts levied upon a carcass are based on individual carcass quality characteristics and constitute any particular grid's incentive mechanism to encourage producers to sell on a grid relative to selling cattle at an average price. Our empirical study relies on data published by the Agricultural Marketing News Service (AMS). The AMS publicly reports weekly grid premium and discount information supplied voluntarily by the packing industry.

The intent of this study is to investigate if the "barriers to the adoption of grid pricing by fed cattle producers" alluded to in the literature are empirically verifiable over time. These general issues are addressed: (1) over the 4-year period of the study, has it been advantageous for producers to sell fed cattle on a grid relative to selling fed cattle at an average price, and (2) has the producer's incentive to sell fed cattle on a grid relative to selling cattle at an average price changed over time.

Greater understanding of these "barriers to adoption" is needed. The possible permanence of these barriers and their consequences for the future health of the beef industry need to be recognized by industry stakeholders. The implications for the cattle industry if average pricing of slaughter cattle continues to dominate the fed cattle market into the future are (1) inconsistent beef quality and dissatisfied consumers; (2) failure to reduce excess fat production, which is costing the industry billions of dollars; (3) continuing pressure on beef's market share of total U.S. meat sales resulting from overall improvement in pork and poultry meat quality and reduced production costs; and (4) the segmentation of the market for beef into two submarkets, branded product versus commodity product.

2. Data description and methodology

2.1. Data description

The empirical approach adopted for this study is an extension of that developed by Fausti et al. (1998). Two data sets containing carcass information on 1,500 slaughter steers used in the Fausti et al. study are evaluated on a grid and on an average pricing system over time. Carcass quality premium and discount information collected from weekly grid price reports published by the AMS over a 4-year period (January 1997 to December 2000) is used in the study (USDA-AMS weekly reports, 1997–1999).

The analysis is based on weekly market data collected over a 206-week period combined with carcass data on a set of 2,590 South Dakota slaughter steers. Weekly market data were collected from USDA-AMS reports (USDA-AMS weekly reports, 1997–1999). The carcass data were collected by the Animal and Range Sciences Department at South Dakota State University.

The Animal and Range Sciences 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., 1991–1995). During this period 2,590 steer calves were entered into the program by 250 beef producers and raised to slaughter weight. Two data sets of 1,500 randomly selected carcasses were constructed from the set of 2,590 carcasses. The data selection procedure allowed 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 designed by the Agricultural Marketing Service (AMS) division of the USDA for the purpose of price reporting.[6] For each individual steer carcass, a grid carcass price was determined weekly by applying the reported premiums and discounts according to the yield grade, quality grade, and weight classification and then adding its individual premium or discount to the AMS grid's base price.[7] As a result of this approach, for each of the 1,500 steers a grid price per cwt. and grid price per-head are calculated for each week. Next, the weekly average and standard deviation is calculated for each pen and recorded. The pen level summary statistics data are used to construct the above- and below-average quality data sets.[8]

Next, for each individual steer, a dressed weight price per-head is calculated and collected.[9] The next step was to derive the weekly price differential for each carcass (grid price per cwt. minus HCWP per cwt.). The average weekly price differential for the above- and below-average data sets were then derived. An important feature of this approach is that *cattle quality characteristics are held constant over time*. Thus, changes in the price differential are due solely to weekly changes in the AMS grid's base price, and the reported premiums and discounts. The price differential is the monetary incentive to market on a grid versus marketing fed cattle at an average price.

2.2. AMS grid price structure: a brief overview

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

$$\text{grid price} = \text{base price} + \text{premiums} - \text{discounts} \tag{1}$$

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 (1999a), 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)

$$\text{base price} = \text{HCWP} + (\text{select discount})(1 - \%\text{Choice})^{10} \tag{2}$$

There are well over 25 fed cattle price grids being used by the beef packing industry (Feuz, 1998).[10] 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,

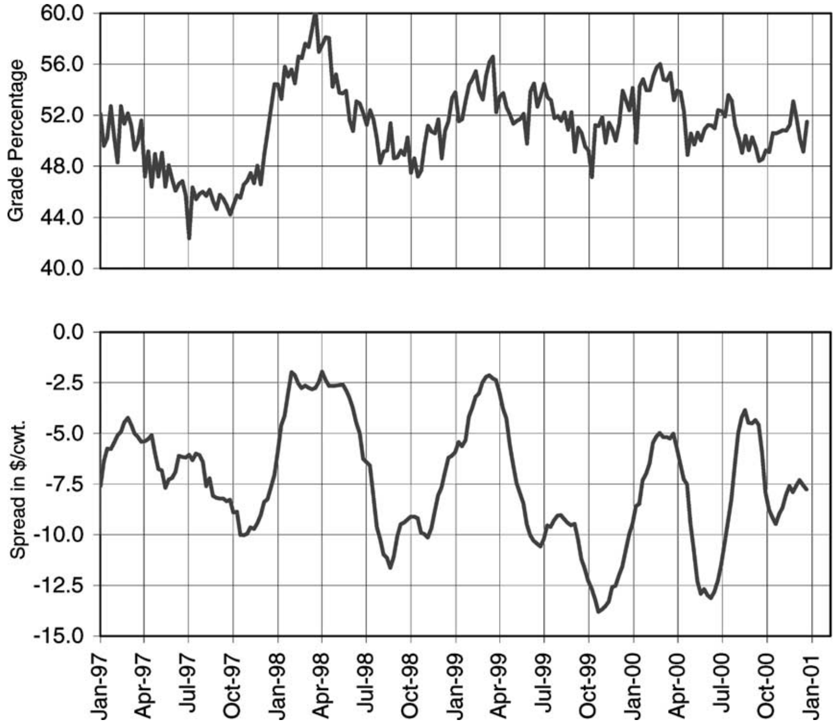

Fig. 1. Grade percentage for regions 7 & 8 and choice select spread.

yield Grade 3 carcass that weighs between 550 lb and 950 lb. On any given week the grid base price will vary from packer to packer.[11] Over time, however, it is reasonable to postulate that there is a very strong positive correlation among 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. Fig. 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 Fig. 2. Figs. 1 and 2 confirm that the calculated base price is consistent with conditions in the market for slaughter cattle.

The price differential (PDIFF) for any particular carcass is defined as the grid price per cwt. minus the HCWP per cwt.

$$\text{PDIFF} = \text{grid price} - \text{HCWP} \tag{3}$$

Substituting Eqs. (1) and (2) into Eq. (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

$$\text{PDIFF} = (\text{select discount})(1 - \%\text{Choice}) + \text{premiums} - \text{discounts} \tag{4}$$

The data used in the empirical analysis is aggregated on a weekly basis.[12] From Eq. (3), the weekly price differential per cwt. (PDIFF) for each carcass is summed and then averaged for

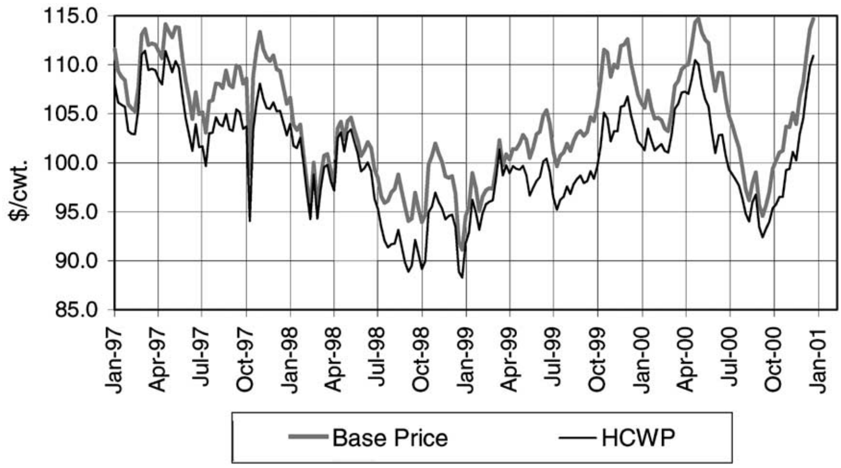

Fig. 2. Base price and HCWP.

the 1,500 head in each pen to derive a weekly average carcass price differential per cwt. (WAPD) for a respective pen

$$\mathrm{WAPD} = \frac{\sum_{i=1}^{1,500} \mathrm{PDIFF}_i}{1,500} \tag{5}$$

3. Results and discussion

3.1. Objective I, analysis of the price differential and revenue variability over time

Table 1 provides pen level summary statistics for the weekly average price differential per cwt. for the above- and below-average carcass quality data sets over a 206-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.

The 206-week calculated average for the WAPD per cwt., for both the above- and below-average pens, is reported in Table 1. The summary statistics reveal that the average weekly pen level premium or discount per cwt., respectively, associated with selling fed cattle on the AMS grid relative to selling on a hot carcass weight (HCW) basis is nonzero.[13] The results

Table 1
Mean, standard deviation, and the 206-week range of the weekly average price differential per cwt. (WAPD) for the above- and below-average pen

WAPD	Mean	SD	Min	Max
Above-average pen	1.10	0.561	0.01	2.27
Below-average pen	−1.259	0.53	−2.65	−0.477

reported in Table 1 can be interpreted in the following manner: (1) if the steers in the above-average pen were sold at an average price, then the producer's implicit discount would be a minus $1.10 per cwt.; and (2) if the steers in the below-average pen were sold at an average price, then the producer's implicit premium would be a positive $1.26 per cwt. The ranges of the two price differentials indicate that the implicit discounts and premiums associated with average pricing are erratic but persistent over time.[14]

The issue of implicit discounts and premiums arising when slaughter cattle are sold by the pen at an average price is at the center of the push for the development of a value-based marketing system for slaughter cattle. Grid pricing eliminates implicit premiums and discounts which distort the information contained in transaction prices when fed cattle are sold by the pen at an average price. Grid pricing improves market efficiency by reducing uncertainty over carcass quality traits during the transaction (Fausti et al., 1998; Feuz et al., 1993; Schroeder & Graff, 2000; Value Based Marketing Task force, 1990).

The persistence of a positive price differential (over time) reported in Table 1 for the above-average pen indicates that packers are rewarding producers who can supply high quality cattle to the market and sell on a grid. However, the range in the price differential for the above-average pen is 1 cent to $2.27 per cwt. The range in the price differential indicates substantial fluctuations in the incentive to market higher quality cattle on a grid. The risk associated with variability in the grid incentive mechanism is the next issue to be addressed.

Weekly average-per-head-revenue for each pen is calculated along with the respective standard deviations for each week in the 206-week period.[15] Table 2 provides pen level summary statistics for the 206-week period. First moment statistics (averages) are reported for the weekly per-head revenues and the weekly standard deviation of per-head revenues for the above- and below-average pens for both the AMS grid and dressed weight marketing alternatives.[16]

The statistics provided in Table 2 indicate that at the pen level, per-head revenue differentials have been persistent over time. The AMS grid paid, on average over 4 years, a per-head premium of $7.92 for cattle in the above-average pen relative to what those cattle would have received if they were sold dressed weight. The AMS grid levied a discount of

Table 2
Mean values for the weekly per-head pen revenue and the weekly standard deviation of per-head revenue for the above- and below-average pens

First moment statistics	206-Week pen average for per-head revenue	206-Week pen average for the weekly per-head revenue standard deviation and 90% confidence interval
Above-average pen		
Grid rev	$730.87	$82.98 (74.53 to 91.43)
DRWT rev	$722.95	$74.20 (67.67 to 80.73)
Below-average pen		
Grid rev	$713.10	$81.11 (73.80 to 88.42)
DRWT rev	$722.15	$74.98 (68.36 to 81.58)

Estimated 90% confidence intervals were calculated for the 206-week time period covered in this study. The confidence intervals clearly show increased per-head revenue variability associated with grid pricing over time relative to dressed weight pricing.

\$9.05 per head on cattle in the below-average pen relative to what those cattle would have received if they were sold dressed weight. These results are consistent with the price differential results reported in Table 1 and the findings reported in the literature.

The summary statistics reported in Table 2 also reveal that the mean value of the weekly standard deviation of per-head revenue is significantly higher for the AMS grid relative to the dressed weight pricing alternative for both the above- and below-average pens.[17] The implication is that, on average, per-head revenue variability has been higher when cattle are sold through a grid relative to selling fed cattle dressed weight, regardless of overall pen carcass quality.[18] Furthermore, the mean values for the weekly standard deviation of per-head revenue associated with each pricing system compared across pens are not statistically significant.[19] This implies that per-head revenue variability is associated with the pricing method and not pen quality during the 4-year period covered in this study. Assuming that revenue variability is a reasonable indicator of riskiness, grid pricing has consistently been the riskier marketing alternative relative to dressed weight pricing over the 4-year period covered in this study. The effect of increased revenue variability on producers' marketing decisions has been discussed in the literature. Our empirical results support the hypothesis put forth in the literature that producer risk aversion may explain the continuing demand by producers for multiple marketing alternatives for fed cattle (Fausti & Feuz, 1995).

3.2. Objective II, empirical analysis of how consistent the grid incentive mechanism is over time

The calculated pen level WAPD is a proxy for the producer's incentive or disincentive to market cattle on a grid. Given that cattle quality characteristics are held constant over time in this study, a change in the WAPD over time indicates that the incentive structure associated with marketing on a grid has shifted. Feuz (1999b) raises the issue of variable grid premium and discount values over time and this is the issue to be investigated next. To provide insight on this question, an autoregressive model is employed. The data reveal a seasonality component in the time series that is the result of a seasonal fluctuation in the proportion of choice cattle being slaughtered (regional grading percentage) in regions 7 and 8 (Fig. 1). Seasonal variability in the regional grading percentage results in seasonal variability in the choice/select spread, which in turn introduces a seasonal component into the price differential.

To handle this econometric issue a two-stage recursive autoregressive model is adopted. The theoretical justification for employing a recursive modeling structure is based on the supposition that the packing industry uses market information to formulate a grid pricing strategy. It is assumed that packers calculate their grid base price and carcass premiums/discounts for week t based on USDA data reported for week $t-1$. Thus, it is assumed here that packer grid pricing strategies are a function of a recursive information process: USDA market data reported at time t for market conditions that prevailed at time $t-1$ are used by packers to construct grid pricing strategies at time t. Widely reported USDA data on market conditions include (1) regional grading percentage (%Choice), and (2) average price per cwt. for dressed weight sales (HCWP).

The empirical analysis utilizes a two-step recursive OLS estimation procedure (corrected for serial correlation) as described in Johnston (1972, pp. 376–380) and Kennedy (1984,

p. 118).[20] In the first stage, seasonal monthly dummy variables and a time-trend variable are regressed on *%Choice*.[21] Predicted values from the first-stage analysis, along with a weekly time-trend variable and weekly hot carcass weight price, are regressed on the price differential *WAPD*.[22]

$$\text{first stage}: \quad \%\,\text{Choice}_{t-1} = a + b_1\text{time trend} + b_2\text{Jan} + b_3\text{Feb} + b_4\text{Mar} + b_5\text{Apr} + b_6\text{May} + b_7\text{June} + b_8\text{July} + b_9\text{Aug} + b_{10}\text{Sept} + b_{11}\text{Oct} + b_{11}\text{Nov} + V_t \quad (6)$$

$$\text{second stage}: \quad \text{WAPD}_t = a + b_1\text{time trend} + b_2\%\overline{\text{Choice}}_{t-1} + b_3\text{HCWP}_{t-1} + E_t \quad (7)$$

The time-trend variable in the first-stage equation is included to detect any change in the weekly proportion of choice cattle being slaughtered over time. The time-trend variable in the second-stage equation is for detecting any change in the weekly price differential not due to changes in the weekly quality composition of cattle being slaughtered over time.[23] The hot carcass weight price is included in the second-stage regressions to determine if there is any evidence of packers adjusting grid premiums and discounts to changes in the general market price of fed cattle. While Eq. (4) implies that the HCWP has no direct effect on WAPD, it is possible the HCWP may have an indirect effect. A change in the HCWP does reflect a change in the equilibrium price for slaughter steers.

We propose two plausible hypotheses explaining how a change in equilibrium price will affect packer grid premium and discount strategies: proportional versus supply response. The *proportional hypothesis* asserts that packers will raise and lower premium and discount levels *proportional* to changes in HCWP. This implies the size (in absolute terms) of the WAPD, the incentive or disincentive to market on a grid, is positively related to HCWP. For the below-average pen, an increase in the HCWP will result in an increase in the size of the disincentive to market on a grid. For the above-average pen, an increase in HCWP will result in an increase in the size of the incentive to market on a grid. The *supply response hypothesis* asserts that 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 (supply response). This second hypothesis implies that, for the below-average quality pen, when the HCWP increases the size of the disincentive (WAPD) to market on a grid declines. For the above-average quality pen, the size of the incentive to market fed cattle on a grid is positively related to changes in the HCWP.

The Yule–Walker correction procedure was used to estimate the first and second-stage autoregressive models.[24] The results for the first-stage equation are reported in Table 3. The results for the above-average data set are reported in Table 4 and the results for the below-average data set are reported in Table 5.

The coefficients for the January through April variables are positive and significant, indicating that there is a higher proportion of fed cattle grading at least choice and less than yield Grade 4 at slaughter. The coefficients for the September and October variables are negative and significant. The regression results generated by the first-stage equation (Table 3) are consistent with the life cycle production pattern of the fed cattle industry in regions 7 and

Table 3
Yule–Walker estimates (first stage)

Variable	df	Parameter estimate	SE	T for HO parameter = 0	$p > \|T\|$
Intercept	1	48.674	1.290	37.71	0.001
Time trend	1	0.017	0.009	1.88	0.061
Jan	1	2.343	0.627	3.73	0.001
Feb	1	3.179	0.774	4.10	0.001
Mar	1	3.674	0.858	4.28	0.001
Apr	1	1.835	0.909	2.02	0.045
May	1	0.588	0.933	0.63	0.529
June	1	0.665	0.938	0.71	0.478
July	1	0.070	0.924	0.08	0.934
Aug	1	−1.07	0.889	−1.20	0.230
Sept	1	−1.899	0.828	−2.29	0.029
Oct	1	−2.095	0.726	−2.88	0.001
Nov	1	−0.538	0.554	−0.97	0.337
Ar(1)	1	−0.468	0.058	−7.96	0.001
Ar(4)	1	−0.377	0.058	−6.41	0.001

Dependent variable: $\%\text{Choice}_t$. Durbin–Watson $D = 2.13$; SSE = 391.6; TOT RSQ = 0.813; MSE = 2.05; number of observations = 206.

Table 4
Yule–Walker estimates (second stage for the below-average data set)

Variable	df	Parameter estimate	SE	T for HO parameter = 0	$p > \|T\|$
Intercept	1	−2.364	0.966	−2.45	0.011
Time trend	1	−0.0041	0.002	−2.10	0.037
$\%\text{Choice}_{t-1}$	1	0.0334	0.012	2.81	0.005
HCWP_{t-1}	1	−0.013	0.006	−1.93	0.054
AR(1)	1	−0.905	0.029	−30.21	0.001

Dependent variable: WAPD_t; Durbin–Watson $D = 2.30$; SSE = 6.74; TOT RSQ = 0.883; MSE = 0.03; number of observations = 206.

8. A preponderance of the calving in regions 7 and 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. An interesting trend developing over the 4-year period of this study was that the proportion of fed steers slaughtered grading

Table 5
Yule–Walker estimates (second stage for the above-average data set)

Variable	df	Parameter estimate	SE	T for HO parameter = 0	$p > \|T\|$
Intercept	1	2.692	0.819	3.29	0.001
Time trend	1	0.0017	0.009	1.94	0.053
$\%\text{Choice}_{t-1}$	1	−0.055	0.010	−5.10	0.001
HCWP_{t-1}	1	0.010	0.006	1.71	0.089
AR(1)	1	−0.777	0.044	−17.49	0.001

Dependent variable: WAPD_t; Durbin–Watson $D = 1.40$; SSE = 6.27; TOT RSQ = 0.9027; MSE = 0.031; number of observations = 206.

at least choice/yield Grade 3 increased in regions 7 and 8, as indicated by the positive and significant coefficient for the time-trend variable.

The regression results in Table 4 provide statistical evidence to support the following conclusions: (1) removing the effects of seasonality and time, the below-average carcass quality data set received a discount of $2.36 cwt. when evaluated using the AMS grid relative to dressed weight; (2) this discount was lower (6 cents to 13 cents per cwt.) during the months of January through April, and higher (6 cents to 7 cents per cwt.) during September and October;[25] (3) the time-trend variable's coefficient is significant and negative, indicating that the discount per cwt. levied on the below-average pen increased by an estimated −72 cents per cwt. over the 4-year period.[26] As an example, in Week 1 of the study, the model estimates the average discount per cwt. at $2.36, and at Week 206 the discount increases to $3.08 per cwt.; and (4) changes in the general price level of fed steers (HCWP) do contribute additional information toward explaining the variability in the price differential for the below-average pen. For the below-average pen, a $1 increase in the HCWP will increase the discount per cwt. by 1.3 cents. This result is consistent with the *proportional hypothesis* discussed earlier.

The regression results in Table 5 provide statistical evidence to support the following conclusions: (1) removing the effects of seasonality and time, the above-average carcass quality data set received a premium of $2.69 cwt. when evaluated using the AMS grid relative to dressed weight; (2) this premium was lower (10 cents to 20 cents per cwt.) during the months of January through April, and higher (11 cents to 12 cents per cwt.) during September and October; 3. The time-trend variable's coefficient is significant and positive, indicating that the premium per cwt. paid for cattle in the above-average pen increased by 16 cents per cwt. over the 4-year period.[27] In Week 1 of the study, the model estimates the average premium per cwt. at $2.69, and at Week 206 the premium increases to $2.85 per cwt.; and (4) changes in the general price level of fed steers (HCWP) did contribute a small amount of information to help explain the variability in the price differential for the above-average pen. A $1 increase in the HCWP per cwt. increased the price differential premium for the above-average pen by 1 cent per cwt. The regression results in Tables 4 and 5 provide evidence in support of the supposition (proportional response hypothesis) that an increase in the HCWP results in packers adjusting their grid pricing strategy proportionally to changes in the market price of fed cattle.

4. Summary and implications for decision makers in the slaughter cattle market

The simple response to the question implied in the title of this paper is yes. For the above-average quality data set the monetary incentive to sell cattle on a grid rather than dressed weight has been positive and increasing over the last 4 years. However, for producers marketing cattle not meeting minimum quality standards in order to earn grid premiums, or for those producers who are risk averse, the empirical evidence indicates that these types of producers will have a propensity to market their cattle dressed or live weight. We conclude that the "barriers to the widespread adoption" of grid pricing do exist and have been persistent over the time period covered by this study.

The value-based marketing literature suggests the incentive mechanism of a value-based pricing system (grid pricing) should reward producers for producing superior quality cattle. The positive time-trend variable for the above-average quality pen and the negative time-trend variable for the below-average quality pen suggests that the incentive structure of the grid system has been increasing both premiums for above-average cattle and discounts levied on below-average cattle. It seems that packers are sending consistent signals concerning the type of cattle they are willing to pay a premium for.

The empirical results also suggest that packers are sending consistent signals concerning the negative consequences of delivering cattle that fail to meet the minimum carcass quality standards desired by the packer. As a consequence, implicit premiums have been increasing for below-average cattle being sold at an average price. This amplifies the market distorting effect of average pricing and suggests that averaging pricing has become an even more pressing problem for the industry during the period covered in this study. With a majority of slaughter cattle still being sold at an average price, there will not be a dramatic improvement in the overall quality of beef produced or a large reduction in excess fat production because, at an average price, fat receives the same price as lean. However, there is empirical evidence that the quality of cattle being slaughtered in regions 7 and 8 has marginally improved over the last 4 years. To what extent grid pricing has influenced the improvement in regional carcass quality is a topic of future research.

The price differential associated with selling on a grid relative to selling at an average price is robust and exhibits a strong seasonal pattern (Fig. 3). The price differential narrows for both the above- and below-average pens during the spring. This infers a lower incentive to market above-average cattle on a grid as the price differential narrows relative to selling cattle dressed weight. In the fall months, the price differential widens for both the above- and below-average pens. In the fall, the grid premium paid for above-average cattle increases and the grid discount levied on below-average cattle deepens. This infers a greater incentive to market above-average quality cattle on a grid as the price differential widens. The marketing implications for producers are: (1) grid incentives are influenced by seasonal market

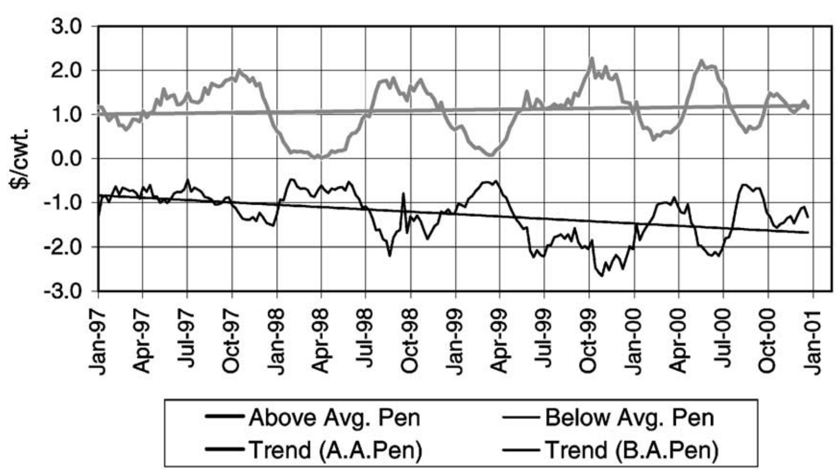

Fig. 3. Trends in grid incentives and disincentives.

conditions and producers should incorporate that information into their marketing decisions; and (2) if a producer is uncertain about carcass quality, then the potential revenue loss (poor carcass quality) from selling on grid versus selling at an average price is less in the spring relative to selling in the fall. These results are consistent with the seasonal pattern in the choice-select spread and the results reported by Feuz (1999b) that grid price signals are not consistent over time.

This empirical evidence suggests the "barriers to adoption" have been substantive over the period covered in this study. The results of the study support the conclusions arrived at in the earlier literature on the existence of price differentials (Fausti & Feuz, 1995). The empirical evidence presented indicates that the price differentials are persistent over time and highly variable, lending further support for the time inconsistency conjecture proposed by Feuz (1999b). The data provide evidence that selling cattle on a grid relative to selling cattle at an average price does result in higher per-head revenue variability. This result is also shown to be persistent over time. The implication is that marketing fed cattle on a grid has consistently been a riskier marketing option for the producer relative to selling at an average price during the period covered in this study.

It is clear from the data that the price differential, the incentive or disincentive to market on a grid, has been variable over time. However, it is also clear that the incentive (for above-average quality carcasses) and the disincentive (below-average quality carcasses) are diverging. The time-trend coefficient for the below-average pen is negative and larger than the positive coefficient for the above-average pen. The implication is that the penalty associated with grid pricing has increased more than the reward. This trend in the incentive structure has negative implications for producer selection of grid pricing over average pricing for the marketing of their slaughter cattle.

We conclude that barriers to the adoption of grid pricing continue to exist and that average pricing will continue to dominate the cash market for fed cattle. Therefore, the problems of excess fat production and inconsistent meat quality associated with average pricing will continue to plague the industry. The segmentation of the market for beef into two submarkets, branded product versus commodity product, may be in the industry's future.

Notes

1. Purcell (1998) provides an excellent discussion on the economic causes and consequences associated with the decline in the demand for beef after 1975.
2. See Fausti et al. (1998) for a review of this literature.
3. Carcass quality characteristics included hot carcass weight, ribeye area, marbling, backfat thickness, etc.
4. Ward et al. (1999) estimates that, at most, 20% of slaughter steers and heifers are marketed on a grid pricing system.
5. Except in the study by Feuz (1999b) discussed earlier.
6. 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 packer reported discounts and

premiums. The AMS first began to report grid premiums and discounts in October 1996 (USDA-AMS weekly reports, 1997–1999).

7. See Fausti et al. (1998) for a detailed discussion of the AMS grid price reporting system.
8. Price data was adjusted for inflation using Bureau of Labor Statistic (1982-1985)'s Consumer Price Index values.
9. The HCWP is the reported five-area (Texas/Oklahoma, Kansas, Nebraska, Colorado, Iowa/South Minnesota) 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). A steer's dressed price per-head is the HCWP multiplied by hot carcass weight. The result of this approach is that for each of the 1,500 steers, a dressed weight price per cwt. and dressed weight price per-head are calculated for each week and then the weekly mean and standard deviation of these price variables for each pen is recorded and used in the empirical analysis.
10. The regional grading percentage reflects the weekly proportion of slaughter steers grading choice in AMS reporting regions 7 and 8 (IA, KS, MO, NE, CO, MT, ND, SD, UT, and WY). 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 its weekly grid base price.
11. Base price and premium and discount formulas are considered to be confidential by packing firms.
12. The select-discount also represents the premium paid for choice carcasses relative to select carcasses. In Eqs. (2) and (4), the select-discount is entered into the calculations as a positive value.
13. A simple hypothesis test indicated that the mean price differential was nonzero at a level of significance of less than 1% for both the above- and below-quality data sets.
14. The implicit premium and discount discussion is based on the assumption that when cattle are marketed on the grid system, the true market value of the carcass is realized. At the pen level (1,500 head), the weekly average implicit discount is \$12,000.00 for the above-average pen. The weekly average implicit premium for the below-average pen is \$13,500.00.
15. In the below-average quality pen, the mean and standard deviation for hot carcass weight is 718.56 lb and 74.16 lb, respectively. In the above-average quality pen, the mean and standard deviation for hot carcass weight is 719.37 lb and 73.83 lb, respectively.
16. The weekly per-head grid revenue and per-head dressed weight revenue standard deviation for the above- and below-average pens were calculated and collected over the 206-week period. The weekly revenue standard deviations were then summed, and the mean values are those reported in Table 2. The reported mean of the weekly standard deviation reflect both the average variability in the pen level hot carcass weight per head

and the average variability in price, whether it is a grid or dressed weight price. However, hot carcass weight variability in the two data sets is constant over time because carcass characteristics are being held constant over time (see Note 15).

17. Test for the difference between population means (large sample) for both the above- and below-average pens across pricing systems indicate that the mean revenue per-head standard deviations are statistically different, with *p*-values of less than 1%.
18. For both the above- and below-average pens, the weekly revenue per-head standard deviation is higher for the AMS grid than for dressed weight pricing. Analysis indicates that the range for the difference of the weekly standard deviation of per-head revenue (grid minus dressed weight) is positive for both the above- and below-average pens over the entire 206-week period.
19. Test for the difference between population means (large sample) for both the AMS grid and dressed weight pricing systems across pens indicates that the mean revenue per-head standard deviations are not statistically different from zero for both pricing systems across pens.
20. The recursive modeling assumption is that the price differential is a function of the regional grading percentage, but the reverse is not true. This one-way relationship is based on the assumption that packers use publicly reported information on the average quality of cattle sold last week (at time $t-1$) to make adjustments to their base price formulas and the associated grid premiums and discounts this week (time t). Johnston (1972, p. 379) argues that a recursive process at work in the market adjustment process for price and quantity is a robust supposition when one takes into account the institutional realities of the market place. The empirical model was tested for contemporaneous correlation and it was found not to be a significant problem.
21. December was selected as the reference month.
22. It is this information structure we propose that justifies the structure of the empirical model. Variability in the weekly average price differential for a pen of cattle is assumed to be explained by the information structure used by the packers to set premiums and discounts. The regional grading percentage is highly correlated with the choice-select spread (Fig. 1). A change in the HCWP is hypothesized to effect the other premium and discount levels. Therefore, these two variables are assumed to contain all the information used by packers to design their grid pricing strategy. The bar symbol denotes the predicted value of the independent variable.
23. The time-trend variable in the second-stage equation test is whether packers are making adjustments to their grid pricing strategies over time for reasons other than changes in the average quality of cattle being slaughtered. For instance, packers adjust their grid pricing strategy for the purpose of signaling to producers the demand for a specific carcass quality characteristic or to maximize profit from grid purchases.
24. The error terms V and E are assumed to be generated by an autoregressive process. For example, $V_t = \varepsilon_t - \alpha_1 v_{t-1} - \cdots - \alpha_p v_{t-p}$ 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, 1990).
25. The seasonality price effect is calculated by multiplying the first-stage coefficient estimate for a particular month by the second stage estimated coefficient for

%Choice. This procedure allowed an estimate for each month's price effect to be calculated.

26. The time-trend variable has a direct and indirect effect on the dependent variable: $\partial\text{PDIFF}/\partial\text{time trend} + (\partial\text{PDIFF}/\partial\%\text{Choice})(\partial\%\text{Choice}/\partial\text{time trend})$. The direct effect at 206 weeks is 84.4 cents and the indirect effect is 11.9 cents; therefore, the discount (in absolute terms) increased by 72.5 cents over the 206-week period.
27. However, the time-trend variable has a direct and indirect effect on the dependent variable: $\partial\text{PDIFF}/\partial\text{time trend} + (\partial\text{PDIFF}/\partial\%\text{Choice})(\partial\%\text{Choice}/\partial\text{time trend})$. The direct effect at 206 weeks is 35 cents and the indirect effect is (-19.2 cents); therefore, the net premium per cwt. increased by 16 cents over the 206-week period.

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