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Value Based Marketing for Fed Cattle: A Discussion of the Issues

ABSTRACT: The U.S. beef industry has been struggling with the erosion of domestic market share relative to pork and and poultry for several decades. Many factors may have contributed to this shrinkage, including the industrial organization of the domestic beef industry. A discussion of the institutional structure of beef production in the U.S., and the cash market for fed cattle, as possible contributing factors to the decline in beef's competitive position is provided.

In the literature, a consensus agrees that average pricing of fed cattle in the cash market has contributed to beef's diminished competitive position. One solution to the average pricing problem which has gained widespread support is the idea of implementing a value based marketing system (VBMS); to replace the current cash marketing system. The value based marketing concept and the probability of it successfully supplanting the current cash marketing system for fed cattle is discussed and evaluated.

A comparative empirical analysis of a VBMS relative to the current cash marketing system is reported. Evidence suggests that the ability of a VBMS to supplant the current cash marketing system will be dependent on the premium and discount structure.

INTRODUCTION

Beef demand in the United States began to weaken relative to the demand for pork and poultry in the 1970s. The literature offers two possible explanations: (1) the

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lifestyles hypothesis and (2) the relative-prices hypothesis.[1] Barkema and Drabenstott (1990) concisely outline these two possible explanations: "The lifestyles argument suggests that consumers chose to eat less beef due to health concerns and changes in lifestyles. The relative-prices explanation suggests consumers switched from beef to poultry because beef became relatively more expensive than poultry."

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 (VBMTF) 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 & grade) to encourage producers to raise leaner cattle that still will grade USDA low choice or higher. In turn, leaner cattle will reduce revenue loss due to fat (estimated at $2 billion per year) and increase consumption of leaner beef by fat conscious consumers. Thus, a VBMS (beyond dressed weight & grade) has the potential to address both the lifestyles and relative-prices dilemmas.

The NCBA report and recent articles in the animal science literature (Cross and Whittaker, 1992; Cross and Savell, 1994) clearly implicate traditional cash pricing alternatives for fed cattle as a major obstacle to improving beef's competitive position in the domestic market. This view is articulated in the NCBA report (CONSENSUS POINT 7): "Fed cattle should be valued on an individual carcass basis rather than an average live price." Proponents of a VBMS argue that the traditional cash pricing system for fed cattle (live; dressed weight; dressed weight & grade) is a barrier to the transmission of consumer preferences for a particular type of beef product to the fed cattle producer. The barrier arises because cattle are sold live weight or dressed weight by the pen or multiple-pen basis at an average price. This implies that above-average cattle in the pen are paid less than their market value and below-average cattle in the pen are paid more than their market value. Thus, the price discovery mechanism fails because **information** to the producer on individual animal market value is not provided or is distorted.[2]

In the VBM and price discovery literature, there are a number of reasons cited for why dressed weight & grade pricing has not been preferred by many producers: 1) distrust of USDA graders; 2) distrust of packers; 3) increase in transactions cost; 4) increase in management cost; 5) increased risk; and 6) system of discounts only. These barriers to marketing dressed weight & grade will also limit the willingness of these same producers to participate in a VBMS.

With respect to the USDA grading system, many producers believe that it is flawed. Compounding this mistrust of the grading system is the real or perceived subjectivity of USDA graders by producers. At any cattlemen's meeting one can hear testimonials from producers who split lots of cattle into two groups and sent

them to different packing plants to find that the cattle graded significantly different at the two plants. Current research efforts by meat scientists to develop instrument grading systems could address this problem. In theory, an instrument-based VBMS will allow USDA graders to estimate quality and yield grades more accurately (Cross and Whittaker, 1992). Until instrument systems are in place, mistrust of graders will remain an issue raised by producers who are skeptical of VBM.

Some fed cattle producers mistrust the meatpacking companies and prefer to be paid "on the hoof" for the cattle leaving their lot. Many large feedlots prefer to sell all pens for that week at the same price, reducing the time and costs involved in marketing. This practice has implications for customer relations; The custom cattle feeder does not have to explain to cattle owners or investors why their inferior pen of cattle received a lower price if all cattle are priced the same. Finally, if feeder cattle are bought on an average live weight and fed cattle are sold on an average live weight, then it is not uncommon for a feedlot operator to focus on weight gain and the cost of gain. Cattle production performance with respect to quality and yield grade may be a subordinate concern to this type of producer.[3]

Another issue that has limited participation in the traditional dressed weight & grade pricing system is that producers have viewed it as a system of discounts. Rather then referring to it as "grade and yield" producers have called it "grade and steal" (Cross and Savell, 1994). A VBMS may address this issue somewhat in that both premiums and discounts are applied to a base price. However, it is still the case that the size of the discounts are much greater than the size of the premiums.[4]

Each of these issues could be discussed in much greater detail. However, their common thread is the element of risk associated with pricing on an individual head basis. The risk issue associated with the multiple cash marketing alternative for fed cattle is addressed in the price discovery literature, and will be discussed below.

The discussion of the effect of risk on price discovery in the economic literature (Ward, 1987; Feuz et al., 1993) suggest that the implementation of a new premium and discount pricing system (grid, formula, etc.) beyond the traditional dressed weight & grade pricing system will increase per-head and per-pen revenue variability. This will be the case with VBM, simply because carcass quality characteristics do vary within and among pens. In other words, the base price per cwt. may be the same for multiple pen sales, but premiums and discounts are based on individual carcass quality. Therefore, revenue variability is likely to increase relative to live weight, dressed weight, or dressed weight & grade.[5]

An increase in revenue variability will result from the packer being able to price closer to market value with respect to overall cattle quality under a VBMS as compared to the traditional pricing alternatives. The price discovery literature suggests that fed cattle producers will react negatively to increased revenue per-head or per-pen variability under a VBMS. If this is correct, then a VBMS will have a difficult time supplanting traditional average pricing systems currently being utilized in the cash market for slaughter cattle.

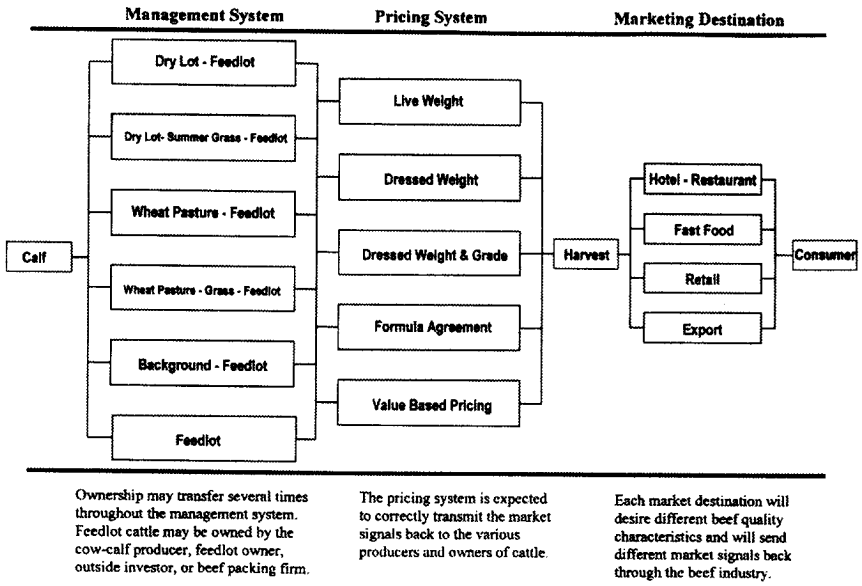

Figure 1. Simplified Schematic of Cattle Feeding, Fed Cattle Pricing, and Beef Market Outlets

The objectives of this paper are to:

1. Provide an overview of the current structure of the cash market for fed cattle;
2. Discuss and compare the concept of VBM to the traditional pricing systems used in the cash market;
3. Review the relevant price discovery literature; and
4. Provide an empirical analysis that compares revenue from cattle on a hypothetical VBMS to the dressed weight pricing system.

VBM AND STRUCTURE OF THE CASH MARKET FOR SLAUGHTER CATTLE

The beef industry is unique among the livestock and poultry industries in that there are a number of different management and marketing alternatives available to move product from producer to consumer: 1) Cattle are raised in all regions of the country; 2) Several feeding alternatives are available to raise calves to an appropriate harvest (slaughter) weight and quality at the desired stage of maturity; and 3) Then, once the cattle are ready for harvest, producers also have a choice of marketing or pricing methods. This production and marketing system is complicated relative to other livestock and poultry production and marketing systems. A schematic of some of the present feeding and marketing alternatives is displayed in Figure 1. Sales can and often do occur between each of the feeding alternatives.

The use of average pricing continues to dominate the cash market for slaughter cattle. According to the Packers and Stockyard Administration's 1996 report (*Packers and Stockyards Statistical Report: 1991-94 reporting years, pp. 40-44*), in the U.S. during 1994, 45.4% of steers/heifers and 44.5% of cattle (steers, heifers, bulls, and cows) were purchased on a carcass basis (dressed weight or dressed weight & grade).[6] The proportion of carcass-based purchases increased from 27.4% in 1980 to 44.6% in 1994. The PSA statistics can be used to infer that a carcass-based pricing alternative to live weight has had limited success in attracting producers. But the issue of why the dressed weight & grade system has failed to supplant the other pricing alternatives has not been adequately addressed in the VBM literature.

The VBM literature also asserts that beef production and marketing channels contribute to inconsistent product quality (VBMTF, 1990; Cross and Savell, 1994). A number of factors are associated with the issue of inconsistent slaughter cattle quality: 1) the variability in production methods used to raise animals to slaughter weight; 2) the genetic diversity of the national herd; and 3) the current multiple pricing system.

Supporters of VBM assert that the current three pricing alternatives are flawed and partially responsible for inconsistent quality and beef's declining market share (Cross and Savell, 1994). The VBM literature has labeled the live and dressed weight alternatives as inadequate systems because of average pricing, and while the dressed weight & grade alternative is value based, it is also a barrier because it is unpopular among producers (see CONSENSUS POINT 7 in the NCBA report). The NCBA report argues that the dressed weight & grade alternative has been rejected by the majority of producers because: 1) humans grade the carcass; and 2) there is a time lag (between the sale of an animal and payment for the animal) associated with the dressed weight & grade marketing alternative.

With respect to the effect the current multiple pricing system has on the method of production selected and the quality of beef produced, Feuz et al. (1993) reported that the most important variable in explaining profit variability when cattle were sold live weight was average daily gain. However, when slaughter cattle were sold dressed weight & grade, quality grade became the most important variable explaining the variation in profit.[7] The implication of this study is that the selection of the pricing system determines which production variables will be rewarded. In turn, this reward signal will be incorporated into the producer's livestock selection and management plan. The claim of VBM supporters that VBM will reduce beef quality inconsistency and strengthen demand for beef by sending consistent reward signals to beef producers is consistent with the Feuz et al. study.

THE CONCEPT OF A VBM PRICING SYSTEM

The USDA beef grading system is two-dimensional: quality grade and yield grade. Carcass quality grades of finished cattle are divided into four categories: *prime,*

choice, select, and standard, determined by animal maturity and degree of marbling (percentage of intramuscular fat content). Marbling is the primary factor determining quality grade: The higher the intramuscular fat content, the higher the quality grade. Carcass yield grades of finished cattle are divided into five categories: *yield grade 1 to yield grade 5*. Yield grade refers to the percentage of the carcass suitable for boneless retail cuts. The higher the percentage, the lower the numeric value assigned as the yield grade.[8]

Until recently, in the cash market for fed cattle, the dressed weight & grade system was the only widely used value based system. When cattle are sold under the dressed weight & grade system, their value is determined by how they grade and the carcass weight. The packer sets a base price per hundred weight. The base price is determined by market forces for cattle that meet minimum yield and quality grades. Under this pricing system the minimum is quality grade *choice* and yield grade *3*. For all practical purposes, all carcasses that meet the minimum grade receive the base price and no premium is given when carcasses exceed the minimum standard. For those carcasses that fail to meet the minimum, discounts are applied. For many of animals marketed dressed weight & grade, the system is a value based system of discounts only. This particular characteristic of the dressed weight & grade system is considered a serious deficiency by many producers.

The explicit goal of the VBM initiative is to develop a marketing system that incorporates a greater range of premiums and discounts than what currently exists under the dressed weight & grade system. Several designs, commonly referred to as grid systems, have been proposed.[9] The grid system discussed here is three-dimensional and was developed by the Agricultural Marketing Service (AMS 1997) division of the USDA for the purpose of price reporting.[10] The AMS grid pricing system expands the yield categories from five under the dressed weight & grade system to seven. It also adds an additional dimension: weight class, divided into five weight class categories.

All grid pricing systems have a particular formula for calculating a grid base price. According to the AMS, for the purpose of price reporting, the base price of the AMS grid system is dependent on three factors: a) the choice/select price spread, b) the current dressed weight market price in the region the producer sells cattle, and c) the region's percentage of slaughter cattle grading choice or higher.

All information provided below is for the time period corresponding to AMS grid report for April 14, 1997. This date was selected because the carcass data used in this study come from slaughter cattle marketed in the spring. According to the AMS office in Des Moines, Iowa, the base price for the AMS grid is determined by using the following procedure: To calculate the base price, multiply the choice/select price spread by the percentage of carcasses grading select in the region and then add that product to the dressed weight price prevailing in the corresponding region.[11] The carcass data used in this study represent cattle raised in South Dakota (region 7&8); the percentage grading choice for this region was 49.18%

Table 1. Prices from AMS Grid System ($/cwt)

	Yield Grade							
Quality Grade	*Less than YG 2.0*	*Greater than YG 2.0*	*Greater than YG 2.5*	*Greater than YG 3.0*	*Greater than YG 3.5*	*Greater than YG 4.0*	*Greater than YG 5.0*	*Carcass Weight*
Prime	98.37	97.55	97.55	96.52	96.37	84.37	79.22	
Choice	92.64	91.84	91.84	90.81	90.64	78.64	73.52	Less than
Select	87.36	86.54	86.54	85.51	85.36	73.36	68.22	500 lbs.
Standard	78.22	77.40	77.40	76.37	76.22	64.22	59.08	
Prime	102.64	101.84	101.84	100.81	100.64	88.64	83.52	
Choice	96.95	96.13	96.13	95.10	94.95	82.95	77.81	500-550
Select	91.65	90.83	90.83	89.80	89.65	77.65	72.51	lbs.
Standard	82.51	81.69	81.69	80.64	80.51	68.51	63.37	
Prime	118.64	117.84	117.84	116.81	116.64	104.64	99.52	
Choice	112.95	112.13	112.13	111.24	110.95	98.95	93.81	550-950
Select	107.65	106.83	106.83	105.80	105.65	93.65	88.51	lbs.
Standard	98.51	97.69	97.69	96.64	96.51	84.51	79.37	
Prime	105.09	104.27	104.27	103.24	103.09	91.09	85.95	
Choice	99.38	98.56	98.56	97.53	97.38	85.38	80.24	950-1000
Select	94.08	93.26	93.26	92.23	92.08	80.08	74.94	lbs.
Standard	84.94	84.12	84.12	83.09	82.94	70.94	65.80	
Prime	100.80	99.98	99.98	98.95	98.80	86.80	81.66	
Choice	95.09	94.27	94.27	93.24	93.09	81.09	75.95	Greater than
Select	89.79	88.97	88.97	87.94	87.79	75.79	70.65	1000 lbs.
Standard	80.65	78.83	79.83	78.80	78.65	66.65	61.51	

(USDA National Steer & Heifer Estimated Grading Percent Report for the week ending 4/12/97). The weekly average for the choice/select price spread and the Nebraska Hot Carcass price as reported by the AMS is $5.30/cwt and $108.55/cwt, respectively. The calculated base price for the AMS grid for this time period is $111.24/cwt.

The grid carcass price is determined by premiums and discounts added or subtracted from the base price according to the carcass's yield grade, quality grade, and weight classification. The AMS grid premium and discount pricing report for April, 14, 1997, was used to construct the price grid in table 1. There are 112 possible prices per hundred weight. The price per hundred-weight for a particular animal is dependent on the carcass weight, yield grade, and quality grade, as indicated in Table 1.

Grid pricing systems, such as the AMS system, differentiate carcass quality with respect to price to a much greater degree than the other cash pricing systems. For example, the dressed weight & grade pricing system does evaluate each carcass on an individual basis. However, revenue per head variability for a particular pen of cattle is lower relative to a grid pricing system. This is due to the lack of premiums and the discount structure associated with the dressed weight & grade pricing system. When slaughter cattle are sold live weight or dressed weight, an average price per hundred weight is negotiated (dependent on estimated average quality of the cattle) for all animals in the pen. Per-head revenue variability for a

particular pen of slaughter cattle sold live weight or dressed weight declines relative to the revenue per head variability if those cattle would have been sold through a value based pricing system such as the AMS grid or dressed weight & grade price system.

The economic implication is that the revenue per head variability increases for a particular pen of cattle as the cattle are priced live weight relative to dressed weight, dressed weight relative to dressed weight & grade, or dressed weight & grade relative to a grid pricing system. According to the price discovery literature, increased revenue variability may be a barrier to successful implementation of a new VBMS.

PRICE DISCOVERY LITERATURE

Ward (1987) compares and contrasts three pricing alternatives (live weight, dressed weight, dressed weight & grade) and the price discovery process associated with each alternative. Ward concludes that informational disparities concerning carcass quality and quantity (dressing percentage) among the three alternatives will lead buyers of finished cattle to adjust their bids to compensate themselves for incurring increased risk when purchasing cattle without full information on carcass weight and quality.

Ward's article has stimulated recent research on the economic consequences of informational disparities between marketing alternatives. Feuz et al. (1993) indicated that there are profit differentials between marketing alternatives. Dressed weight & grade generates, on average, the highest profit. Live weight generates, on average, the lowest profit for producers of finished cattle. They hypothesize that risk aversion on the part of buyers (meatpackers) is the cause of the profit differentials.

Feuz et al. (1995) extended their earlier paper by deriving risk aversion coefficients for buyers of finished cattle and concluded that packers are risk averse. They also provided estimates of the average risk premiums charged by cattle buyers when they purchase cattle live or dressed weight. They reported that the coefficient of variation increases as sellers move from the live to dressed weight to the dressed weight & grade marketing alternatives. They hypothesized that the coexistence of the three pricing alternatives with revenue differentials between the alternatives is the result of risk aversion varying among cattle producers. The most risk averse producer sells cattle via the live alternative and the least risk averse producer sells cattle dressed weight & grade.

Fausti and Feuz (1995) developed a theoretical model of a competitive firm in the meatpacking industry purchasing finished cattle via the three pricing alternatives. Their theoretical conclusions are consistent with the empirical results presented in their earlier papers. Their "theory of factor price disparity" explains the

revenue differentials between the marketing alternatives as arising from an informational disparity over cattle quality.[12]

The literature on buyer and seller behavior in the cash market for slaughter cattle makes a strong case that varying degrees of incomplete information generate uncertainty over the dressing percentage and carcass quality 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 the three pricing alternatives. If the conclusions in the recent literature are correct, then a VBMS will be successful only if the risk/return tradeoff for producers is significantly superior to the other existing cash market alternatives.

The price discovery literature has a strong theoretical and empirical foundation relative to the VBM literature. If a grid-based VBMS is designed on the premise that the only obstacles to producer acceptance of an individual animal grading system are: 1) producers' distrust of human graders, and 2) lag time between sale and payment, then the probability of a VBMS being successfully implemented will be greatly diminished. For a VBMS to have broad producer support, it should be designed so that it takes into consideration the findings presented in the price discovery literature.

DATA DESCRIPTION

The Animal and Range Science Department at South Dakota State University (SDSU) has conducted a Retained Ownership Demonstration Program (RODP) for steer calves over a six year period (Wagner et al. 1991-95).[13] 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.

The cattle in the 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 12^{th} 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, the mean yield grade was 2.68. This implies the animals, at slaughter, were well muscled and showed well. The proportion of yield grade 1-3 slaughter cattle grading choice or higher in region 7&8 for the week ending April 12, 1997, was 49.18%. The proportion of yield grade 1-3 cattle grading choice or higher was 41.5% in the study. The cattle in the South Dakota study are slightly below the regional average with respect to quality grade. However, 68% of the cattle in the South Dakota study yield graded less than 3 as compared to 55.5% for the region, indicating the South Dakota cattle were above the regional average with respect to yield grade.

The actual dressed weight and grade price data, collected by SDSU animal scientists, indicates that RODP animals which attained a quality grade of choice and a yield grade of less than 4 received the highest price per cwt. on market day. Animals which graded select and less than yield grade 4 received the next highest price on market day. Discounts were applied to approximately 5.1% of the animals that did not meet the above standards.[14] However, no premiums were given despite the fact that 68% of the animals yield graded less than 3 and 42% quality graded choice. Given that the animals were sold over a six year period, on 28 different marketing days, the dressed weight & grade systems appears to be only a system of discounts for this group of cattle.

AN EMPIRICAL COMPARISON OF GRID VS. DRESSED WEIGHT PRICING

The carcass data collected allows the marketing performance of RODP animals under the AMS grid pricing system to be compared with the dressed weight pricing system. This is possible because prices for both systems had been collected for the price reporting week proceeding April 14, 1997.

The dressed weight pricing system requires the buyer of a pen of slaughter cattle to estimate the percentage of the pen grading choice or higher and the yield grade average for the pen before slaughter. The buyer then negotiates a single hot carcass per hundred weight price for all animals in the pen. The price of the pen is then equal to the negotiated price multiplied by the total hot carcass weight/cwt of the pen. Individual carcass value is dependent on its weight only, once the price has been set.

The market value of each carcass is calculated under the dressed weight pricing system by multiplying the HCW price of $108.55/cwt by the weight of each carcass.[15] The AMS grid price per carcass was calculated using the grid presented in Table 1. Table 2 contains the summary statistics with respect to revenue per head under the two pricing alternatives.

The summary statistics indicate that marketing under the grid system decreased average revenue per head by $2.41 and increased the standard deviation by $5.03 relative to the dressed weight alternative. This indicates that for a similar group of slaughter cattle, the producer's revenue risk would increase and average revenue would decline under the grid pricing system relative to the dressed weight price system. Lower average revenue per head under the grid system is primarily due to

Table 2. Mean, Standard Deviation, Coefficient of Variation, and Range of Revenue per Head (2590 head, $/head)

Marketing Method	*Mean*	*SD*	*CV*	*Max*	*Min*
Dressed Weight	781.24	79.93	.1023	1046.42	503.67
AMS-Grid System	778.83	84.96	.1091	1046.17	401.54

Table 3. Mean, Standard Deviation, Coefficient of Variation, and Range of Revenue per Head (1500 head, **above-average** quality, $/head)

Marketing Method	*Mean*	*SD*	*CV*	*Max*	*Min*
Dressed Weight	780.87	80.15	.1026	1046.42	518.87
AMS-Grid System	787.63	85.46	.1085	1046.17	429.69

Table 4. Mean, Standard Deviation, Coefficient of Variation, and Range of Revenue per Head (1500 head, **below-average** quality, $/head)

Marketing Method	*Mean*	*SD*	*CV*	*Max*	*Min*
Dressed Weight	780.00	80.99	.1038	1046.42	518.87
AMS-Grid System	774.53	84.46	.1090	1046.17	429.69

only 42% of the carcasses grading choice or higher in the data set. Whereas, the reported HCW price used to derive dressed weight revenue reflects the region's choice/select mix of 49.1%.

An equality of variance hypothesis test and a non-parametric difference in means: matched pairs hypothesis test were conducted. The results of the matched pairs hypothesis test suggest that there is a statistically significant difference with respect to average revenue per head.[16] The results of the equality of variance test suggest that there is a statistically significant difference with respect to the variance of revenue per head.[17]

The above results are consistent with the price discovery literature assertion that incomplete information over carcass quality associated with the dressed weight pricing system results in the buyer assuming the risk of a positive probability of carcass quality estimation error occurring when cattle are sold dressed weight. The consequence is a per head or per pen revenue differential between the dressed weight marketing alternative and a VBM alternative (Fausti and Feuz, 1995).

To further explore the issue of how carcass quality affects per head or per pen revenue, two data sets were created with 1500 animals each. The first data set contained 1000 animals randomly selected from the 2590 which graded choice or higher and 500 animals randomly selected which graded select. The second data set contained 500 animals randomly selected from the 2590 which graded choice or higher and 1000 animals randomly selected which graded select.

Table 3 contains the summary statistics with respect to revenue per head under the two pricing alternatives for the above-average pen of 1500 slaughter cattle.

The summary statistics indicate that marketing under the grid system increased average revenue per head by $6.76 or $10,140 for the above-average pen of 1500 head. Marketing under the grid also increased the standard deviation by $5.31.[18] This indicates that a producer selling similar groups of slaughter cattle would experience an increase in revenue per head and an increase in revenue variability under the grid pricing system relative to the dressed weight price system.

Table 5. Mean, Standard Deviation, Coefficient of Variation, and Range of Revenue per Head Under the AMS Grid System and the Dressed Weight Pricing System with **Zero Buyer Estimation Error of Quality Grade** ($/head)

Dressed Weight Choice/Select	*Mean*	*SD*	*CV*	*Max*	*Min*
Above Average	787.49	80.82	.1026	1055.29	523.26
Below Average	773.89	80.35	.1038	1038.23	514.80
AMS-Grid System					
Above Average	787.87	85.46	.1085	1046.17	429.69
Below Average	774.53	84.46	.1090	1046.17	429.68

Table 4 contains the summary statistics for revenue per head under the two pricing alternatives for the below-average pen of 1500 slaughter cattle.

The summary statistics indicate that marketing under the grid system decreased average revenue per head by $5.47 or $8,205 for the below-average pen of 1500 head. However, marketing under the grid also increased the standard deviation by $3.47.[19] This indicates that a producer selling similar groups of slaughter cattle would experience decreased revenue and increased revenue variability under the grid pricing system relative to the dressed weight price system.

The above analysis is based on the assumption that buyers would offer the reported weekly average HCW dressed weight price. The choice/select mix of the randomly constructed cattle pens are very different from the regional average (49.1%), but the average yield grade of both pens are similar. The implication is that the revenue differentials are the result of the assumptions made concerning the choice/select mix.

Assume the buyer could accurately estimate the choice/select mix of the two (1500 head) pens of cattle at the feedlot and then offered a dressed weight price reflecting the pen's actual choice/select mix. The below-average pen would be offered $107.70 cwt., and the above-average pen would be offered $109.47.[20]

Table 5 contains revenue per head summary statistics (dressed weight, AMS Grid) for the above and below average pens under the assumption that the buyer has knowledge of the choice/select mix.

In comparing the summary statistics for the dressed weight pricing system (under the assumption of zero buyer estimation error) to the summary statistics for grid pricing, it is clear that the average revenue per head differential converges toward zero, but the variance differential remains. The standard deviation differential between the grid system and the dressed weight pricing system for: 1) below-average cattle is $4.08; and 2) above-average cattle is $4.60.

The ramification of the comparative analysis is that carcass quality and the estimation of carcass quality play a significant role in determining which pricing system provides the greatest average return to a pen of cattle. Another important

implication of the analysis is that the cause of average revenue differentials among pricing systems is estimation error.

Even if we assume that on average buyers are correctly estimating the quality of the cattle they purchase, the price differential may not converge to zero. Combining estimation error with risk aversion may result in average revenue differentials persisting among the cash pricing systems. This view is consistent with Fausti and Feuz (1995).

If producers are uncertain about the quality of their cattle, there is significant financial risk associated with selling those animals on a grid system. However, selling them dressed weight greatly reduces the producer's down-side risk due to the presence of estimation error on the part of the buyer when cattle are sold on an average price. The implication for producers selling in the cash market is this: A grid pricing system generates increased financial risk for the producer if the producer is uncertain about the carcass quality of the animals to be sold.

A risk to return trade off measure, the coefficient of variation, suggests that there is little change in the risk to return trade off as sellers move from the dressed weight pricing system to the AMS grid system. If the seller risk aversion hypothesis touted in the price discovery literature is correct, then one must conclude that a new VBMS incorporating a grid pricing system which increases revenue variability will meet producer resistance.[21] The consequence of producer resistance to grid pricing systems will be the limited success in supplanting the live and dressed weight pricing systems. At best, grid pricing systems will replace the dressed weight & grade pricing system.

The implication for the industry of producer resistance to VBM is that average pricing will continue to play a major role in the market for slaughter cattle. The consequences for the industry are:

1. The transmission of consumer preferences for a particular type of beef product through the supply chain will continue to meet resistance;
2. Inconsistent beef quality will continue to plague the industry; and
3. Inefficient production practices will continue to produce excess fat.

CONCLUSION

The empirical analysis indicates that a revenue differential between average and individual pricing systems is the result of estimation error associated with incomplete information on carcass quality. However, increased revenue variability with grid pricing systems persists relative to average pricing systems even in an environment of complete information on carcass quality.

The call for the development and implementation of a VBMS for slaughter cattle is not a new issue in the beef industry. The goal of many of the proposed systems is to provide a conduit for the transmission of consumer preferences for a

specific type of beef product to producers that is superior to the traditional pricing system. In turn, it is argued that producers will alter production practices to improve the consistency of cattle quality. However, such a system can only be successful if it is accepted by producers.

Cow-calf producers who retain ownership of their calves through the feedlot finishing stage may prefer a VBMS because of the individual carcass information they can receive. This information can then be used in genetic selection and future cattle management and marketing strategies. Owners of cattle with superior carcass traits also may prefer a VBMS because they are confident they will receive above-average revenue by pricing on a grid. In essence, their revenue risk is reduced by prior and more complete information. This could then lead to more sorting at the feedlot, with cattle that are expected to have superior carcass traits being sold on a VBMS and the remaining cattle sold on a live or dressed weight basis. If this does occur on a large scale, then there are some interesting implications for the quality of cattle sold via each pricing method. This needs to be addressed by agricultural economics research but is not a part of this paper.

The risk aversion hypothesis touted in the price discovery literature casts doubt upon the premise that such a system will be widely accepted by producers. Further research on the factors with the greatest influence on the producer's decision process when selecting a pricing alternative is needed. Important informational issues include:

1. Does risk averse behavior on the part of producers pose an important barrier to the implementation of a VBMS?
2. Is the presence of producer bias toward the current grading system and the VBM concept an important barrier to the implementation of a VBMS?
3. What features need to be incorporated into a VBMS to gain producer acceptance?
4. What effect will the success or failure of a VBMS have on beef's long-run competitive position?

This last issue of the long-run consequences associated with the success or failure of VBM for the competitive position of the beef industry was not addressed in this paper. However, our discussion does provide insight on the long-run implications. Under the live weight and dressed weight pricing systems, the price discovery process is hampered by incomplete information which leads to estimation error. The existence of estimation error influences the negotiation over the expected quality and price of the cattle to be sold. The larger the pen to be sold, the greater the tendency for the agreed upon expected quality and price to be near the average for the region. The tendency toward larger feedlot operations in the United States may be a powerful economic influence sustaining average pricing for the

foreseeable future. Further research into the relationship between feedlot size and feedlot operator selection of a cash pricing system for fed cattle may be needed.

Our empirical results demonstrate that average pricing, with estimation error, favors producers who sell below-average pens of cattle and penalizes owners of above-average pens of cattle. While our results are tied to a specific market day, the implications of the results suggest that risk aversion and producer bias toward VBM are potential long-run barriers to producer acceptance of the VBM concept. If our supposition is correct, then average pricing will continue to dominate the cash market. If average pricing continues to dominate the cash market, then the supply response predicted by supporters of VBM, through changing genetics and management strategies, will not be industry wide. This possibility needs to be considered by supporters of VBM.

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NOTES

1. For a discussion of the lifestyles issue see Chavas (1989), Wohlgenant (1989), and Purcell (1998). For a discussion of the relative-prices issue see Huang and Haidacher (1989), and Purcell (1998).
2. For a discussion of the informational problems associated with selling slaughter cattle at an average price per pen, see Feuz et al. (1993, 1995), Cross and Savell (1994).
3. For additional discussion of these issues see Schroeder et al. (1997).
4. The USDA's Agricultural Marketing Service provides a weekly grid price report based on the AMS weekly packer survey of grid premiums and discounts. The price report clearly shows that the range for carcass discounts exceeds the range for carcass premiums.
5. In a recent paper, Feuz (1998) showed that revenue variability is affected by the specific VBMS selected for marketing and the time period when cattle are sold.
6. Dressed weight purchases are on a per pen basis. Buyers bid an average price per cwt. based on actual hot-carcass-weight (HCW) and estimated average yield and quality grade for the pen.
7. Adjusted R^2 for the live weight profit regression equation was .93. The coefficient of separate determination for average daily gain in the live weight profit model was .486, days on feed was .309, dressing percentage was -.0034, and quality grade was only .0068. Adjusted R^2 for the dressed weight & grade profit regression equation was .94. The coefficient of separate determination for quality grade in the dressed weight & grade profit model was .334, dressing percentage was .1937, days on feed was .120, and average daily gain was .264.
8. For an in-depth discussion of the USDA grading system and how it relates to determining the value of finished cattle see Thonney (1990).
9. At the present time, grid pricing arrangements are being offered to slaughter cattle suppliers by several major packers. We know of at least 25 grid pricing systems being used in the beef packing industry Feuz (1998). The common link between these systems is the addition of premiums

and a disaggregation of the discounts as compared to the dressed weight & grade system. However, there is no industry standard in place at this time.

10. USDA-AMS grid pricing system is reported weekly. The pricing data presented in table 1 were collected from the April 14, 1997, report, *National Carcass Premiums and Discounts for Slaughter Steers and Heifers*. 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.
11. The average HCW price reflects the weighted average of carcasses grading choice and select in the region. To calculate the value of a dressed carcass grading choice, the influence of the select discount must be adjusted for.
12. A 1996 PSA study, *Concentration in the Red Meat Packing Industry*, reported that when packers purchase cattle dressed weight or on a formula basis, the cost per hundred wieght deckubes 18 cents and 25 cents respectively as comnpared to live weight purchases (page 19). These reported results are consistent with the price differential results reported in the price discovery literature.
13. The SDSU 1996 Beef Report has not been published.
14. Discounts were applied to 134 animals which either quality graded standard (80) or yield graded 4 or 5 (54).
15. The Nebraska HCW price is the regional average HCW price for the week ending April 12, 1997, as reported by the AMS.
16. A parametric test is not appropriate because the distribution of the differences was not normal. The SAS Univariate Procedure estimated the higher moments of the distribution and generated estimates of skewness = 1.75 and kurtosis = 6.67. The second and third moments for a normal distribution under the univariate procedure are zero. The null hypothesis that the distribution is normal was rejected with a p-value less than 1%. A nonparametric test, Wilcoxon Signed Rank Test, was used to test the null hypothesis that the mean revenue of the two pricing systems are equal. The null hypothesis was rejected with a p-value of less then 1%. The test indicated that the mean revenue was higher under the dressed weight system by $2.41.
17. The Equality of Variances test requires the distributions of gird revenue and dressed weight revenue to follow a normal distribution. The estimates for skewness and kurtosis were (.02, .43) and (.25, -.08) for gird revenue and dressed weight revenue variables, respectively. These estimates indicate the two distributions are approximately normal and the test rejected the null hypothesis that the distributions were equal. The probability value of the test was .001.
18. The non parametric match pairs hypothesis test (again higher moments indicated that the distribution of differences was non normal) indicates that there is statistically significant evidence to suggest that the average revenue per head for this pen of above-average cattle is higher under the grid pricing system relative to the dressed weight pricing system. The p-value of the test was .001. The equality of variance test (again higher moments indicated that the distributions of the two pricing systems was normal) indicated that there is statistically significant evidence to suggest that the distribution of revenue per head is greater under the grid pricing system relative to dressed weight pricing system for this pen of cattle. The p-value of the test was .007.
19. The non parametric match pairs hypothesis test (again higher moments indicated that the distribution of differences was non normal) indicates that there is statistically significant evidence to suggest that the average revenue per head for this pen of below-average cattle is lower under the grid pricing system relative to the dressed weight pricing system. The p-value of the test was .025. The equality of variance test (again higher moments indicated that the distributions of the two pricing systems was normal) indicated that there is statistically significant evidence to suggest that the distribution of revenue per head is greater under the grid pricing system relative to dressed weight pricing system for this pen of cattle. The p-value of the test was .055.

20. For the week of April 12: 1) the Nebraska HCW price per cwt was $108.55, 2) the choice/select price spread was $5.30; and 3) 49.1% of the region's cattle graded choice or higher. Therefore, estimated HCW price/cwt for choice cattle would be $111.24 and for select cattle $105.94. The HCW price for the above and below average lots is a weighted average based on the choice/select mix.
21. In order to switch from dressed weight pricing to grid pricing, a risk averse producer would require the coefficient of variation to be lower under the grid pricing system relative to the dressed weight pricing system to compensate for increased revenue variability. The empirical analysis indicates the opposite case is true: The coefficient of variation is slightly lower for dressed weight.

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