Formula Pricing and Grid Pricing Fed Cattle: Implications for Price Discovery and Variability

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Contents

Executive Summary

Grid pricing and formula pricing have become common ways to price fed cattle. Grid pricing does not necessarily have to be formula pricing and formula pricing does not necessarily involve grid pricing. Further, the market implications of grid pricing are quite different from those of formula pricing.

When formula pricing is used with grid pricing, a formula is used to establish a base price in the premium-discount grid. Formula prices that are based on plant averages and/or other cash market live cattle trade can adversely effect price discovery unless they are tied to the wholesale beef market or futures market.

Grid pricing sends clearer price signals from the wholesale beef to fed cattle level. This improves beef market coordination relative to pricing on a live or dressed weight basis. However, plant average (formula) base prices used in grids often send incorrect or, at best, mixed price signals because they do not necessarily change in consistent ways with current market conditions. From a price discovery perspective, negotiated base prices are preferred to using plant averages or cash market live cattle prices.

Base prices used in grid pricing systems vary and methods used to calculate net price received using grids also vary. Therefore, producers must know how base prices and how grid prices are calculated.

Receiving the highest price from a grid may not imply the highest revenue or highest profit. Prices alone do not reflect the impact on revenue of varying cattle weights. Revenues alone do not reflect costs of feeding animals shorter or longer periods.

Some premiums and discounts in grids vary considerably over time, while others have remained stable. Greatest variation has occurred with the Choice-Select price spread, discounts for heavy or light carcasses, and "out" or non-conforming carcasses. Premiums for Prime and Yield Grade 1 and 2 carcasses have been relatively constant over the past two years. This indicates which market factors producers may want to closely monitor as they develop production and management practices that target cattle to value-based marketing alternatives.

Understanding cattle quality and targeting individual carcasses toward the pricing method (either live weight, dressed weight, or grid system) offering the highest revenue can result in significant increases in overall revenue. The value of this increased information and related management practices was estimated to be as much as $35/head.

With grid pricing, producers need to recognize that the penalty (discounts) for a few lower quality animals can more than offset the reward (premiums) from a number of higher quality animals. Cattle producers must know the quality of cattle marketed using grids or they may be disappointed in the final price.

"Average" live weight or dressed weight prices fail to recognize value differences of individual animals. The estimated pricing error, or the amount higher quality cattle subsidize lower quality cattle, was estimated to be $30/head or more.

Alternative grids and formulas may value the same animal quite differently. A grid that is targeting a hotel/restaurant market will have a different premium and discount structure than one that is targeting a Select grade retail outlet.

Grid prices vary significantly more than live weight or dressed weight prices. Sources of variation include the base price used, the premium-discount grid, the plant where slaughtered (if using plant average base prices or plant-adjusted premium-discount grids), the time when priced, and cattle quality.

Price variation may be twice as much for grid pricing as with "average" live or dressed weight pricing. Research found grid pricing frequently varied by $2-6/dressed cwt or about $15-45/head. Revenue variation with grid pricing also increased.

Cattle producers can target cattle to specific grids and receive higher prices. However, this short-run gain may not be consistent with the long-run goal of value-based marketing, i.e., changing the mix of cattle fed and marketed to better match consumer demands. Producers need to strive to completely eliminate lower quality cattle (those most severely discounted) from the total mix of cattle produced.

Formula Pricing and Grid Pricing Fed Cattle:
Implications for Price Discovery and Variability

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The formation of marketing agreements between large cattle feeders and the largest meatpackers in the late 1980s created considerable interest in formula pricing and grid pricing of fed cattle. Since that time, numerous formula and grid pricing arrangements and marketing agreements have been used to market fed cattle. Increasingly, grid pricing, with or without a formula pricing component, has become popular for cattle feeders trying to secure higher prices for better quality fed cattle.

The main body of this report describes formula and grid pricing and addresses a number of questions and issues which have been raised regarding these pricing arrangements for fed cattle. Sections A, B, and C contain reports of research on related aspects of grid pricing conducted at Kansas State University, the University of Nebraska, and Oklahoma State University, respectively.

Formula Pricing and Grid Pricing

Formula pricing refers to establishing a transaction price using a formula that includes some other price as a reference. As such, formula prices are not discovered for each transaction. Rather, some other price is used, a price discovered external to the particular formula priced transaction.

Grid pricing consists of a base price with specified premiums and discounts for carcasses above and below a base or standard set of quality specifications. Grid pricing involves a formula for establishing the base price. Interviews with feeders and packers revealed several base pricing methods being used (Schroeder *et al.*):

- Average price (cost) of cattle purchased by the plant where the fed cattle were scheduled to be slaughtered for the week prior to or the week of slaughter
- Specific market reports, such as the highest reported price for a specific geographic market for the week prior to or week of slaughter
- Boxed beef cutout value
- Futures market price
- Negotiated price.

Of these methods, all involve formula pricing except where base prices are established by negotiation. Thus, grid pricing is not necessarily synonymous with formula pricing. Formulas have one thing in common: All are based on some external price and therefore require a minimal amount of market information to establish prices across transactions under the same formula. However, important differences exist among the formulas. These differences include the source of the external price (e.g., plant averages vs. USDA quoted prices) and the market level of the external price (e.g., live or carcass weight cash market, futures market, or wholesale beef market). These differences lead to important implications regarding the formula pricing method and impacts on other markets.

The final transaction price with most grid pricing methods is established after animals have been slaughtered. Most grids are based on dressed weights (used interchangeably here with carcass weights) for fed cattle. The intent is to assign higher prices to higher quality cattle and lower prices to lower quality cattle. Both feeders and packers indicated that premiums and discounts present in grids also varied (Schroeder *et al.*). Some were based on:

- Plant averages
- Wholesale price/value spreads
- Negotiated values.

Grid premiums and discounts that are based on plant averages are related to the quality of cattle being delivered to a specific plant. In contrast, those based on wholesale price spreads reflect wholesale supply and demand conditions for boxed beef.

In summary, formula pricing is not necessarily grid pricing, and grid pricing does not necessarily involve formula pricing. Most formula pricing in recent years refers to the method of finding the base price in grid pricing systems. Formula pricing relies on a price discovered in transactions external to the ones involving the formula. The base price in grid pricing may be established by a formula but may also be negotiated between feeders and packers. Grid pricing attempts to better match price with quality, rewarding producers for marketing higher quality carcasses and penalizing them for marketing lower quality carcasses.

Grid Pricing Example

Individual packers develop their own grids. The format in which they are presented may vary but Table 1 contains an example grid. It is *not* the grid for any specific packer but it is representative of typical grids. The premiums and discounts in Table 1 can be put into a matrix format (Table 2). The term "grid" comes from the matrix framework of premiums and discounts for specified carcass characteristics in Table 2. Quality grade and yield grade premiums and discounts compared with the base price are shown in the Choice row and Yield Grade 3 column of Table 2. To complete the matrix in Table 2, we assume quality grade and yield grade premiums and discounts are additive. For example, the premium for a Prime grade, Yield Grade 1 carcass based on premiums and discounts in Tables 1 and 2 is $11/cwt. That amount is the sum of the $6/cwt premium for Prime grade carcasses plus the $5/cwt premium for Yield Grade 1 carcasses.

Packer grids may identify additional premiums for carcasses meeting specifications of Certified Angus Beef (CAB) or other marketing programs. Likewise, packers may specify discounts for hide damage, injection site blemishes, condemnations and other "out" or unmarketable carcasses (in addition to discounts for dark cutters and light or heavy carcasses shown in the sample grid).

To compute a grid-based price, the distribution of carcasses by quality grades and yield grades from a sale lot of fed cattle must be known. That distribution also is put into a matrix framework. The hypothetical distribution of carcasses for a 100-head sale lot of steers is shown in Table 3. Our hypothetical pen is a mix of exceptionally high quality carcasses (80 percent Choice and Prime quality grade) and lower quality carcasses (20 percent Yield Grades 4 and 5).

Table 1. Example Grid, as Presented by a Packer ($/dressed cwt)

Choice YG3 600-900 lb	Base Price ($/dressed cwt)
Prime-Choice Price Spread	6.00
Choice-Select Price Spread	-6.00
Select-Standard Price Spread	-10.00
Dark cutters	-20.00
Light Carcasses (<600 lb)	-10.00
Heavy Carcasses (>900 lb)	-20.00
Yield Grade 1	5.00
Yield Grade 2	3.00
Yield Grade 4	-20.00
Yield Grade 5	-25.00

Table 2. Example Grid in a Matrix Format

	Yield Grade				
Quality Grade	1	2	3	4	5
	$/dressed cwt)				
Prime			6.00		
Choice			BASE		
Select	5.00	3.00	-6.00	-20.00	-25.00
Standard			-16.00		
Dark Cutters		-20.00			
Light Carcasses (<600 lb)		-10.00			
Heavy Carcasses (>900 lb)		-20.00			

Table 3. Example Distribution of Carcasses by Quality and Yield Grades (100 Head Total)

	Yield Grade					
Quality Grade	1	2	3	4	5	Sum
Prime	1	2	3	4	5	15
Choice	3	15	40	5	2	65
Select	4	3	2	1	1	11
Standard	3	2	2	1	1	9
Sum	11	22	47	11	9	100

The grid price can be computed in one of two ways, both resulting in the same weighted average price for the sale lot, assuming quality grade and yield grade premiums and discounts are additive in Table 2. For the example here, a base price of $110/dressed cwt is assumed for Choice quality grade, Yield Grade 3 carcasses and the weighted-average price is $105.56/cwt. This assumes no discounts for extremely light or heavy carcasses and no "out" carcasses, i.e., those not conforming to packer specifications. Out carcasses may include dark cutters, heiferettes, and dairy breeds, among others.

In some cases, packers may return information (kill sheets) on a per-animal basis. Thus, the number of carcasses and weight in *each* cell of the matrix in Table 3 is known. In other cases, packers may only provide pen-level summaries, or just the totals for rows and columns in Table 3. If premiums and discounts are additive, either method will result in the same weighted-average price for the sale lot.

In practice, premiums and discounts in packer grids are not always additive. The term additive means that the price for a particular carcass is the base price plus any quality grade premium (discount) *plus* any yield grade premium (discount) assigned to that carcass. However, some packers pay the same price for all Standard quality grade cattle regardless of the yield grade. Others have fixed discounts for dark cutters regardless of yield or quality grades. As a result, cattle feeders considering grid pricing need to understand the intricacies of the grid premiums and discounts and understand which are and are not purely additive.

The base price assumed in the above example was a dressed weight price. Essentially, it is a boxed beef price per head plus byproducts value and less slaughtering-fabricating costs. However, the base price can be a formula tied to a plant average price or packer cost of cattle. Assume we have two packing plants, each using a plant average base price in their formula price bids. Both may use the same dressed weight cash price and the same Choice-Select price spread (Table 4). Assume the plant average base price is calculated on the basis of last week's slaughter results. Carcasses in Plant A last week averaged 60 percent Choice grade, which was better than carcasses in Plant B that averaged 40 percent Choice.

Table 4. Plant Average Grid Price Example ($/dressed cwt)

	Plant A	Plant B
Dressed weight cash price	$110.00	$110.00
Choice-Select price spread	$6.00	$6.00
Plant average percent Choice	60%	40%
Plant average percent Select	40%	60%
STEP 1: Compute the Choice-Select Price Spread Effect (Choice-Select price spread x plant average percent Select)	$2.40	$3.60
STEP 2: Add the Choice-Select Price-Spread Effect (Dressed weight cash price + Choice-Select price spread effect) Base Price	$112.40	$113.60

The Choice-Select price spread effect is greater for Plant B than Plant A because the quality of carcasses on average was lower for Plant B. Other adjustments may be made, such as for Prime or CAB carcasses, Yield Grade 1-2 or 4-5 carcasses, heavier or lighter weight carcasses, etc. Note that in this example, the plant which had the lower quality cattle the preceding week pays the highest base price. The higher base price is an incentive to ship higher quality cattle to Plant B, in order to bring its plant average up to or above its competitor's plant. If cattle feeders know how their cattle will grade on average, *and* know the plant averages, they can choose which plant will pay the highest base price. They have an incentive to market cattle that are better than the plant average to the plant with the lowest plant average for the week to which the base price is tied. That plant can pay the highest plant average base price.

A disadvantage of base prices tied to plant averages is that the "true value" of a pen of cattle is relative to the plant average, rather than strictly on the quality of the pen itself. In addition, from a market efficiency point of view, mixed price signals are sent to producers. This creates an inefficiency in the market place and can impede the efforts of the beef industry to improve the quality and consistency of their product.

Motivation and Extent of Grid Pricing

One driving force behind the move toward grid pricing is the beef industry's interest in moving toward a value-based marketing or pricing system. With value-based marketing, pricing efficiency should be improved. Clearer economic signals should be transmitted through market prices from retail to cow-calf producer. When consumer preferences are transmitted more clearly and correctly to producers, those producers can respond accordingly. Research reported in Sections A and B confirm that grid pricing improves price signal transmission from the wholesale beef market to cattle feeders.

Value-based marketing is intended to reward producers of high quality beef products and penalize producers of lower quality beef products. Thus, pricing accuracy is also enhanced. Price and quality are matched more correctly. Grid pricing typically enables cattle feeders and sometimes cow-calf producers to receive carcass data on cattle marketed for slaughter. Knowing how cattle perform in the packing plant, i.e., the quality of cattle in carcass or product form, is vital information in making management decisions such as breeding, feeding, or animal health changes. Knowing the quality of cattle marketed may enable cattle producers to target their cattle to specific consumer market segments. Results of research discussed in Section A provide an estimate of the value of such information.

For years, head buyers at meatpacking firms have developed a daily buy order which is given to their field buyers. Their order resembles the sample grid in Table 1. Most packers paid only small premiums for higher quality cattle and imposed larger discounts for lower quality cattle, based on visual appraisal of live animals. Premium-discount grids used in recent years differ from previous years in that premiums for higher quality cattle are frequently larger than in earlier years in part because the carcass quality is determined in the plant and not estimated based on visual estimation of the live animals. Some argue that premiums are not large enough relative to the costs associated with producing cattle of a particular quality. While the point can be debated, premiums can be as much as $70/head relative to base prices for the highest qualities of cattle.

Discounts for lower quality cattle are typically larger than premiums for higher quality cattle. Discounts can reach $200/head. Again, some argue this is excessive. However, a beef merchandiser who has been given the task of marketing the lowest quality beef realizes the necessity of sizeable discounts. Large discounts reflect lower wholesale meat values and large discounts are needed to send clear signals to producers to help eliminate lower quality beef products in order to provide consumers with more satisfying eating experiences. Finally, sizes of premiums and discounts is really an argument in semantics. By simply changing the location of the base price in the grid (e.g., instead of the base being a Choice, Yield Grade 3 carcass, make it a Standard, Yield Grade 5 carcass) all discounts can quickly be converted to premiums (and some will be quite large). The point is, the grid premiums and discounts reflect wholesale value differences and the location (quality and yield grade) of the base price is arbitrary.

The extent of grid pricing is not known with certainty. A rough estimate of the maximum extent is 20 percent of steer and heifer slaughter. U.S. Department of Agriculture reports of packer feeding and forward contracts/marketing agreements for 1997 were 19.8 percent for the four largest packers (Grain Inspection, Packers and Stockyards Administration). Of that, 3.8 percent was packer feeding. The remaining 16.0 percent was forward contracting and marketing agreements. Forward contracting is believed to have declined somewhat, so that most of the 19.1 percent was marketing agreements. Nearly all marketing agreements and strategic alliances use some type of formula pricing and/or grid pricing method and the extent of marketing fed cattle through alliances is believed to have increased. Thus, the estimate of perhaps 20 percent of steer and heifer slaughter being accounted for by grid pricing.

Grid pricing is believed to be higher in some regions than others, in part because dressed weight pricing is more common in some regions than others. Grain Inspection, Packers and Stockyards Administration reported for 1996 that dressed weight pricing in the south central region was 7.8 percent of steer and heifer slaughter, but was 51.2 percent in the west north central region and 66.7 percent in the mountain region.

Matching Cattle to a Grid

Several questions will be addressed in this section: Do cattle producers sufficiently understand grid and formula pricing to be able to use this pricing method? Do cattle producers know their cattle quality sufficiently to target specific grids? Can producers alter feeding and marketing practices so that the cattle "fit the grid"? If each of these questions can be answered in the affirmative, then grid or formula pricing can likely benefit individual producers. However, if the answer to any of these questions is no, then there is probably an increase in market risk when selling on grid, and profits may be reduced as well.

Grid pricing is similar to "grade and yield" pricing with slightly greater price differentiation. Producers generally understand this pricing method. However, the added complexity of grid selling in many cases is associated with the plant-adjusted base prices. These plant-adjusted base prices were previously discussed but are mentioned again here to illustrate how they increase uncertainty to producers. It is straight forward to compare the difference in premiums and discounts from two grids. Producers can estimate the carcass characteristics of a pen of cattle and determine which grid would result in the highest net price. However, if the base price is adjusted for a different plant average, with a slightly different formula, for each of the grids it then becomes more difficult to determine which grid will result in the highest net price. Not only do producers need to be able to estimate the carcass characteristic of the pen of cattle, but they also must know how the cattle will compare to all cattle being killed at a particular plant. In some instances, it is more profitable to deliver high quality cattle to a plant on a grid which does not pay for large premiums for high quality than to deliver the cattle to a plant on a grid that offers substantial quality premiums. This anomaly results because the cattle may be better than the plant average quality for the plant not paying large quality premiums, but may be below the plant average

quality at the plant offering substantial quality premiums. This method of establishing the base price confuses the price signaling function of market prices and inhibits effective pricing accuracy and efficiency.

Perhaps a greater challenge to producers than understanding grids and base prices is knowing accurately the carcass characteristics of the pens of cattle they are selling. Understanding grid premiums, discounts, and base prices is of limited value if the carcass characteristics of the cattle are unknown. Just how much variability is there between pens of cattle? There are differences in carcass weight, dressing percent, yield grade and quality grade across the pens, all factors that are important when selling on a grid. Sections A, B, and C each confirm that substantial variation exists with grid pricing. Sources and extent of the variation are discussed in each section.

How much of this variability is known before the hide is taken off cattle? Feedlot managers and meat packers generally feel they can estimate carcass weight and yield grade with greater accuracy than quality grade. Furthermore, the ability to estimate quality grade on a specific pen increases if the quality grade on other pens from the same feedlot is known and if the feedlot has fed calves from the same herd before.

Carcass information is valuable to feedlot producers, as discussed further in Section A. Many feedlot managers who are selling cattle on a grid have not only modified their cattle marketing practices but also have changed cattle procurement and feeding practices. Initially, many of their pens of cattle may not have "fit" the grid and received severe discounts. However, these feedlot managers have been able to alter feeding practices to get more pens to "fit" the grid and/or stop buying feeder cattle that don't "fit" the grid.

Matching a given set of cattle to a specific grid is important from a short-run perspective and affects price (see Section C). However, true value-based marketing can only be achieved when the number of cattle severely discounted by consumers and wholesale markets are reduced or eliminated from the mix of cattle produced and brought to slaughter. Thus, carcass information must be used by producers and feedlot managers in changing cowherd genetics, purchases of feeder cattle, and feeding practices.

From Tables 1 and 2 it is apparent that the largest discounts are associated with carcasses that are Yield Grades 4 or 5, quality grade Standard, too light or too heavy, or "out" cattle. This is true for almost all grids. Feedlot managers can change feeding and sorting practices to eliminate almost all of the Yield Grade 4 and 5, light, and heavy carcasses. Cattle from a particular source that fail to grade Select or Choice are simply not purchased again. In some cases, cattle handling facilities and practices can be changed to reduce the incidence of dark cutters or cattle bruising. By eliminating, or greatly reducing, these major price discounts, there is a much greater probability the cattle will receive a price premium from selling on a grid. Does a higher price imply greater profit?

Maximizing Price vs. Profit

Cattle have a natural end point to which it is most economical to feed them. This end point will vary by frame size, breed, genetics within a breed, and market prices. For example, one pen of cattle may finish with an average 850-pound, Select, Yield Grade 2 carcass and another pen may finish with an average 700-pound, upper Choice, Yield Grade 3B carcass. With the first pen, a grid that pays a premium for Yield Grades 1 and 2, has no or very little discount on Select carcasses, and does not penalize heavy weight carcasses will be most advantageous. For the second pen, a grid that pays a large premium for upper 2/3 Choice and Prime, does not discount Yield Grade 3B carcasses and has a relative small discount on Yield Grade 4 carcasses will be most advantageous. However, as noted in the previous section, the base price calculations for each grid could alter how profitable it is to sell on that grid.

If cattle are not naturally lean, can they be fed and managed to fit a grid that rewards leanness? If cattle do not naturally grade Choice or higher, can they be fed and managed to fit a grid that rewards high marbling cattle? In answering the two questions, it is necessary to distinguish between maximizing the price received, the revenue received, and the profit earned for a pen of cattle. Receiving the highest price does not imply the greatest revenue, nor does the greatest revenue imply the largest profit. Revenue is equal to price multiplied by weight, and profit is equal to revenue minus costs of feeding and feeder cattle. To maximize profit on a pen of cattle, selling weight and feeding costs need to be considered, in addition to selling price.

Consider a pen of cattle that if fed for the normal number of days on feed would finish with the majority of the carcasses being Yield Grade 3 and about 60 to 65 percent Choice or higher. If these cattle were fed for fewer days and marketed on a grid that rewards Yield Grade 1 and 2 carcasses, what would be the likely result? There would most likely be more Yield Grade 1 and 2 carcasses, the cattle should still grade 55 to 60 percent Choice, and it is likely that the net grid price would be higher than the cash market price. The grid apparently worked; the cattle were sold at a higher price. But what about revenue and profit? Feeding for fewer days would result in selling lighter weight carcasses. Revenue is equal to price multiplied by weight. Two weeks fewer days on feed would probably reduce carcass weight by 25 to 35 pounds. If the carcass price is $100 /cwt, that is a reduction in revenue of $25 to $35 per head. If the net grid price was $1 to $2/cwt higher than the cash price, and the average carcass weight was 750 pounds, that is an increase in revenue of $7.50 to $15/head. Revenue could have decreased by $10 to $27.50/head. Depending upon feed prices and consumption, feeding costs would likely decline by $20 to $30/head. Therefore, profit could have been reduced by as much as $7.50/head or increased as much as $20/head in this example. The point of this example is that producers need to consider more than price when changing the feeding program to fit a grid. It should be noted that the higher the carcass market price, the more critical the carcass weight becomes.

A similar analysis needs to be done if a producer is considering feeding cattle longer than normal to improve quality grade for a grid. Normally, the quality grade may not increase that much, there will be a larger number of Yield Grade 4 carcasses and fewer Yield Grade 1 and 2 carcass, there may be some heavy weight carcass, and feeding costs will definitely increase. All of these factors need to be considered to determine whether profit has increased or decreased.

Benefits of Grid Pricing

Increased movement toward value-based, individual carcass merit pricing, is essential if the beef industry is going to send proper economic signals to producers. One of the greatest impediments to value-based pricing of fed cattle has been reluctance of both cattle feeders and beef packers to change from a live animal pricing system to a carcass merit pricing system. In interviews with both beef packers and cattle feeding operations in 1996, Schroeder *et al.* found general agreement that pricing fed cattle on averages was detrimental to the industry because it sent inappropriate price signals to cattle feeders, stockers, and, ultimately, cow-calf producers. Use of grid pricing is the only way cattle producers will be adequately rewarded for producing high quality beef and properly discounted for producing low quality beef.

The results in Sections A, B, and C show that price variability increases significantly with grid pricing. However, an increase in price variability is essential if the industry expects to improve pricing accuracy and send the correct economic signals from the wholesale level to producers.

Enhanced opportunities to profit from better matching fed cattle prices to value have encouraged packers, alliances, and producers to increase use of carcass merit-based pricing. Table 5 contains a

summary and comparison of issues associated with typical fed cattle pricing arrangements. Differences across the various methods of fed cattle trade are important because price will likely differ across the various pricing methods even for the same pen of cattle. Prices for the same pen of cattle may differ because different kinds of information are used in the various pricing methods to arrive at a price. The key element is that as a producer moves from live weight pricing, to dressed weight pricing, to grid pricing, it is increasingly important to understand the type of cattle being marketed, the pricing system being used, and to assess net price received.

Grid Pricing Issues

Despite the significant market enhancing benefits grid pricing can offer in terms of improving beef market coordination and information flows, current popular grid pricing methods also have issues worth considering. First, premiums and discounts associated with various carcass traits vary across packers at any point in time. Premium-discount grids are reported weekly by the Agricultural Marketing Service, U.S. Department of Agriculture (AMS-USDA) in its *National Carcass Premiums and Discounts for Slaughter Steers and Heifers* report. In the six-packer survey of grid prices for the week of December 7, 1998, the range in premiums for Prime quality grade carcasses was from $3/cwt to $10/cwt for Choice grade carcasses. Select grade carcass discounts typically closely follow USDA wholesale Choice to Select boxed beef price spreads. Nonetheless, Select grade carcasses had discounts ranging from $7.02/cwt to $8.50/cwt across packers relative to Choice base prices. Standard grade carcass discounts relative to Choice ranged from $10/cwt to $22/cwt, premiums for Yield Grade 1-2 relative to 3 ranged from $0/cwt to $3/cwt, and discounts for heavy-weight carcasses (greater than 950 lb) ranged from $10/cwt to $30/cwt.

Table 5. Assessing Ways to Sell Fed Cattle

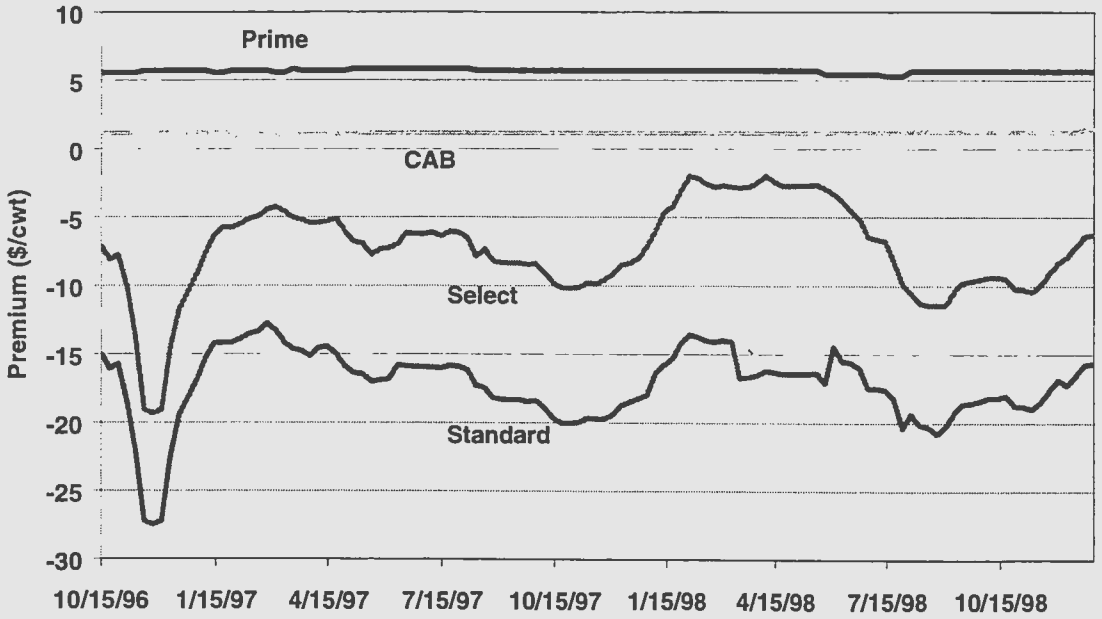
	Fed Cattle Pricing Method		
Pricing Attribute	Live	Dressed	Grid
Value Based	no	no	yes
Pricing Level	pen	pen	individual carcass quality and yield
Quality Premiums/Discounts	minimal	minimal	yes
Yield Premiums/Discounts	minimal	minimal	yes
Price Range Across Carcasses	none	none	high
Trucking Costs Paid by	buyer	seller	seller
Base Price	live	dressed	formula or negotiated
Carcass Performance Risk Burden	buyer	buyer	seller

Why these and other traits have such wide ranges in premiums and discounts across packer grids is not known with certainly. The differences are likely related to the kinds of market opportunities different packers have for merchandising beef of varied quality, as well as to the handling/sorting/ processing cost differences that may be present for carcasses having varied attributes across different plants or firms. The important point regarding this variability is that a producer needs to compare several grids for the type of cattle the producer has in order to determine which grid offers the highest expected price without undue risk for large discounts. Of course, as discussed earlier, varying base prices should also be considered when a producer assesses various grid price alternatives. As noted in Section C, grid price variation can be attributed to base prices, premium-discount grids, slaughter plants, and cattle attributes.

Another issue cattle producers should consider with grid pricing is which premiums and discounts vary over time and which tend to be more stable. This is important because if a producer makes production decisions targeting particular grid price signals, how likely are they to realize premiums close to the ones present when the production decision was made (be it breeding herd, feeder calf purchase, yearling purchase, or feeding decisions)? Longer run genetic, feeder cattle purchasing, and feeding management decisions toward value-based systems are necessary but are difficult if the "target" continues moving. Therefore, stability of the marketing target is important.

Figures 1-4 illustrate trends in average USDA reported grid premiums and discounts for various carcass attributes over the last two years (the only time period for which such data are available). Quality grade premiums and discounts are all quoted relative to Choice. Average premiums for Prime and Certified Angus Beef have been stable over the time period whereas discounts for Select and Standard quality beef vary considerably (Figure 1). The average discount for Select carcasses relative to Choice closely matches the USDA Choice-to-Select price spread for wholesale boxed beef on a weekly basis. Standard discounts are typically $8/cwt to $13/cwt relative to Choice baseline prices.

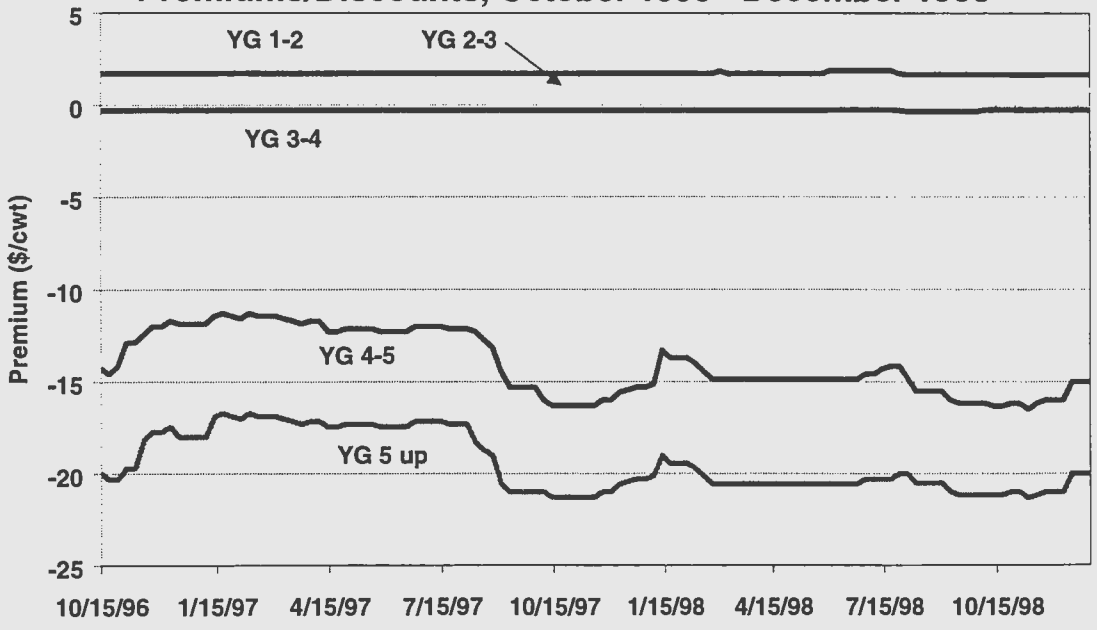
Figure 1. USDA Packer Survey Quality Grade Grid Premiums/Discounts, October 1996-December 1998



Source: USDA

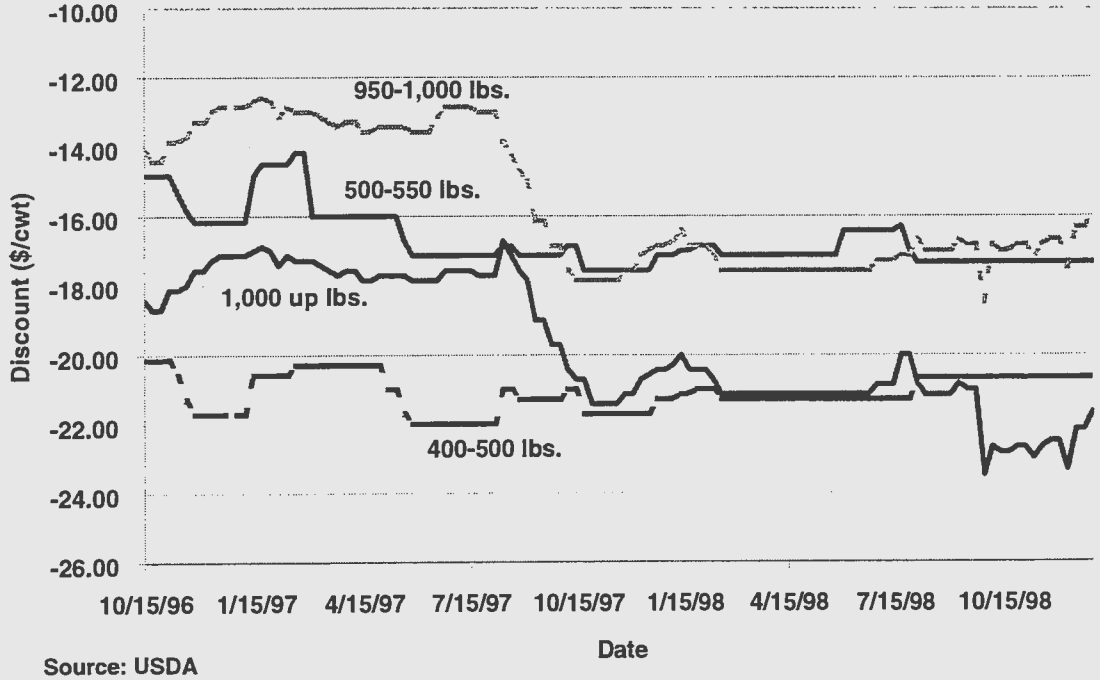
Yield grade premiums and discounts are illustrated in Figure 2. Yield Grade 1 and 2 carcasses have had relatively stable premiums compared with Yield Grade 4 and 5 carcasses whose discounts have varied over time by as much as $5/cwt. Price discounts for heavy or light carcasses (Figure 3) and dark cutters and other "out" carcasses (Figure 4) vary considerably over time.

Figure 2. USDA Packer Survey Yield Grade Grid Premiums/Discounts, October 1996 - December 1998



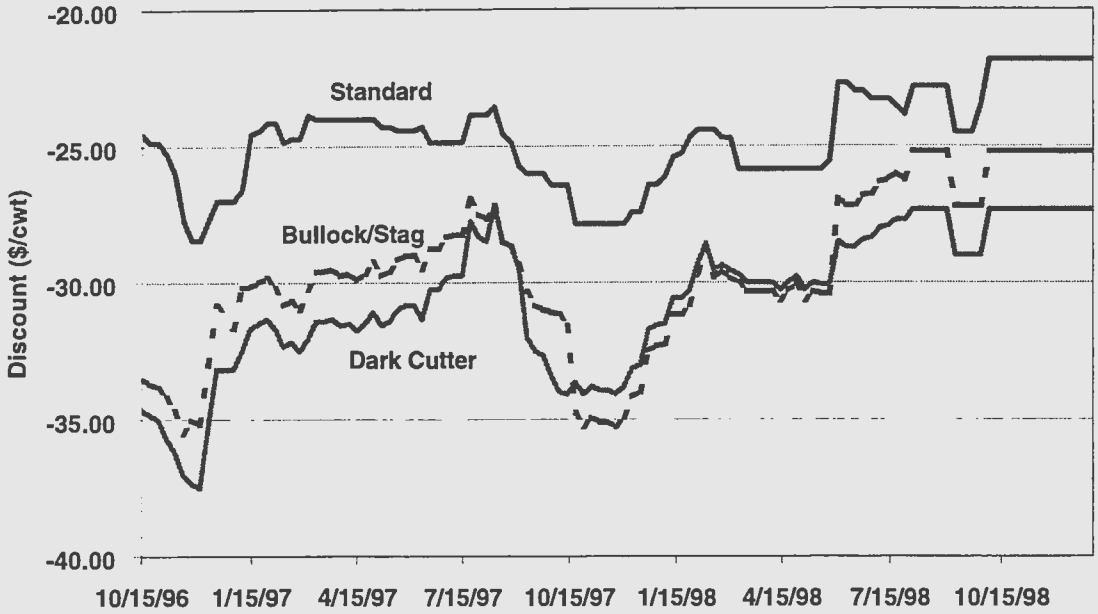
Source: USDA

Figure 3. USDA Packer Survey Weight Discounts, October 1996 - December 1998



Source: USDA

Figure 4. USDA Packer Survey "Out" Carcass Grid Premiums/Discounts, October 1996 - December 1998



Source: USDA

Management of cattle can help deal with some of the variability associated with selected grid premiums and discounts. For example, close sorting of cattle can reduce heavy- and light-weight discount incidence and, to some extent, careful handling may help to reduce incidence of dark cutters. Perhaps adoption of ultrasound or other imaging technology at the feedlot can improve management of yield grades by helping signal when to market cattle to reduce the incidence of Yield Grade 4s and 5s. Longer run genetic management may help target higher quality grades of beef, thus reducing risk associated with varying Select and Standard discounts.

The final, but perhaps most significant concern regarding grid pricing, is determination of the base price. As noted earlier, base prices have numerous sources of determination across different grid pricing systems and packers. Base prices that are formula prices using either plant averages or live price quotes raise serious concerns. First, base prices that are a function of plant averages, as described earlier, vary over time due purely to the types of cattle processed by the plant during the time period, which is not necessarily consistent with market trends.

In addition, base prices based upon either live or dressed weight, plant or cash market prices, use a base that likely does not represent the type of cattle being marketed under the grid. The type of cattle typically being marketed under a grid would be expected to be higher quality cattle targeted towards meeting grid premiums and avoiding discounts. Market- or plant-average cattle may not be the same quality and their average quality may even decline as grid-priced, high-quality cattle are removed from the cash market. Thus, the base price likely even declines (relative to previously) as increased numbers of higher quality cattle are diverted away from the base market to grids. Also, reference prices in formula base prices can become thinly traded or thinly reported, making them less reliable as an accurate reflection of market conditions. For these reasons, base prices that are formula priced using plant averages or other cash market trade are potentially problematic for the producer involved in grid pricing and are detrimental to overall price discovery.

Problems with base price discovery, however, do not eliminate the potential benefits associated with grid pricing. Base price problems are manageable. Base prices do not need to be private, formula agreements. They can be negotiated, market reported prices like other carcass weight (in the beef) transaction prices for fed cattle. Negotiated base prices are relatively expensive to discover in terms of information needed by the parties involved, but they do not rely on unrepresentative prices such as plant averages. In addition, negotiated base prices would contribute to market information and subsequent price discovery.

If formula pricing is to be used to establish the base price in grid pricing, reference prices discovered in competitive markets is essential. One alternative is to tie the base price to the reported wholesale boxed beef cutout or to reported boxed beef prices. Packers have an incentive to increase wholesale prices as much as possible, so as to increase packer revenues. Thus, the base price is tied to a price which packers have an economic incentive to raise, rather than to cash market or plant average prices which packers have an economic incentive to lower. Another possibility is tying the base price to a futures market price, an alternative market for price discovery. Either of these alternatives is subject to fewer problems than those discussed for base prices that are formulas tied to plant averages for example. These formulas are not as susceptible to thin trading or of moving randomly in ways not reflective of market conditions. Formula prices have advantages that include keeping costs of price discovery low for the parties involved. From this perspective, formulas based on wholesale boxed beef cutout or live cattle futures prices are both low cost to negotiate and yet are representative of market conditions.

Summary of Formula and Grid Pricing Issues

Grid pricing methods have become more common in recent years. Grid pricing has the advantage of pricing each animal separately, thereby improving pricing accuracy. Cattle are paid on actual dressed weights. Relative to the grid base price, better quality cattle are rewarded and poorer quality cattle are penalized.

Grid pricing raises both firm-level and industry-level questions. At the firm level, many producers do not know how their cattle perform in carcass form. *Without knowing the carcass quality of their cattle, marketing on a grid may be disappointing*. Grids can provide an incentive to market higher quality cattle. However, the penalty for marketing lower quality cattle is large as is shown clearly in Sections B and C. *Even a few lower quality cattle, priced at large discounts to higher quality cattle, can offset the premiums for many higher quality cattle*. The bottom line results might be a price which is lower on average than a live weight or dressed weight cash price.

Since base prices often vary and both premiums and discounts vary from one packer to another, producers must understand how price is computed. Is cattle quality being paid on an absolute or relative basis? Under plant-average formula-based grid pricing, cattle quality is being paid on the basis of your cattle quality relative to other cattle slaughtered previously in the same plant. With other base prices and premium-discount grids, cattle quality is being priced on its own merit, not relative to other cattle.

Another firm-level issue involves trade-offs between price, revenue, and profit. Price is only one component of revenue and revenue is just one component of profit. Cattle producers need to ask several questions. Do my cattle naturally fit a particular grid? Can they be fed to fit a specific grid? Can they be sorted to fit a specific grid? Receiving the highest *price* does not imply the greatest *revenue*, nor does the greatest revenue imply the largest *profit*.

Many grid pricing systems use formula prices to establish the base. At an industry level, one commonly-raised issue is what impact does formula pricing of fed cattle have on prices paid by packers for cash-market cattle? What impacts does it have for packer behavior and pricing? Can packers leverage prepurchased formula-priced cattle to pay lower cash-market prices?

Grid pricing also raises other short-run and long-run issues. In the short run, cattle feeders can search for the best price, both base price and premium-discount grid, for their cattle. However, simply finding the best price defeats part of the purpose of grid pricing, that being to change the quality of cattle to better match consumer preferences. *Base prices in grid pricing do not need to be formula based.* Are there effective alternatives to formula base prices? *The most concern regarding base prices is with those that are based on plant average prices. Formula base prices based on plant averages reduce the availability of prices which can be reported, do not contribute to price discovery, change across plants as the quality of cattle slaughtered by the plants changes, may not be representative for the cattle being marketed using a grid, and are subject to possible manipulation by the packer.*

Long-run issues involve whether or not the price signaling function has improved with grid pricing. Some larger cattle feeding firms are known to have learned from, and responded to, repeated use of grid pricing. The price signaling function associated with pricing on the average, i.e., especially with liveweight pricing, is clearly inefficient and inaccurate. Long-run effects from increased formula pricing are expected to be detrimental for effective price discovery and formula pricing creates thinner markets for price reporting and price discovery.

Grid pricing has several economically desirable characteristics. *However, to be used effectively by cattle producers, the grid pricing method needs to be understood thoroughly.* In addition, cattle quality characteristics must be estimated accurately to avoid a few low quality, discounted animals offsetting many high quality animals receiving premiums.

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Section A

Comparing Live Weight, Dressed Weight, and Grid Pricing: Assessing the Value of Cattle Quality Information

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Introduction and Objectives

This study demonstrates several factors regarding grid pricing of fed cattle. In interviews with cattle feedlots and beef packers regarding the future of beef price discovery, Schroeder *et al.* found one of the most widely agreed upon concerns was that fed cattle pricing practices did not adequately discriminate among cattle values. Claims were that prices were too high for low quality cattle and too low for high quality cattle. Nearly every individual and firm interviewed felt the common practice of pricing fed cattle on average live weight prices was detrimental to the industry because it did not send producers appropriate price signals. Such sentiments have increased interest in moving away from average live (or dressed) weight cattle pricing and towards value-based grid-type pricing. However, with grid pricing come several issues. Among those issues are questions producers frequently ask:

- Will moving to grid pricing increase cattle feeding profitability?
- How will grid pricing impact cattle feeding risk?
- What factors most impact the changing risks associated with moving from live or dressed weight to grid pricing?
- What is the value associated with having better information regarding cattle quality under grid pricing opportunities?

These questions are the focus of this section. Actual carcass data on cattle marketed to a large midwestern packer on a price grid are used in this analysis. In particular, the research objective is to determine how cattle feeder revenue is affected by selling cattle under a grid pricing system relative to live and dressed weight pricing. In addition, the impact on price variability or risk of changing from live and dressed weight to grid pricing systems is measured. The factors influencing risk across pens of cattle when selling on a grid are estimated. Also, the value of having improved information on cattle quality when marketing on a grid is determined. Finally, an estimate is made regarding the pricing error associated with live and dressed weight cattle pricing assuming the particular packer grid is efficient at sending appropriate value-based pricing signals.

Data and Procedures

The primary data set used consists of 71 pens of cattle, comprising 11,703 head, obtained from a large midwestern cattle feeding operation. The cattle were produced and marketed under a grid pricing formula marketing agreement with a large midwestern beef packer. The cattle were marketed during 1997 and data for just over one pen per week spread throughout the year was provided by the cattle feeder. For each pen of cattle, the data consisted of packer kill sheets indicating the slaughter date, overall revenue, individual price received, carcass weight, quality grade, yield grade, and "out" grades for each carcass. In addition, a pen-average dressing percentage and total pen live weight were provided. These cattle were produced and sold under this grid pricing system. The cattle are from a single cattle feeding operation (though they do not originate from the same cow herd) and as such, are not necessarily

representative of typical pens of cattle marketed on any given day across the nation. Assuming this cattle feeding operation targeted its cattle toward this grid, estimates of the value of information on cattle quality provided here are likely to be conservatively low. That is, because these cattle were produced and targeted toward this grid, they likely fit the grid better than would an average pen of cattle selected randomly from all cattle marketed during any day.

A simulation of selling the 71 pens of cattle using four different pricing methods over the time period is completed to determine differences in prices received by the various methods. The cattle were priced using live weight fed cattle prices, dressed weight prices, and the actual grid prices received. Each carcass was also priced assuming the cattle feeder could have sorted the cattle and sold them individually using the method among live weight, dressed weight, or grid providing the highest price. Often, when cattle are sold on a dressed weight or grid basis, the packer pays trucking. When sold on a live weight basis, the feeder pays trucking. Transportation costs were not included in the pricing simulations. The impact of this approach is that it will make live pricing appear slightly better than it may have actually been. However, trucking costs represent a very small component of the overall price. In addition, no shrink was deducted from the live price since actual delivered live and dressed carcass weights (post-shrink) at the plant were used in calculating revenues.

The live weight and dressed weight prices were obtained from the United States Department of Agriculture (USDA) WH LS725 *Weekly 5-Area Weighted Average Direct Slaughter Cattle Prices*. The live weight and dressed weight prices used for each pen were determined, based on the percentage of Choice or higher and Select or lower quality grade cattle contained in the pen. Typically, four or five categories of live weight and dressed weight prices are reported by the USDA separated by the percentage of Choice cattle in the pen: 80 percent to 100 percent; 65 percent to 80 percent; 35 percent to 65 percent; 20 percent to 35 percent; and 0 percent to 20 percent Choice. However, the 0 percent to 20 percent price is only rarely reported, therefore, it was not used in the analysis. The price from this report was weighted-average data from Texas-Oklahoma, Kansas, Colorado, Nebraska, and Iowa-South Minnesota market regions.

To determine the relative importance of various factors affecting price variability across carcasses when pricing on a grid basis, the following regression model was estimated:

$$(1)\quad \sigma_{price} = \beta_0 + \beta_1 HEAVY + \beta_2 LIGHT + \beta_3 \sigma_{Weight} + \beta_4 \sigma_{Quality} + \beta_5 \sigma_{YieldGrade} + \beta_6 SPREAD + \varepsilon$$

where σ_{rice} is the standard deviation of price per cwt (or revenue per head) in each pen of cattle, *HEAVY* is the percentage of carcasses in the pen that weigh more than 950 lb, *LIGHT* is the percentage of carcasses that weigh less than 525 lb, σ_{Weight} is the standard deviation of carcass weight in the pen, $\sigma_{Quality}$ is the standard deviation of quality grade of cattle in the pen (quality grade coded as Prime=1, Choice=2, Select=3, No Roll=4, Miscellaneous=5, Hieferette=6), $\sigma_{YieldGrade}$ is the standard deviation of yield grade in the pen, and *SPREAD* is the weekly Choice-to-Select wholesale boxed beef cutout price spread during the week the cattle were sold.

Variability in price within a pen is expected to be positively associated with each variable in the model. As any of the right-hand-side variables increase, price variability within the pen should also increase because variability in these factors will lead to variability in grid discounts and/or premiums being applied.

Comparative Prices

This section analyzes selling the 11,703 fed cattle using three different methods: live weight, dressed weight, and an actual packer's grid. Summary statistics of the cattle are presented in Table 1. The cattle graded 65 percent Choice or higher and had a few heiferettes and other miscellaneous "out" quality types of cattle. The cattle were 40 percent Yield Grades 1 and 2 and 43 percent Yield Grade 3, with a few Yield Grade 4 and 5 carcasses. A small number of the cattle were either excessively heavy or light weight; 14 head had carcasses weighing less than 525 lb and 219 weighed more than 950 lb. The carcasses had average weight of 798 lb and an average dressing percentage of 63.6.

Summary statistics of the prices for the cattle when sold under the different pricing methods are presented in Table 2. Although the cattle were from 71 pens, for the analysis completed here all cattle are priced as if they were sorted and sold individually. When the cattle were sold on a live weight basis the average price was $65.60/cwt with a standard deviation of $1.78/cwt. If all cattle were sold on a dressed weight basis, they would have brought an average price of $67.16/cwt (converted to a live weight basis) with a standard deviation of $1.84/cwt. When the cattle were priced using the packer grid, the average was $66.90/cwt (live weight basis price again) with a much larger standard deviation than either live or dressed weight pricing of $3.91/cwt. As illustrated in Figure 1, selling the cattle using a grid resulted in nearly twice the variability in price across carcasses relative to selling all the cattle either on live or dressed weight. When sold on a live weight basis, over 50 percent of the cattle received a price in a $2/cwt range between $64-$66/cwt and on a dressed weight basis just under 50 percent brought a similar $2/cwt range of $66-$68/cwt. However, when sold on the packer grid, just over 50 percent of the cattle received a price within a $6/cwt range of $64-$70/cwt.

To determine the value of information on cattle quality attributes to the cattle feeder, each carcass was priced using the method that resulted in the highest price among the three methods. The average price under each of these scenarios is reported in Table 2. If the cattle were sold using the method that resulted in the highest price for each carcass, the overall average price would have been $68.37/cwt, gaining $1.21/cwt over just selling all cattle on the next highest average pricing method (dressed weight basis). Interestingly, selling the cattle using the method with the highest price resulted in 198 (2 percent) head being sold on a live weight basis, 5,401 (46 percent) on a dressed weight basis, and 6,104 (52 percent) head using the grid pricing system.

Summary statistics of cattle having each of the respective highest pricing opportunities reveal important differences across the types of cattle that fit each pricing method best relative to the other three (Table 1). It is difficult to make broad generalizations about the type of cattle that will get the highest price under each method primarily because so many different characteristics jointly impact price when using a grid. However, a few generalizations can be gleaned from these results. First, *cattle with a low dressing percentage received the highest price when sold on a live weight basis.* This is simply because when cattle having a low dressing percentage are sold on a dressed basis, fewer pounds are being sold (after adjusting the carcass back to a live-weight equivalent) than if they were sold on a live weight basis. In other words, the dressing percent implied in the live weight relative to the dressed weight market prices was greater than the actual dressing percent of the carcass. Similarly, *lower quality grade cattle generally receive the highest price on a live weight basis.* Of the 198 carcasses with live weight price the highest, 58 percent were Select and lower quality grade. This indicates that higher quality cattle will often receive higher prices under a method other than live weight pricing.

About half of the cattle would have brought the highest price when sold on either a dressed (46 percent) or grid (52 percent) basis. Cattle that would have received the highest price when sold on a dressed basis would have gained $1.63/cwt relative to live pricing these same cattle and $3.13/cwt

relative to selling these same carcasses on the grid. Similarly, carcasses that would have been best sold using the grid would have resulted in a price $3.87/cwt greater than live and $2.31/cwt higher than dressed pricing (Table 1). Comparing the quality of the cattle that would have realized the highest price under grid vs. dressed pricing indicates that, not surprisingly, *the higher quality cattle typically are best priced using the grid.* Only 4 of the carcasses that had a quality grade worse than Choice would have received the highest price using the grid. This contrasts with the dressed priced cattle in which more than 70 percent had quality grades of Select or below. This demonstrates the need for cattle producers to have an idea of the quality grade of cattle they are producing. *Higher yield grade cattle were also favored by the grid pricing method* although this was not nearly as important for Yield Grade 1 and 2 cattle (since premiums are relatively modest) compared to Yield Grade 4 and 5 cattle which receive discounts in excess of $15/cwt (dressed basis) relative to Yield Grade 3 carcasses.

Table 1. Summary Statistics for Marketing 11,703 Head of Cattle Overall and for Three Highest Pricing Methods, Marketed Weekly During 1997

		Method with Highest Price		
Pricing Attribute	Overall	Live Weight	Dressed Weight	Grid
Quality Grade:				
Prime (%)	1.48	0.00	0.41	2.47
Choice (%)	63.49	42.42	25.83	97.49
Select (%)	27.47	46.97	57.77	0.03
No Roll (%)	5.84	8.08	12.37	0.00
Miscellaneous (%)	1.49	2.53	3.13	0.00
Heiferette (%)	0.23	0.00	0.50	0.00
Yield Grade:				
Yield Grade 1 (%)	17.97	21.21	26.14	10.63
Yield Grade 2 (%)	32.85	23.74	30.83	34.94
Yield Grade 3 (%)	43.47	52.53	30.88	54.31
Yield Grade 4 (%)	5.23	2.53	11.11	0.11
Yield Grade 5 (%)	0.48	0.00	1.04	0.00
Carcass Weight & Dressing:				
Less than 525 lb (%)	0.12	0.00	0.26	0.00
Greater than 950 lb (%)	2.73	1.01	5.81	0.07
Carcass Weight (lb)	798.29	769.37	798.22	799.29
Dressing (%)	63.62	62.27	63.62	63.67
Prices & Revenues:				
Live Price ($/cwt – live weight)	$65.60	$68.49	$65.70	$65.42
Dressed Price ($/cwt – live weight)	$67.16	$68.01	$67.33	$66.98
Grid Price ($/cwt – live weight)	$66.90	$66.42	$64.20	$69.29
Live Revenue ($/head)	$823.00	$845.79	$824.17	$821.22
Dressed Revenue ($/head)	$842.60	$839.97	$844.66	$840.87
Grid Revenue ($/head)	$839.07	$820.12	$805.15	$869.71
Number of Head (head)	11,703	198	5,401	6,104
Percent of Cattle (%)	100%	2%	46%	52%

Table 2. Summary Statistics of Price and Revenue for Various Pricing Methods, 11,703 Head of Cattle Marketed Weekly During 1997

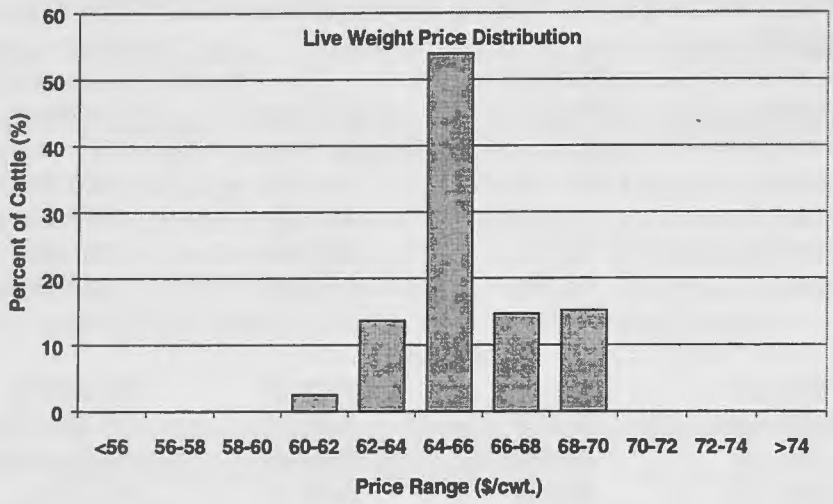
Pricing Method	Average	Standard Deviation	Minimum	Maximum
	($/cwt) Live Weight			
Live Weight	$65.60	$1.78	$61.89	$69.96
Dressed Weight	$67.16	$1.84	$63.07	$71.22
Grid	$66.90	$3.91	$44.46	$80.69
Highest Price	$68.37	$2.39	$63.07	$80.69
	($/head)			
Live Weight	$823.00	$82.38	$478.73	$1,200.33
Dressed Weight	$842.60	$84.92	$486.19	$1,247.19
Grid	$839.07	$91.60	$357.49	$1,251.85
Highest Revenue	$857.74	$87.29	$486.19	$1,251.85

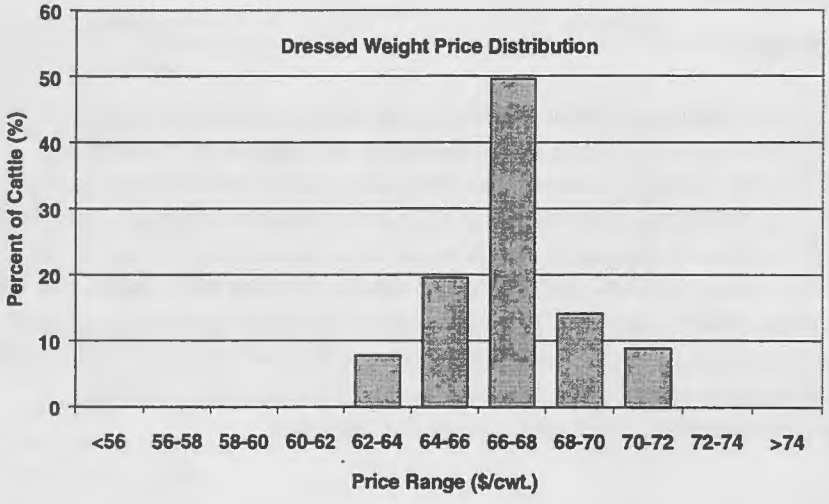
Value of Information and Price Error

Overall, what is the value of information on cattle quality and associated premiums and discounts to the producer? Table 3 reports the total value of selling the cattle under the highest price method relative to each of the alternative methods. *Selling all carcasses using the pricing method having the highest price increased total revenue by $406,590 ($34.74/head) relative to simply selling all cattle using live weight pricing, by $177,171 ($15.14/head) compared to selling all on a dressed weight basis, and $218,455 ($18.67/head) compared to selling all on the grid.* Thus, there are considerable values per head for having a better understanding of the cattle quality and properly marketing by the particular method returning the highest price compared to selling all cattle using the same method, whether it be live weight, dressed weight, or grid. This represents short-term value of information. The long-term value is influenced by management changes that are made in response to the information.

Table 3. Revenue Comparisons and Value of Information Selling 11,703 Head of Cattle Weekly During 1997 using Three Pricing Methods

Pricing Method	Total Revenue ($)	Highest Pricing Revenue ($)	Value of Information ($)	Value of Information ($/head)	Value of Information (%)
Live Weight	$9,631,541	$10,038,131	$406,590	$34.74	4.22%
Dressed Weight	$9,860,960	$10,038,131	$177,171	$15.14	1.80%
Grid	$9,816,676	$10,038,131	$218,455	$18.67	2.22%





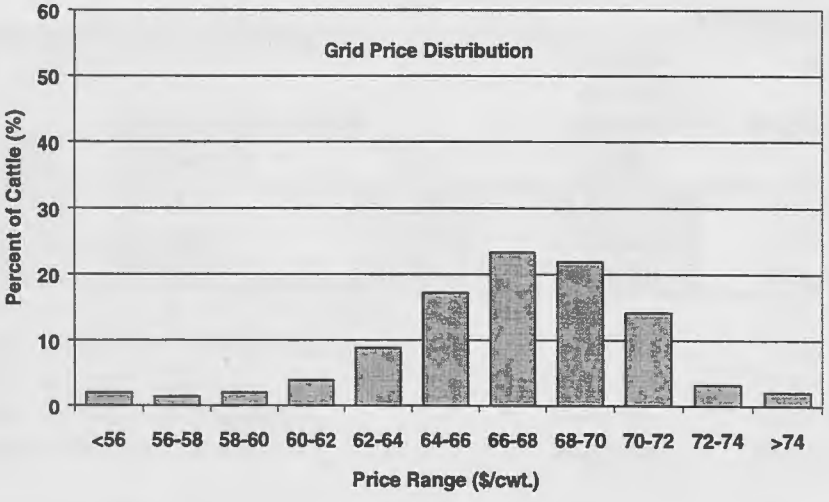


Figure 1. Price Distributions for Pricing Cattle using Live Weight, Dressed Weight, or Grid Pricing, 11,703 Head of Cattle Marketed Weekly During 1997

To determine from a producer welfare perspective the value of pricing cattle on a grid instead of live weight or dressed weight pricing, the differences in revenue received for the carcasses by pricing method were compared. *Assume the grid price paid for these cattle is an efficient price in the sense that it fully reflects the market value of the carcass.* Then, any carcass that sells for a higher price brings more than the efficient price and any carcass selling for less brings less. This is essentially what many have argued is the case of poor quality cattle being subsidized by higher quality cattle (a welfare transfer from owners of high quality cattle to owners of low quality cattle) when the cattle are sold on a live or dressed weight basis with little price differentiation for quality differences. *To determine the amount that cattle were "over-priced" or "under-priced" relative to the assumed efficient actual grid price, the difference in the revenue from selling the cattle on the grid relative to live or dressed weight was computed. It is important to note in this analysis is that pricing these cattle using different grids would likely result in different estimates of pricing error because different grids with varying premium/discount structures value carcasses differently.*

For the 11,703 cattle in this data set, Table 4 presents the amounts of "over-" or "under-pricing" that would have been present had the cattle been sold live or dressed weight instead of on a grid. For 3,650 of the cattle, the grid price was less than the live weight price by an average of $2.90/cwt or $36.80/head. This means that *if these cattle were sold on a live weight basis, they would have received $134,335 more than they were actually worth (assuming the grid price is the efficient value).* For the remaining 8,053 head, the grid price exceeded the live weight price and if these cattle were sold live instead of on the grid *they would have received $322,442 ($40.04/head) less than they were worth.* Similar magnitudes of pricing errors are present for dressed pricing relative to grid pricing. *The primary conclusion is that if these cattle were sold via live or dressed weight pricing, assuming the grid pricing system is the most efficient in terms of sending appropriate pricing signals, this would have resulted in typical "pricing error"(positive or negative) of $30/head or more.*

Table 4. Magnitude of Pricing Error from Selling Cattle on a Live Weight or Dressed Weight Basis Instead of a Grid, 11,703 Head of Cattle Marketed Weekly During 1997

Revenue Comparison	Number of Cattle (head)	Average Price Difference ($/cwt live weight)	Average Revenue Difference ($/head)	Total Revenue Difference ($)
Grid Less than Live Weight Revenue	3,650	-$2.90	-$36.80	-$134,335
Grid Exceeds Live Weight Revenue	8,053	$3.20	$40.04	$322,442
Grid Less than Dressed Weight Revenue	5,521	-$3.11	-$39.38	-$217,435
Grid Exceeds Dressed Weight Revenue	6,182	$2.28	$28.49	$176,150

Explaining Grid Price Variability

This section uses the same 11,703 cattle as was used in the previous section only here the cattle are evaluated on a pen-level basis (71 pens). In particular, this section presents the regression model estimates used to explain factors affecting the standard deviation of price across carcasses for cattle sold using a grid within a particular pen of cattle.

The results of this regression estimation are reported in Table 5. Two models are estimated, one with the dependent variable measured on a price per cwt and the second with the dependent variable on a revenue per head basis. All of the signs on the parameters, except one, conform to expectations. The one

sign that is not consistent with expectations is the parameter on the percent of heavy carcasses on revenue per head. This could simply be an anomaly of this set of cattle. These models explained the majority of price (68 percent) and revenue per head (88 percent) variability. Statistical problems caused by autocorrelation, multicollinearity, and/or heteroskedasticity were tested for and none were generally present in either model. One exception was collinearity between yield grade and the intercept term. This is primarily a result of yield grade variance not having large variability across pens. Dropping yield grade and re-estimating the models resulted in qualitatively identical conclusions on all other variables in the models; therefore, nothing was done to adjust the models for this type of collinearity.

Table 5. Regression Results for Models Estimating the Influence of Carcass Quality Characteristics on Variability in Price per cwt and Revenue per Head

	Dependent Variable			
	σ_{Price} (Price per cwt)		σ_{Price} (Revenue per head)	
Independent Variable	Parameter	Standard Error	Parameter	Standard Error
Intercept	-2.810**	1.311	-10.851	6.960
HEAVY	-0.059*	0.034	-1.154**	0.181
LIGHT	0.490	0.340	3.466*	1.803
σ_{Weight}	0.004	0.010	0.922**	0.053
$\sigma_{Quality}$	3.497**	0.983	11.055**	5.218
$\sigma_{Yield\ Grade}$	1.319	1.545	6.881	8.200
SPREAD	0.609**	0.070	2.793**	0.372
R^2	0.68		0.88	
Observations	71		71	
Breusch-Pagan test				
χ^2 Value	18.017		25.300	
Probability	0.903		0.878	
Durbin-Watson test				
Test statistic	1.960		1.907	
1st Order Autocorr.	0.016		0.045	

**Denotes significance at the 5% level.
*Denotes significance at the 10% level.

To further aid in the interpretation of the regression results, the elasticities of each factor are reported in Table 6. The elasticities indicate the percentage response in the dependent variable to a one percent change in the independent variable, all else constant. *The elasticities help to identify which variables have the largest percentage impact on changes in the dependent variable whether price or revenue.* The elasticities indicate that on a price per cwt basis, *the USDA Choice-to-Select wholesale boxed beef price spread has the largest impact on price variability in a pen with an elasticity of 0.773.* This indicates that for each one percent increase in the Choice-to-Select price spread, the variability in price within a pen increases by 0.77 percent. This is because as the Choice-to-Select price spread increases, Choice cattle receive an increasingly divergent price relative to Select carcasses which increases the range of prices in a pen of cattle sold on a grid. *The next most important factor is standard deviation in the quality grade of the cattle in the pen.* This is as expected because quality grade premiums

and discounts tend to be larger than yield grade price differentials (with perhaps the exception of Yield Grade 4 and 5 carcasses which, in this data set, has very few observations).

When evaluating variability in revenue per head, *weight variability is more important than any other factor (Table 6).* Each one percentage point increase in weight variability increases revenue variability by 0.77 percent. *The Choice-to-Select spread has the next largest elasticity at 0.23.*

Table 6. Elasticities of Regression Parameters Explaining Pen Level Price and Revenue Variability

	σ_{Price} (Price per cwt)	σ_{Price} (Revenue per head)
Variable	Elasticity	
HEAVY	0.012	-0.015
LIGHT	0.096	0.045
σ_{Weight}	0.052	0.771
$\sigma_{Quality}$	0.463	0.097
$\sigma_{Yield\ Grade}$	0.205	0.071
SPREAD	0.786	0.238

Conclusions and Implications

This study compared prices for individual fed cattle sold using live weight, dressed weight, and grid pricing. Actual data from 11,703 carcasses produced from 71 pens of cattle marketed weekly during 1997 were evaluated. Several conclusions and implications can be drawn:

- *Grid pricing resulted in more than twice the variability in price received per cwt (live weight basis) across carcasses compared to live and dressed weight pricing.* This indicates that grid pricing is more discriminating in terms of pricing signals conveyed to producers.

- *Cattle with low dressing percentage and low quality grade tended to receive a higher price when sold on a live basis.* Cattle with low quality, but high dressing percentage tended to receive the highest price when sold on a dressed weight basis. *Grid pricing resulted in the highest price for high quality grade, better yield grade, and not excessively heavy- or light-weight carcasses. Only about half of the cattle evaluated would have received the highest price by selling them using the grid.* This is not an indictment against grid pricing, rather it is a reinforcement that grid pricing leads to more price dispersion associated with cattle quality than do live or dressed weight pricing.

- *If cattle could have been sorted and sold to the option offering the highest price, approximately $15/head more could have been made relative to selling the cattle using the next highest price method (dressed weight), $18/head more than selling all on a grid, and $35/head more than live weight pricing.* This indicates substantial value of information for producers to understand the kind of cattle they market and target the cattle to the best pricing opportunity. However, over time if producers target cattle accordingly, the live and dressed weight markets will represent predominantly lower-quality cattle and grids will have the higher quality cattle. If enough producers adopt such a targeting strategy, the live and dressed weight prices could decline relative to grid pricing opportunities or beef packers would be over-paying for live and dressed

weight cattle. This could result in the live and dressed weight markets having less advantage than they currently do relative to grid pricing for even lower-quality cattle.

- *If grid pricing is efficient at sending appropriate pricing signals, large pricing errors exist in both under-pricing and over-pricing carcasses on live and dressed weight selling methods compared to grid pricing.* High-quality cattle subsidized low-quality cattle by an average of more than $30/head. This quantifies how poorly average live or average dressed weight pricing is at conveying appropriate pricing signals to cattle feeders. Cattle feeders that want to get paid for the quality of cattle they produce will only realize this value if the cattle are sold using more than live or dressed weight average pricing methods.

- *The Choice-to-Select boxed beef wholesale cutout price spread had the most impact on variability of price per hundredweight for carcasses sold on a grid followed by variability in quality grade of carcasses in a pen.* Carcass weight variability followed by the Choice-to-Select price spread had the largest influence on variability of revenue per head. Yield grade variability did not have a statistically significant impact on price or revenue variability. This shows the importance of the Choice-to-Select price spread and quality grade on grid price variability. Producers trying to manage the increased price risk associated with grid pricing will find most benefit from managing cattle quality grade, carcass weights, and monitoring the Choice-to-Select price spread. Perhaps forward markets (e.g., contracts) that will allow a producer to lock in the Choice-to-Select price spread will evolve.

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Section B

Economic Implications of Show List, Pen Level, and Individual Animal Pricing of Fed Cattle

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There is concern in the beef industry that present marketing practices may be impeding the transmission of economic signals from consumers to producers. Presently, fed cattle may be sold on a show list, pen by pen, or individual head basis and may be priced using live weight, dressed weight, or grid or formula pricing. Are market signals more likely to reach producers if cattle are priced individually? How consistent are the price signals over time and across grids? What are the risk implications from pricing cattle on an individual head basis? The objectives of this research were to 1) quantify revenue variability differences from selling on a show list, pen or individual head level using live weight, dressed weight or grid pricing; and 2) evaluate the transmission of economic signals from packers to producers when cattle are priced on an individual carcass merit basis. The two objectives were accomplished in two separate research endeavors using the same carcass data set. However, different time periods and pricing grids were used for each of the separate analysis.

Data Sources and Summary

Detailed carcass data on 85 pens of fed cattle, 5,520 head, marketed throughout 1997 from numerous feedlots were collected. Table 1 contains summary statistics of carcass characteristics for these cattle. The 85 pens were cattle for which producers had requested detailed carcass data and all came from one large packer. Pens ranged in number of head from 20 to 205 and averaged 65 head per pen. The average live weight was just over 1200 pounds, dressing percent averaged 62.8, 61 percent graded Choice or above, and yield grade averaged 2.2. The range in the percent of the pen grading Choice or above was from 15 to 96 percent. The cattle appear to be typical of the cattle killed in USDA regions 7-8 (IA, KS, MO, NE, CO, MT, ND, SD, UT, and WY). From October 1995 through September 1998, cattle slaughter in these regions averaged 58 percent Choice or above, 52 percent have been Yield Grade 1 or 2, and 1.5 percent have been Yield Grade 4 or 5 (U.S. Department of Agriculture).

Procedures

For objective 1, sales were simulated over three pricing levels, three time periods, and three pricing methods. Average revenue per pen and individual revenue per head were determined for each marketing scenario. The three pricing methods were live weight, dressed weight, and grid based pricing. The terms "live" and "dressed" are used interchangeably with live weight and dressed weight, respectively. Grids from two different packers were used. One was representative of a grid that had large premiums and discounts associated with quality grades and generally had lower premiums and discounts associated with yield grades. The other grid had high premiums and discounts associated with yield grades, and had lower premiums and discounts associated with quality grades. Both grids used plant average adjusted base prices which impacted the net price received from the grid and the method of arriving at the base was considerably different for each grid. The time periods were the first week in December, 1996, the first week of May, 1997, and the second week of May, 1998. The December time period was one in which the Choice-Select spread was relatively large, $19.06/cwt, the May, 1998 time period had a relatively narrow Choice-Select spread, $2.69/cwt, and the May, 1997 time period had a spread of $6.79/cwt (Table 2).

Table 1. Summary Statistics on the Carcass Characteristics of the 85 Pens and 5520 Individual Fed Cattle.

	85 Pens		5520 Individual Fed Cattle	
	Mean[a]	Std. Dev.	Mean[a]	Std. Dev.
Live Weight (lb)	1203.24	74.91	NA	NA
Dressing % (%)	62.81	1.15	NA	NA
Hot Carcass Weight (lb)	755.80	49.20	758.41	80.17
Prime %	1.69	3.14	1.45	NA
Upper 2/3 Choice %	19.87	14.18	18.89	NA
Low Choice %	39.43	13.52	40.22	NA
Select %	37.04	17.70	37.52	NA
Standard %	1.97	2.79	1.92	NA
Yield Grade 1 %	15.94	17.24	15.33	NA
Yield Grade 2 %	47.89	15.79	46.88	NA
Yield Grade 3 %	35.59	21.41	36.96	NA
Yield Grade 4 & 5 %	0.59	1.37	0.83	NA
Marbling Score ([b])	4.32	0.44	4.30	0.90
Fat Thickness (inch)	0.41	0.11	0.41	0.19
Rib eye Area (sq. inch)	12.81	0.85	12.74	1.45

[a] Pen means and individual means differ because of unequal pen sizes and the means of the pens are simple means and not weighted by pen size.
[b] Marbling Score:1-2=Standard, 3=Select, 4=Low Choice, 5=Choice, 6=High Choice, 7-8=Prime.

Table 2. Prices used in the Analysis for Objective 1. (Dollars/cwt)

	Show list		Pen Level		Choice-Select Spread	Grid A Base	Grid B Base
	Live	Dressed	Live[a]	Dressed[a]			
Dec. >96	67.77	111.48	66.27-69.27	110.48-112.48	19.06	118.50	118.71
May >97	68.94	111.09	67.44-70.44	110.09-112.09	6.79	114.00	113.71
May >98	66.04	106.05	64.54-67.54	105.05-107.05	2.69	107.07	106.00

[a] Price depends upon the percent Choice in the pen and for Live the dressing percent of the pen.

The three pricing levels were show list, pen level, and individual animal pricing. For show list pricing, all 85 pens were sold at the same average market price. The percentage of cattle grading Choice or above and dressing percent were used to differentiate prices on a pen level. Those pens that were within one standard deviation of the average for the two variables received the same price. Pens that exceeded 80 percent Choice received a $1.00/cwt premium dressed and a $0.50/cwt premium live and pens that were less than 42 percent Choice received an equivalent discount. For live weight pricing, pens that exceeded 63.97 dressing percent or were less than 61.65 dressing percent received a $1.00/cwt

premium or discount, respectively. These price ranges were consistent with the USDA reported prices for the respective time periods. The prices used in the analysis are displayed in Table 2.

For objective 2, sale prices were computed for three value-based pricing systems and six different marketing dates. The value-based pricing systems used in this analysis were three different actual packer grids. One was representative of a grid that had large premiums and discounts associated with quality grades and generally had lower premiums and discounts associated with yield grades. Another grid had higher premiums and discounts associated with yield grades, and had lower premiums and discounts associated with quality grades. Two of the grids used plant average adjusted base prices which, as noted above, impacts the net price received from the grid. The third grid adjusted the base price for the USDA Choice-Select carcass spread but did not adjust the base for plant averages.

As this analysis was concerned with value-based price premiums or discounts for different pens of cattle, the general price level was not a concern. However, the six different marketing dates represent time periods when there was a higher/lower percentage of cattle grading Choice and a narrower/wider Choice-Select price spread. This information is displayed in Table 3.

Under the present fed cattle marketing practice of pricing an entire show list of market ready cattle at one price, profit on an individual pen of cattle can be defined as:

$$(1) \qquad \begin{aligned} Profit_{showlist} &= Dressed\ Price * Dressed\ Weight \\ &\quad - FeedingCosts - Feeder\ Price * Feeder\ Weight \end{aligned}$$

where each variable is the average for the pen. The * symbol indicates multiplication. Given that all pens sell for the same dressed price, the dressed price is a function of the overall supply and demand forces determining the general market level, but it is not a function of the carcass characteristics of the cattle. This is true for the individual pens of cattle sold at one show list price. However, the show list price probably reflects the buyers overall estimation of the carcass characteristics of the entire show list. If cattle are sold on a carcass merit, value-based pricing system, then profit on an individual pen of cattle can be defined as:

$$(2) \qquad \begin{aligned} Profit_{grid} &= Grid\ Price\ f(Carcass\ Characteristics) * Dressed\ Weight \\ &\quad - Feeding\ Costs - Feeder\ Price * Feeder\ Weight \end{aligned}$$

where the grid, or value-based, price is a function of the carcass characteristics for that pen of cattle. The grid price is still a function of the general market level and would account for the same supply and demand forces as the average dressed price does. In fact, the Grid Price could be defined as:

$$(3) \qquad Grid\ Price = Dressed\ Price + Price\ Premium/Discount\ f(CarcassCharacteristics)$$

Table 3. Prices (Dollars/cwt) and Grading Percentage Used for the Analysis of Objective 2.

	2/6/98	2/21/97	6/20/97	12/19/97	10/24/97	12/6/96
Nebraska Dressed Price	$98.47	$106.25	$105.17	$104.84	$107.85	$114.76
Choice-Select Carcass Spread	$1.15	$3.26	$5.62	$7.85	$10.13	$15.81
US Carcass % Grading Choice	63.58	52.71	48.75	51.86	45.34	44.44
USDA Rg7-8 % Grading Choice[a]	61.30	59.68	54.49	57.75	55.63	52.35
USDA Rg7-8 % Yield Grade 1-2[a]	50.70	55.59	55.54	54.50	49.13	56.42
USDA Rg7-8 % Yield Grade 4-5[a]	1.56	1.09	1.16	1.00	1.19	1.01

[a] The USDA Rg 7-8 is the USDA reported region 7-8 (IA, KS, MO, NE, CO, MT, ND, SD, UT, and WY) and is the percent of cattle reported for each of these classifications.

By substituting Equation 3 into Equation 2 and subtracting Equation 1 from Equation 2 and canceling terms, it can be shown that the profit differences from selling on a grid, or value-based pricing system, compared to selling a show list at one dressed price can be explained by the grid price premium or discount multiplied by the dressed weight:

$$(4) \qquad Profit_{grid} - Profit_{showlist} = Price\ Premium/Discount\ f(Carcass\ Characteristics) * Dressed\ Weight$$

$Profit_{grid}$ - $Profit_{showlist}$ can be defined as the Profit Differential from selling on a value-based pricing system compared to selling on an average show list dressed price. If dressed weight is moved to the left-hand side of equation 4, then it can be shown that the weight adjusted profit differential is equal to the price premium/discount from the value-based pricing system:

$$(5) \qquad \frac{Profit\ Differential}{Dressed\ Weight} = Price\ Premium/Discount\ f(Carcass\ Characteristics)$$

Before looking at the market signals that producers receive from value-based price premiums/discounts, it is necessary to discuss a critical assumption underlying equations 4 and 5. These equations are based on the assumption that only the pricing method changed. It is assumed that feeding and cattle procurement practices remain constant regardless of fed cattle pricing method. This assumption is likely correct for the short-run, i.e., for the first few pens of cattle a producer sells on a value-based pricing system. However, if there are market signals being sent to producers in the form of price premiums or discounts, and if those premiums or discounts can be associated with specific carcass characteristics, and if management decisions can impact those characteristics, then rational producers would be expected to alter feeding and procurement practices to receive greater premiums and smaller discounts. Therefore in the long-run, equation 4 would be:

$$\begin{aligned} (6) \qquad Profit_{grid} - Profit_{showlist} = {} & [Grid\ Price\ f(Carcass\ Characteristics) * Dressed\ Weight\ f(Management) \\ & - FeedingCosts\ f(Management) - Feeder\ Price\ f(Management) * Feeder\ Weight\ f(Management)] \\ & - [Dressed\ Price * Dressed\ Weight\ f(Management) - FeedingCosts\ f(Management) \\ & - Feeder\ Price\ f(Management) * Feeder\ Weight\ f(Management)] \end{aligned}$$

and long-run profit differentials are not only a function of price premiums and discounts, but also are dependent upon dressed weights, feeding costs, and feeder costs which all may vary. Producers who have changed management practices cannot simply compare the value-based revenue (grid price * dressed weight) to the average dressed revenue (dressed price * dressed weight) and assume the difference is their change in profit. Feeding costs and purchased feeder costs must also be examined.

What short-run market signals are conveyed in the price premiums/discounts of a value-based pricing system? If producers only received the net grid price as information, this would be of limited value in making management decisions. Most value-based pricing systems will supply the producer with pen average carcass data. For an additional fee, producers can receive individual carcass data.

At the pen level, data are typically the average dressed or hot carcass weight, the percentage of cattle in each of the USDA quality grades (Prime, Choice, Select, Standard) and Yield Grades (1-5), the percentage of the pen with light or heavy carcasses, and the percentage of the pen that are "Out" Cattle, discounted for various non-conformance criteria. On an individual animal level, individual carcass weights, quality grade, yield grade, marbling score, fat depth over the 12^{th} rib , and rib eye area are reported to producers.

Research has shown that consumers want a consistent, tender, palatable cut of beef with minimal outside fat cover (Smith *et al*). Consumers want lean meat. Therefore, if the marketing system were functioning efficiently, production of fat should be penalized; higher yielding, heavier muscled cattle should receive a price premium; and cattle with a more tender, palatable carcass should also receive a premium. At the individual animal level, the measure of fat should be negatively related to price and be non-linear as increasing fat becomes increasingly less desirable. Rib eye area, a measure of muscling, should be positively related to price, and marbling score (a subjective measure of tenderness and palatability) should be positively related to price and may be non-linear. Non-conforming carcasses should also be negatively related to price. At the pen level, increasing yield grade from 1-5, a subjective measure of fat depth and muscling, should be negatively related to price and higher quality grades; Prime and Choice should be positively related to price and lower quality grades; and Select and Standard grades should be negatively related to price.

Regression analysis was used to analyze the relationship between the carcass characteristics and the value-based pricing premiums and discounts, the right hand side of equation 5. These relationships are the marketing signals that the value-based pricing systems were sending to producers. The following equation was analyzed using OLS regression procedures on the individual animal data:

$$(7) \quad VBP = b_0 + b_1 Marbling + b_2 Marbling^2 + b_3 Fat + b_4 Fat^2 + b_5 Ribeye + b_6 Ribeye^2 + b_7 Light + b_8 Heavy + b_9 Spread + e$$

where VBP is the value-based price premium or discount compared to the USDA average dressed market price for Nebraska for the specific week; Marbling is the USDA reported degree of marbling for each carcass and is coded as $1^{0\text{-}100}$ - Practically Devoid, $2^{0\text{-}100}$ - Traces, $3^{0\text{-}100}$ -Slight, $4^{0\text{-}100}$ - Small, $5^{0\text{-}100}$ - Modest, $6^{0\text{-}100}$ -Moderate, $7^{0\text{-}100}$ -Slightly Abundant, $8^{0\text{-}100}$ -Moderately Abundant, and $9^{0\text{-}100}$ - Abundant (where 0-100 allowed the grader to use 0, 10, etc., to identify marbling within the categories such as "abundant"); Fat is the fat thickness over the 12^{th} rib in inches; Ribeye is the size of the rib eye in square inches; Light and Heavy are dummy variables that take on the value of 1 if the carcass is light weight (< 550 lb) or heavy weight (>950 lb), respectively; and Spread is the USDA Choice-Select carcass spread. The minimum marbling score for each of the USDA quality grades is a $Slight^0$ for Select, $Small^0$ for low Choice, and $Slightly\ Abundant^0$ for Prime.

Results

Summary statistics on average revenue per pen and revenue for each individual animal are displayed in Tables 4 and 5, respectively. Feuz, Fausti, and Wagner have shown that revenue variability increased on a per head basis if marketing method went from live weight to dressed weight to dressed weight and grade. Does per pen revenue variability increase when going from live weight to dressed weight to grid pricing, and when going from show list to pen level to individual animal pricing? From Table 4, it appears that there was a slight increase in variability in going from live to dressed weight pricing. However, the differences were not statistically significant at the 0.05 level. There was no significant difference, at the 0.05 level, in revenue variability at the pen level between pricing methods over any of the time periods. The data indicate that moving from show list to pen level marketing does not increase per pen revenue variability nor does it significantly impact the mean level of revenue. This is likely a result of the manner in which pen level prices were computed in this analysis. Revenue variability would likely increase if cattle were sold on a pen by pen basis rather than on a show list basis. In comparing show list or pen level pricing to individual pricing, the mean level of revenue is significantly greater with individual animal pricing in all but one comparison. There was not a significant difference between dressed weight and grid A in period 1.

Per head revenue variability (Table 5) substantiates the earlier work of Feuz, Fausti, and Wagner. Revenue variability increased significantly from live to dressed weight, to dressed weight and grade, or in this case, grid marketing. There was no significant difference in revenue variability between show list and pen level pricing. The mean level of revenue is significantly different for all pricing methods and price level comparisons, except live versus dressed in period 3. However, producers are paid on a pen basis, not an individual head basis, even if cattle are priced on an individual head basis. Therefore, it would appear that pricing method and price level had only a minimal impact on per pen revenue variability with this data set. Other data sets may show greater variability. However, increased price variability, as is documented in Section C, may not always lead to increased revenue variability because of differences in carcass weight. Essentially, weight variability may offset or at least minimize some of the price variability.

Results of computing sales of 85 pens of cattle on three different packer grids over six different marketing dates are presented in Table 6. Many of the complexities of current value-based pricing systems can be illustrated from this table. Packer grid A is a for a regional packer that had a desire to procure cattle that typically graded Choice or higher. The grid had the highest reported premiums for Prime and Upper 2/3 Choice carcasses. The base price for the grid was adjusted for plant averages and was based on low Choice, Yield Grade 3 carcasses. This base exceeded the other two packer grid bases on all marketing dates. However, on average for the 85 pens of cattle, this grid resulted in the smallest premium or largest discount. Over the six marketing dates, the 85 pens averaged -$0.33 per cwt discount from the average dressed price. Given that this packer was interested in above average quality cattle, this is not surprising. This packer did pay the highest premium on four of the six marketing dates and consistently had the largest discounts for poorer quality cattle that did not fit their grid.

Table 4. Mean and Variability of Revenue for 85 Pens of Fed Cattle with Sales Simulated over Three Pricing Levels, Three Time Periods and Three Pricing Methods ($/Head).

Date	Level	Pricing Method	Mean	Standard Deviation	Coefficient of Variation (%)
Dec. '96	Show List	Live Weight	815.44[a]	50.77	6.23
		Dressed Weight	833.57[b]	54.85	6.58
	Pen Level	Live Weight	815.73[a]	51.55	6.32
		Dressed Weight	833.55[b]	54.70	6.56
	Individual	Grid A	837.12[b]	60.14	7.18
		Grid B	837.48[c]	57.64	6.78
May '97	Show List	Live Weight	829.51[a]	51.65	6.23
		Dressed Weight	830.62[a]	54.65	6.58
	Pen Level	Live Weight	829.81[a]	52.42	6.32
		Dressed Weight	830.60[a]	54.51	6.56
	Individual	Grid A	837.48[b]	53.83	6.42
		Grid B	839.82[c]	53.83	6.41
May '98	Show List	Live Weight	794.62[a]	49.47	6.23
		Dressed Weight	792.53[a]	52.18	6.58
	Pen Level	Live Weight	794.92[a]	50.27	6.32
		Dressed Weight	792.51[a]	52.04	6.56
	Individual	Grid A	799.15[b]	50.84	6.36
		Grid B	799.01[b]	51.01	6.38

Note: Means with different superscripts in the same time period are significantly different at the .05 level. None of the standard deviations are significantly different.

Packer B and Packer C are two of the major packers that have markets for all types of cattle. Packer B has a plant-adjusted base price that floats between a Choice and Select, and a Yield Grade 2 and 3 carcass, i.e., there is a premium for Choice and Yield Grade 2 and a discount for Select and Yield Grade 3 compared to the base. Packer C does not adjust the base for plant average and the base is for a Yield Grade 3 carcass. The Choice premium and the Select discount relative to the base are fixed proportions of the Choice-Select spread. The grid premium over all pens and time periods averaged $1.20 and $1.58 per cwt of carcass weight for grid B and grid C, respectively. The difference in the average premium/discount between grid B and grid C range from grid C offering an average premium $2.11 per cwt above grid B to grid B offering an average premium of $1.24 per cwt above grid C.

Table 5. Mean and Variability of Revenue for 5,520 Head of Fed Cattle with Sales Simulated over Three Pricing Levels, Three Time Periods and Three Pricing Methods ($/Head).

Date	Level	Pricing Method	Mean	Standard Deviation	Coefficient of Variation (%)
Dec. '96	Show List	Live Weight	816.07[a]	84.32[w]	10.33
		Dressed Weight	836.47[b]	89.37[x]	10.68
	Pen Level	Live Weight	817.69[a]	85.21[w]	10.42
		Dressed Weight	836.59[b]	89.29[x]	10.67
	Individual	Grid A	838.97[c]	125.67[z]	14.98
		Grid B	851.23[d]	113.59[y]	13.34
May '97	Show List	Live Weight	830.16[a]	85.77[w]	10.33
		Dressed Weight	833.51[b]	89.06[x]	10.68
	Pen Level	Live Weight	831.70[a]	86.66[w]	10.42
		Dressed Weight	833.63[b]	88.98[wx]	10.67
	Individual	Grid A	839.79[c]	98.73[z]	11.76
		Grid B	841.85[d]	94.99[y]	11.28
May '98	Show List	Live Weight	795.24[a]	82.16[w]	10.33
		Dressed Weight	795.29[a]	85.02[x]	10.68
	Pen Level	Live Weight	796.86[a]	83.06[w]	10.42
		Dressed Weight	795.41[a]	84.94[wx]	10.67
	Individual	Grid A	801.40[b]	90.02[y]	11.23
		Grid B	800.90[c]	86.79[x]	10.83

Note: Means and standard deviations with different superscripts in the same time period are significantly different at the .05 level.

In summary, *marketing the same set of cattle on three different value-based pricing systems would have resulted in three different price premiums/discounts*. Furthermore, marketing cattle with the same carcass characteristics on the same value-based pricing system over different time periods also resulted in different price premiums/discounts. Lastly, *it is difficult to draw any conclusion about the superiority or inferiority of any specific value-based pricing system by only evaluating price premiums/discounts as they change over time and relative to one another.*

Table 7 contains the regression results using individual animal carcass characteristics to explain the individual price premium or discount received from selling on a grid. All of the characteristics are significant with the exception of rib eye area, which is not significant for either grid B or grid C. Marbling is positive but non-linear on each of the grids. However, the magnitude of the impact of marbling on the price premium/discount does vary by grid. The premium associated with marbling is at a maximum when there is sufficient marbling to change from the mid Choice to high Choice grade. There are some differences in the parameters associated with fat thickness between the grids. The premium/discount associated with varying fat thickness for each of the grids is plotted in Figure 1. Back fat is discounted at thicknesses above 0.38, 0.17, and 0.50 inches for grids A, B, and C, respectively. Rib eye area is only significant for explaining premiums/discounts from grid A. There is a premium over the relevant sizes of rib eye and the premium reaches a maximum at 13.2 square inches of rib eye area. There are also differences in how the three grids discount light weight and heavy weight carcasses. Because of

differences in the way the base prices are calculated for each grid, the Choice-Select Spread has a different impact on the premiums/discounts for each grid. On grid B a widening Choice-Select Spread would increase price premiums while on grids A and C the widening spread would decrease price premiums

Table 6. Grid Premiums/Discount for Three Value-based Pricing Systems and Six Time Periods (Dollars/cwt).

	2/6/98	2/21/97	6/20/97	12/19/97	10/24/97	12/6/96
Nebraska Dressed Price	98.47	106.25	105.17	104.84	107.85	114.76
Grid A Base	99.47	107.25	106.56	106.8	111.27	120.25
Average Premium/Discount	0.80	-0.14	-0.67	-0.97	-0.40	-0.55
Maximum Premium/Discount	4.61	4.18	4.47	4.94	6.29	8.11
Minimum Premium/Discount	-9.22	-11.13	-12.72	-14.02	-14.47	-17.17
Grid B Base	98.99	106.77	105.69	105.36	108.37	115.28
Average Premium/Discount	0.99	-0.03	1.36	1.00	1.53	2.37
Maximum Premium/Discount	3.04	2.69	4.09	4.56	5.65	8.43
Minimum Premium/Discount	-5.18	-8.38	-6.82	-8.57	-8.68	-10.30
Grid C Base	98.47	106.25	105.17	104.84	107.85	114.76
Average Premium/Discount	0.99	1.79	3.47	1.00	1.08	1.13
Maximum Premium/Discount	2.59	3.42	8.00	4.82	5.78	7.79
Minimum Premium/Discount	-4.24	-3.49	-5.56	-7.36	-8.18	-10.68

Is one of the grids more efficient at transmitting consumer preferences to producers? This study cannot answer that question. However, not all consumers have the same preference and if different grids are designed with a different consumer targets in mind, then it is logical that the grids should send different signals to producers. *Producers then need to match the type of cattle they are producing to the grid, or value-based pricing system that rewards that type of cattle. If this is accomplished, then there should be an increase in efficiency in the beef industry that should lead to improved alignment with consumer needs and a more viable industry from the producers' viewpoint.*

Table 7. Results of Estimating the Impact of Various Individual Animal Carcass Characteristics on the Premium/Discount Received ($/cwt) for the Individual Animal Under Three Different Grids.

	Grid A	Grid B	Grid C
Intercept	-111.87*	-45.39*	-62.78*
	(2.009)	(1.107)	(1.302)
Marbling Score	40.82*	17.22*	23.07*
	(0.277)	(0.153)	(0.180)
Marbling Score Squared	-3.61*	-1.40*	-1.97*
	(0.029)	(0.016)	(0.019)
Fat Thickness	2.82*	1.50*	6.55*
	(0.726)	(0.400)	(0.471)
Fat Thickness Squared	-7.51*	-9.29*	-13.17*
	(0.749)	(0.412)	(0.485)
Rib Eye Area	1.06*	-0.18	0.48
	(0.296)	(0.163)	(0.192)
Rib Eye Area Squared	-0.04*	0.01	-0.02
	(0.011)	(0.006)	(0.007)
Light Weight Carcass	-13.90*	-19.84*	-25.87*
	(0.497)	(0.274)	(0.322)
Heavy Weight Carcass	-15.38*	-21.26*	-9.74*
	(0.372)	(0.205)	(0.241)
Choice-Select Spread	-0.07*	0.12*	-0.05*
	(0.007)	(0.004)	(0.005)
Adj R^2	60.83	64.23	61.98
F-Statistic	5714.35*	6608.51*	5998.75*
Number of Observations	33,120	33,120	33,120

Note: A single asterisk denotes significance at the .01 level. Standard errors are in parentheses.

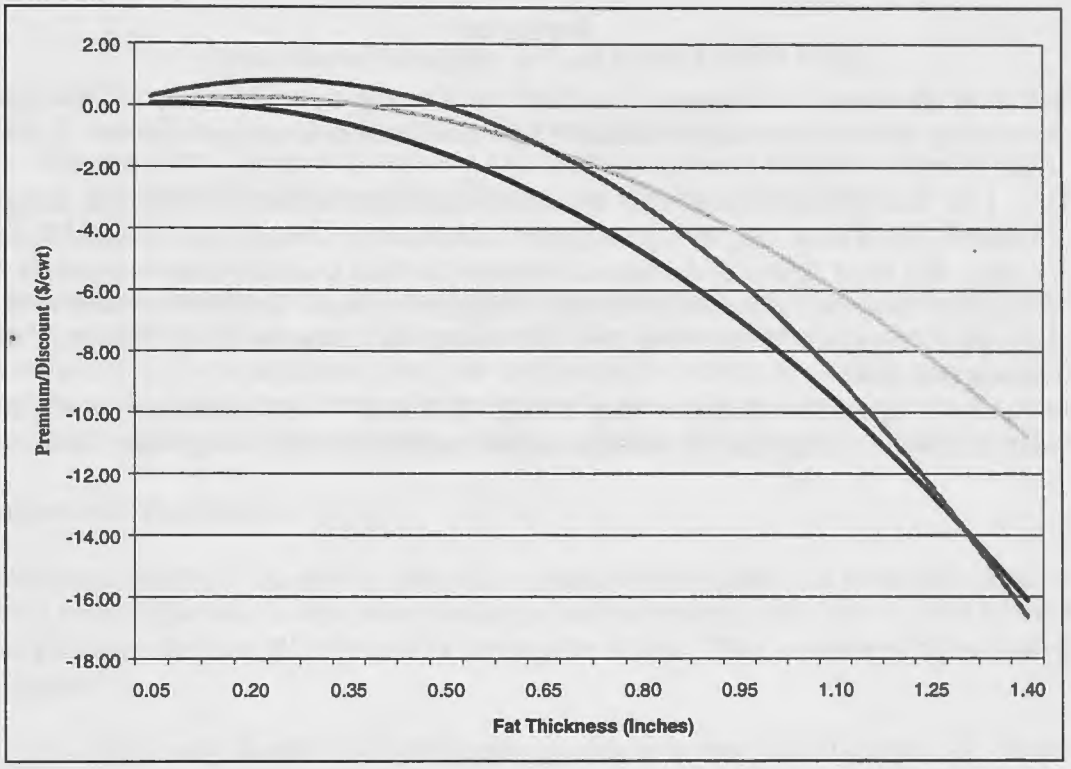

Figure 1. Premium/Discount Associated with Various Levels of Fat Thickness for Three Different Grids.

Summary

Analysis of data on 85 pens, 5,520 head, of fed cattle revealed that method of marketing or marketing level, i.e., show list, pen, or individual, had no significant impact on the variability of revenue on a pen-average basis. This may have been due in part to the manner in which pen level prices were computed and may have been unique to this data set. Mean revenue tended to increase from live weight to dressed weight to grid pricing. *Revenue variability on an individual head basis increased with grid pricing. However, since producers receive payment on a pen basis, this may not be a relevant measure of potential risk. It appears that carcass weight variability may offset or negate some of the price risk variability from pricing on a grid.*

Clearly, market signals are more likely to reach producers if cattle are priced individually. However, present grid pricing practices are sending different price signals to producers over time and across grids. That may not be all bad. Not all consumers desire the same product. *It is likely that pricing efficiency improves with grids and production efficiency may also improve if producers can identify the type of cattle they are producing and sell them on a grid that rewards that type of cattle.* However, there are often additional costs to selling on a grid, and producers may have more costs in sorting cattle to "fit" a grid. Producers must therefore analyze added costs as well as added benefits in deciding what strategy fits their operation.

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Section C

Short-Term Variability in Grid Prices for Fed Cattle

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The overall objective of the research reported in this section was to examine the short-term variability in grid prices. Short-term refers to the variability that can arise on any given day from pricing fed cattle with a formula or negotiated base price and premium-discount grids. Expected variability may arise from alternative base prices, alternative premium-discount grids, packing plant where cattle are slaughtered, and cattle quality characteristics. Results suggest implications both for buyers *and* sellers.

Data Sources and Procedure

This study took a cross-section approach, or examined grid prices at a given point in time. Thus, carcass data for a single point in time were needed, as well as reported prices which could be used as base prices and premium-discount grids in use at a single point in time. Data were provided from several industry sources.

Carcass data were obtained on 140 sale lots of cattle of at least 25,000 pounds (i.e., about 20 head or more) slaughtered on the same day in four plants from Nebraska to Texas (*not* necessarily the same firm). Number of head totaled 19,426. Plants are referred to as Northern Plains 1 and 2 and Southern Plains 1 and 2. Not all packers keep records in the same manner. Therefore, some assumptions were necessary regarding the categories of carcass information kept by packers for the sake of data consistency. These assumptions affected selected results and will be mentioned in the results section. Premium-discount grids were collected for one week and were believed to closely represent premium-discount grids which were reported to the Agricultural Marketing Service (AMS), U.S. Department of Agriculture (USDA) and reported in the *National Carcass Premiums and Discounts for Slaughter Steers and Heifers*. For the week chosen in this study, the week of November 17, 1997, selected sections of the premium-discount summary reported by AMS are shown in Table 1.

Base prices for the analysis were selected by considering reported live weight and dressed weight prices from AMS for the week ending November 15, 1997. Mean dressed weight prices across quality groups in the five-state weighted-average report *(Livestock, Meat and Wool Weekly Summary and Statistics)* ranged from $106 to $107.58/cwt and mean live weight prices (converted to dressed weight prices by dividing by an average 63.3 percent dressing percentage) ranged from $105.67 to 107.33/cwt (Table 2). In addition, an estimate was made of fed cattle prices based on the process followed by packers to estimate fed cattle prices and using summary data for the four plants (Ward, Schroeder, and Feuz). The estimated break-even dressed weight price was $107.05/cwt. From the above reported prices and estimates, selected base prices chosen were: low, $106.00; medium, $107.00; and high, $108.00/cwt. In addition, a plant-average price was estimated following the example in the main body of this research report. Available carcass data from each plant were used along with the medium dressed weight base price.

Several alternative prices were estimated for each of the 140 sale lots of carcass data. Prices assigned to each lot included a live weight and dressed weight price based on the quality category and reported prices in Table 2. In addition, 21 grid prices were estimated using three base prices and seven premium-discount grids. Each base price was assumed to be for Choice, Yield Grade 3 carcasses.

Table 1. Premium-Discount Grids Reported by AMS-USDA for November 17, 1997

	Low ($/cwt)	Ave ($/cwt)	High ($/cwt)
Prime	3.00	5.71	10.00
Choice	0.00	0.00	0.00
Select	-9.00	-9.85	-11.00
Standard	-9.00	-19.70	-30.00
Bullocks, Hard bones			
Dark cutters	-21.00	-32.30	-44.35
YG1	0.00	1.70	3.00
YG2	0.00	0.90	2.00
YG3	0.00	-0.20	-1.00
YG4	-10.00	-16.30	-22.00
YG5	-15.00	-21.30	-27.00
Weight (dressed)			
<550	-13.00	-19.65	-27.50
550/900	0.00	0.00	0.00
>900	-10.00	-19.65	-27.50

Source: *National Carcass Premiums and Discounts for Slaughter Steers and Heifers.* AMS-USDA.

Table 2. Reported Five-State Fed Cattle Prices, Week Ended November 15, 1997

Cattle Category		Dressed Weight ($/cwt dressed weight)	Live Weight Converted To Dressed Weight[a] ($/cwt dressed weight)
Steers	80-100% Choice	107.58	106.76
	65-80% Choice	107.22	106.21
	35-65% Choice	107.12	107.33
	20-35% Choice	106.00	105.67

Source: *Livestock, Meat and Wool Weekly Summary and Statistics.* AMS-USDA

[a] Converted from live weight price to dressed weight price by a fixed 63.3 dressing percentage.

Prices were summarized across alternative base prices and premium-discount grids, both across sale lots and plants. These summaries show the variation *within a given day* across sale lots of cattle. Prices also were summarized across premium-discount grids within each sale lot. These summaries show how much prices may vary *for the same cattle* using alternative premium-discount grids.

Seven grid prices were estimated for each of the 140 sale lots using a common base price. Therefore, to aid in summarizing the effects of carcass attributes on prices and price variability across premium-discount grids, three regression models were estimated. The three models were intended to identify the relative importance of carcass attributes which receive premiums and those which are discounted on prices and price variability. Models of the following form were estimated by OLS regression:

(1) Std Dev of Mean Price = f (%Prime, %Select, %Standard, %YG1, %YG2, %YG4-5, %Light, %Heavy, %Outs)
(2) Mean Price = f (%Premium attributes, %Discount attributes), and
(3) Std Dev of Mean Price = f (%Premium attributes, %Discount attributes).

Variables are defined as follows:

- Std Dev of Mean Price is the standard deviation of prices across seven grids for the same sale lot of cattle
- Each "%" variable is the percentage of the sale lot which consisted of those attributes, i.e., Prime, Select, Standard quality grades, Yield Grades 1, 2, and 4-5, carcasses less than 550 lb or over 900 lb, and "out" or non-specification carcasses such as dark cutters, heiferettes, hard bones, dairy breeds, etc.
- Mean Price is the average of prices across seven grids, assuming a common base price, for each sale lot of cattle
- % Premium attributes is the sum of carcass attributes in the sale lot which receive premiums in most grids, i.e., %Prime, %YG1, and %YG2
- % Discount attributes is the sum of carcass attributes in the sale lot which receive discounts in most grids, i.e., %Select, %Standard, %YG4-5, %Light, %Heavy, and %Outs.

Carcass Data Summary

Table 3 summarizes the carcass data collected from the four packing plants. It is important to keep in mind *these data were for one day's slaughter*. Variation attributable to seasonality and other factors is not reflected in these data. Feeder cattle were purchased under similar market conditions, fed under similar weather conditions, and marketed as finished cattle in response to similar market conditions. Therefore, this analysis illustrates the variation that existed within and between sale lots and within and between packing plants *on the same day*.

Average lot size varied across packing plants though the range within each plant was similar. Average dressed and live weights were similar for three plants and significantly lower for one plant (Southern Plains 2). Average dressing percentage was relatively consistent across plants even though weights were not.

The percentage of carcasses grading Prime was estimated from the percentage of Choice or above in each sale lot. The mean %Prime carcasses from three independent data sets of cattle used in this formula/grid pricing project by the co-investigators (for Sections A, B, and C) were used to estimate the %Prime carcasses consistently across all plants for this set of carcass data (Table 4). Thus, as %Choice increased, so did %Prime. Note that the percentage of %Choice carcasses differed significantly between the two Northern Plains plants and two Southern Plains plants. Some cattle feeders assert that Northern Plains cattle are higher quality than Southern Plains cattle and thus a higher percentage are marketed on a carcasses weight or grid basis (Schroeder *et al.*). As expected, results for %Select were the reverse for the four plants, i.e., lower for the Northern Plains plants and higher for the Southern Plains plants. The percentage of %Standard carcasses varied widely, in part due to the way in which data were provided and

Table 3. Carcass Data Summary Statistics, by Plants and Total

Variable	Statistic	Plant				Total
		Northern Plains 1	Northern Plains 2	Southern Plains 1	Southern Plains 2	
Lot Size (head)	N	52	22	25	41	140
	Mean	92	196	199	131	139
	Std Dev	95.9	147.1	107.7	92.4	114.4
	Min	23	32	41	30	23
	Max	570	524	423	392	570
Average Dressed Weight (lb)	Mean	788	791	776	729	769
	Std Dev	65.0	65.8	58.3	61.6	67.7
	Min	665	649	639	632	632
	Max	891	870	878	887	891
Average Live Weight (lb)	Mean	1242	1252	1225	1155	1215
	Std Dev	96.1	98.3	98.2	101.1	105.0
	Min	1054	1048	997	996	996
	Max	1401	1389	1388	1419	1419
Average Dressing Percentage (%)	Mean	63.5	63.1	63.4	63.2	63.3
	Std Dev	2.0	1.2	1.2	2.5	1.9
	Min	59.4	59.5	60.3	48.9	48.9
	Max	71.5	65.0	64.8	64.8	71.5
% Prime	Mean	2.3	1.7	0.8	0.8	1.5
	Std Dev	2.1	1.3	1.3	1.1	1.7
	Min	0.0	0.0	0.0	0.0	0.0
	Max	7.3	4.4	4.5	4.2	7.3
% Choice	Mean	59.6	58.7	45.1	45.0	52.6
	Std Dev	17.4	11.2	15.4	15.7	17.1
	Min	17.1	32.9	14.6	17.8	14.6
	Max	87.4	76.1	76.6	75.4	87.4
% Select	Mean	30.7	37.9	40.6	45.0	37.8
	Std Dev	17.7	12.3	13.0	13.9	16.0
	Min	2.7	20.0	11.5	17.8	2.7
	Max	71.4	67.1	58.7	71.1	71.4
% Standard	Mean	7.4	1.7	13.6	9.2	8.2
	Std Dev	7.7	2.3	10.6	8.4	8.6
	Min	0.0	0.0	0.0	0.0	0.0
	Max	34.8	8.2	51.0	38.5	51.0

Table 3. Carcass Data Summary Statistics, By Plant and Total (continued)

Variable	Statistic	Plant				Total
		Northern Plains 1	Northern Plains 2	Southern Plains 1	Southern Plains 2	
%YG1	Mean	11.9	12.0	24.1	14.8	14.9
	Std Dev	10.3	8.8	15.7	10.8	12.1
	Min	0.0	0.0	5.6	0.0	0.0
	Max	44.4	34.4	83.8	37.5	83.8
% YG 2	Mean	42.9	49.0	46.9	51.4	47.1
	Std Dev	14.6	11.7	10.2	12.2	13.1
	Min	8.8	18.1	16.2	32.2	8.8
	Max	79.5	62.9	65.9	84.0	84.0
% YG3	Mean	41.1	36.2	27.1	30.8	34.7
	Std Dev	16.3	15.1	11.2	14.4	15.6
	Min	6.9	8.6	0.0	4.0	0.0
	Max	70.2	63.4	54.7	58.5	70.2
% YG4/5	Mean	4.2	2.8	1.8	3.2	3.3
	Std Dev	5.1	4.9	2.6	3.9	4.4
	Min	0.0	0.0	0.0	0.0	0.0
	Max	21.0	21.0	10.9	18.6	21.0
% Light	Mean	0.1	1.1	0.4	1.0	0.6
Carcasses	Std Dev	0.4	3.9	1.0	1.3	1.8
(<550 lb)	Min	0.0	0.0	0.0	0.0	0.0
	Max	2.0	18.4	4.3	5.3	18.4
% Heavy	Mean	3.3	4.5	3.2	2.2	3.2
Carcasses	Std Dev	5.0	4.8	5.6	5.1	5.1
(> 900 lb)	Min	0.0	0.0	0.0	0.0	0.0
	Max	21.5	13.4	22.0	25.7	25.7
% "Out"	Mean	3.5	0.9	7.1	3.6	3.8
Carcasses	Std Dev	7.2	2.0	16.8	15.1	11.7
	Min	0.0	0.0	0.0	0.0	0.0
	Max	37.8	9.1	78.1	96.0	96.0

interpreted. Included in %Standard carcasses were no roll or ungraded Select carcasses as well as Standard carcasses. Thus, the range of %Standard in the 140 lots was wide, and wider than would be expected if *only* carcasses grading Standard were included.

Table 4. Percentage of Prime Carcasses in Three Sets of Cattle[a]

	Percent Prime			
Percent Choice	Set 1	Set 2	Set 3	Average
0-10	0.00	0.00	0.00	0.00
10-19	0.00	0.07	0.00	0.02
20-29	0.39	0.31	0.00	0.23
30-39	0.35	0.54	0.00	0.30
40-49	0.42	0.59	0.24	0.42
50-59	0.93	0.85	0.08	0.62
60-69	1.33	1.73	0.94	1.33
70-79	2.65	2.51	2.74	2.63
80-89	6.78	5.12	5.66	5.85
90-100	11.39	7.52	3.95	7.62

[a] Sets 1 - 3 were carcass data from different sources which was used for the analysis in Sections A and B of this research report.

The percentage of %YG1, %YG2, and %YG3 carcasses varied somewhat among plants. Carcasses in the two Southern Plains plants were somewhat leaner than those in the Northern Plains plants, which would be expected given the differences in quality grades across plants. The percentage of %YG4-5 carcasses tended to be correlated with a higher percentage of carcasses grading Choice and Prime.

Carcass weights have trended higher in recent years, resulting in more heavier carcasses than lighter carcasses. Heavier carcasses were assumed to be greater than 900 lb and lighter carcasses were those less than 550 lb. The percentage of "out" carcasses, those not meeting desired carcasses specifications of packers, included dark cutters, heiferettes, condemned carcasses, and dairy breeds. Thus, the range of %Out carcasses in this set of carcass data was wider than would be expected if dairy carcasses had been excluded.

One point can be concluded clearly from the summary of carcass data. Cattle feeders bring a widely varying set of cattle to packers daily. Packers are then expected to sort and process those carcasses, and market a broad array of product types, sizes, and qualities to a wide set of target markets. Quality inconsistency has been identified as a problem for the beef industry and these carcass data, for a single day, confirm the concern based solely on generic quality attributes. Attributes such as tenderness, flavorfulness, and juiciness which are critically important to consumers were not even considered but would likely further increase the variability of cattle brought to packers.

Price Variation Summary

Base Prices - The focus of this project was on the variation across premium-discount grids. However, it should be noted that significant variation occurs in the base price as well. Plant average base prices were calculated from the one-day slaughter data according to the procedure described in the main body of this research report. The estimated plant average base price for Choice, Yield Grade 3 cattle ranged from $112.91 to $110.74/dressed cwt, a variation of $2.17/cwt or over $16/head. Thus, cattle

feeders may experience a significant difference in the base price when the base price is tied to a plant average cost of cattle. The plant average base depends on the quality of a given pen of cattle relative to the quality slaughtered *in that plant* for the period in which the plant average is calculated, usually the preceding week or a three to four week moving average.

When the base price is tied to a reported market price, the base price may also vary significantly. For the week chosen for this study, the base price varied over $2/cwt or over $15/head. These variations in the base price occur *before* considering any variation from the premium-discount grids and variation in cattle quality.

Prices and Price Grids - Table 5 shows mean prices and price variation associated with each grid and a single base price for the 140 pens of cattle across the four plants. Also shown are mean prices and price variation for live weight and dressed weight prices. Readers are cautioned that *mean live weight and dressed weight prices are not comparable with mean grid prices*. Reported prices have already been adjusted for the estimated cattle quality composition within sale lots during the price discovery process between packers and feeders. Thus, using base prices representing the range of reported prices, then adjusting them for cattle quality and premium-discount grids, is essentially a double adjustment for cattle quality variation. What is important in Table 5 between live and dressed prices and grid prices is the variation, expressed as the standard deviation (std dev) across sale lots and pricing alternatives. "Average" pricing on a live weight or dressed weight basis results in little price variation within and between plants and among sale lots. This finding supports previous work by Feuz, Fausti, and Wagner. This small amount of variation is one attraction to using "average" pricing, both by packers and feeders. Price variation with all grids exceeds the price variation with "average" pricing.

Mean grid prices varied across grids by $2.38, $2.35, $2.92, and $2.61/cwt (or $18 to $22/head) for the four plants (Northern Plains 1 to Southern Plains 2, respectively). Thus, the variation from different grids exceeded the variation from the base price. However, together, the variation could exceed $5/cwt on a dressed weight basis or over $38/head.

The variation in mean prices across plants within a single grid also varied, ranging from $2.94/dressed cwt for grid 7 to $5.76/cwt for grid 2 or $22 to $45/head. Quality of the cattle slaughtered varies from plant to plant which, when combined with alternative premium-discount grids, results in substantial variation.

Thus far, we have only discussed mean prices, not the full range of estimated prices (maximum less minimum price). Much less variation can be expected in mean prices than prices for individual sale lots, yet the variation in mean prices across grids and plants is considerable. Recall, also, this is for a single day's slaughter. Additional variation would occur had data been collected for several slaughter days.

Quality variation and the variation in grid prices can be shown better in Tables 6-9. For those tables, sale lots were sorted into similar groups based on the percentage of Choice carcasses in the sale lot. Then, prices were summarized within like groups of cattle for each grid and each plant. Number of observations in some quality groups was small, especially in the lowest and highest quality groups for each plant. In general and as expected, mean prices increased with higher quality groups of cattle (i.e., sale lots with a higher percentage of Choice carcasses) within all grids. In general, the standard deviation or variation in prices also increased with higher quality groups of cattle within all grids.

Table 5. Summary Statistics for Alternative Prices: Live Weight, Dressed Weight, Seven Grids with Medium Base Price, by Plants and Total (in $/dressed cwt)[a]

Price	Statistic	Plant				Total
		Northern Plains 1	Northern Plains 2	Southern Plains 1	Southern Plains 2	
Live Weight[b]	N	52	22	25	41	140
	Mean	106.65	107.00	106.69	106.60	106.70
	Std Dev	0.62	0.56	0.76	0.78	0.69
	Min	105.67	105.67	105.67	105.67	105.67
	Max	107.33	107.33	107.33	107.33	107.33
Dressed Weight	Mean	107.07	107.09	106.82	106.75	106.94
	Std Dev	0.41	0.25	0.52	0.55	0.48
	Min	106.00	106.00	106.00	106.00	106.00
	Max	107.58	107.22	107.22	107.22	107.58
Grid One	Mean	100.68	101.56	98.16	99.14	99.92
	Std Dev	2.97	2.08	4.26	4.54	3.79
	Min	91.69	95.51	81.55	76.20	76.20
	Max	105.62	105.44	103.99	104.39	105.62
Grid Two	Mean	100.29	102.19	96.43	98.57	99.40
	Std Dev	4.54	2.12	7.04	7.15	5.90
	Min	84.91	96.70	69.02	60.75	60.75
	Max	106.40	106.18	105.14	105.36	106.40
Grid Three	Mean	99.22	100.18	96.22	97.52	98.34
	Std Dev	3.56	2.22	5.06	5.16	4.39
	Min	89.34	95.82	76.76	72.93	72.93
	Max	105.22	104.98	103.31	103.70	105.22
Grid Four	Mean	101.60	102.53	99.08	99.93	100.81
	Std Dev	2.78	1.70	3.32	3.89	3.32
	Min	93.22	98.39	86.90	81.54	81.54
	Max	106.22	105.85	104.92	105.17	106.22
Grid Five	Mean	100.56	101.87	97.80	99.10	99.85
	Std Dev	3.68	2.18	5.91	6.05	4.90
	Min	89.20	96.55	73.88	66.30	66.30
	Max	105.94	105.89	105.12	105.01	105.94

Table 5. Summary Statistics for Alternative Prices: Live Weight, Dressed Weight, Seven Grids with Medium Base Price, by Plants and Total (in $/dressed cwt)[a] (con't)

Price	Statistic	Plant: Northern Plains 1	Northern Plains 2	Southern Plains 1	Southern Plains 2	Total
Grid Six	Mean	100.92	101.93	98.21	99.48	100.17
	Std Dev	3.30	1.76	5.27	5.33	4.36
	Min	91.12	98.62	76.91	71.22	71.22
	Max	105.75	105.63	104.84	105.01	105.75
Grid Seven	Mean	101.34	102.08	99.14	100.13	100.71
	Std Dev	3.32	2.17	6.34	5.92	4.77
	Min	91.18	97.03	72.56	66.60	66.60
	Max	106.22	106.13	105.16	105.33	106.22

[a] See text for discussion of *non-comparability* of mean prices for live and dressed weight versus price grids.

[b] Live weight prices were converted to dressed cwt by an average 63.3 dressing percentage.

In some cases within a quality group and grid for each plant, relatively little variation in the range of prices for individual sale lots was found. For example, there were six sale lots in the Northern Plains 1 plant that had 20-39 percent Choice carcasses in the sale lots. The range in price across the six lots ranged from $1.37 for grid 4 to $2.74/cwt for grid 7. While that variation is important, over $10/head, it is small compared with most other quality groups. In the adjacent quality group (40-59 percent Choice), among the 17 sale lots, prices ranged from $9.91 to $18.23/cwt for grids 4 and 2, respectively, a difference exceeding $65/head.

Examining the minimum and maximum prices within quality groups, grids, and plants reveals large ranges, especially low minimum prices relative to the mean. For example, in the 40-59 percent Choice group for the Southern Plains 2 plant, prices ranged widely. Recall that we had to make some assumptions about carcass characteristics for the sake of data consistency. It is possible that sale lots which have very low prices had dairy cattle which were categorized as "out" carcasses for grid pricing purposes. As a result, those sale lots were severely price discounted. However, this phenomenon occurred relatively infrequently. In most cases, within similar quality groups, grids, and plants, prices still ranged from $4 to $10/cwt or $30 to $77/head.

Variation within Sale Lots - Marketing fed cattle with a premium-discount grid involves two strategies, one long-run and one short-run, as discussed in the main body of this research report. True value-based marketing means changing cattle to meet consumer preferences for beef products from those animals. This takes time, genetic improvements, feeding to correct end points, etc. In the short-run, a given set of cattle with given attributes can be priced with one of several alternative grids. This section discusses how much variation there is *for the same cattle on the same day* with alternative grid prices. This does *not* consider the significant variation arising from alternative base prices as discussed earlier which must be *added* to the variation discussion below to fully recognize and appreciate the true amount of variation with grid pricing.

Table 6. Summary Statistics, Seven Grids, Medium Base Price, by Quality Group and Plant (in $/dressed cwt)

		Plant – Northern Plains 1 Quality Group (% Choice)				
Price	Statistic	0-19	20-39	40-59	60-79	80-100
Grid One	N	1	6	17	23	5
	Mean	96.87	99.15	99.78	101.75	101.38
	Std Dev	--	0.56	2.79	2.94	3.95
	Min	96.87	98.40	91.69	93.18	94.95
	Max	96.87	99.86	103.05	105.62	105.22
Grid Two	Mean	96.01	98.39	98.82	101.80	101.48
	Std Dev	--	0.79	4.66	4.10	7.01
	Min	96.01	97.56	84.91	88.89	89.21
	Max	96.01	99.58	103.14	106.40	106.29
Grid Three	Mean	94.41	97.27	98.07	100.53	100.46
	Std Dev	--	0.66	3.30	3.54	4.39
	Min	94.41	96.62	89.34	90.45	93.54
	Max	94.41	98.13	102.11	105.22	104.81
Grid Four	Mean	97.18	99.39	100.48	102.86	103.16
	Std Dev	--	0.53	2.42	2.46	3.39
	Min	97.18	98.78	93.22	95.83	97.46
	Max	97.18	100.15	103.14	105.97	106.22
Grid Five	Mean	96.56	99.27	99.71	101.66	100.71
	Std Dev	--	0.80	3.46	3.74	5.51
	Min	96.56	98.23	89.20	90.20	91.48
	Max	96.56	100.35	103.27	105.94	105.54
Grid Six	Mean	96.81	99.23	99.97	102.05	101.78
	Std Dev	--	0.75	3.02	3.20	4.94
	Min	96.81	98.35	91.12	92.17	93.36
	Max	96.81	100.31	103.14	105.75	105.75
Grid Seven	Mean	98.18	100.58	100.94	102.11	100.74
	Std Dev	--	1.11	2.90	3.54	5.33
	Min	98.18	99.37	92.27	91.18	91.96
	Max	98.18	102.11	104.19	106.23	105.61

Table 7. Summary Statistics, Seven Grids, Medium Base Price, by Quality Group and Plant (in $/dressed cwt)

		Plant – Northern Plains 2 Quality Group (% Choice)				
Price	Statistic	0-19	20-39	40-59	60-79	80-100
Grid One	N	0	2	8	12	0
	Mean	--	100.47	100.30	102.59	--
	Std Dev	--	0.02	2.11	1.71	--
	Min	--	100.45	95.51	98.16	--
	Max	--	100.48	102.12	105.44	--
Grid Two	Mean	--	101.00	100.74	103.35	--
	Std Dev	--	0.20	2.03	1.63	--
	Min	--	100.86	96.70	99.55	--
	Max	--	101.14	102.72	106.18	--
Grid Three	Mean	--	98.85	98.92	101.24	--
	Std Dev	--	0.16	1.69	2.21	--
	Min	--	98.73	95.82	96.00	--
	Max	--	98.97	100.78	104.98	--
Grid Four	Mean	--	100.84	101.34	103.61	--
	Std Dev	--	0.08	1.31	1.26	--
	Min	--	100.78	98.39	100.42	--
	Max	--	100.89	102.62	105.85	--
Grid Five	Mean	--	100.98	100.52	102.92	--
	Std Dev	--	0.19	1.88	2.05	--
	Min	--	100.85	96.55	97.37	--
	Max	--	101.12	102.36	105.89	--
Grid Six	Mean	--	100.84	100.79	102.88	--
	Std Dev	--	0.25	1.27	1.65	--
	Min	--	100.66	98.62	98.90	--
	Max	--	101.02	102.20	105.63	--
Grid Seven	Mean	--	101.51	100.83	103.01	--
	Std Dev	--	0.45	1.78	2.19	--
	Min	--	101.19	97.17	97.03	--
	Max	--	101.83	102.62	106.13	--

Table 8. Summary Statistics, Seven Grids, Medium Base Price, by Quality Group and Plant (in $/dressed cwt)

		Plant – Southern Plains 1 Quality Group (% Choice)				
Price	Statistic	0-19	20-39	40-59	60-79	80-100
Grid One	N	1	11	8	5	0
	Mean	94.48	99.03	99.59	94.70	--
	Std Dev		1.18	2.00	8.58	--
	Min	94.48	97.77	95.37	81.55	--
	Max	94.48	101.27	101.52	103.99	--
Grid Two	Mean	89.72	97.97	99.06	90.19	--
	Std Dev		1.98	2.93	13.86	--
	Min	89.72	95.99	92.86	69.02	--
	Max	89.72	101.81	101.56	105.14	--
Grid Three	Mean	91.73	97.13	98.03	92.18	--
	Std Dev	--	1.48	2.09	10.30	--
	Min	91.73	95.35	94.03	76.77	--
	Max	91.73	99.82	100.16	103.31	--
Grid Four	Mean	94.52	99.37	100.28	97.44	--
	Std Dev	--	1.08	1.56	6.89	--
	Min	94.52	98.06	97.00	86.90	--
	Max	94.52	101.53	101.81	104.92	--
Grid Five	Mean	94.98	99.36	99.55	92.15	--
	Std Dev	--	1.33	2.49	11.82	--
	Min	94.98	97.67	94.24	73.88	--
	Max	94.98	101.84	101.93	105.12	--
Grid Six	Mean	95.48	99.41	99.96	93.32	--
	Std Dev	--	1.20	2.02	10.67	--
	Min	95.48	97.87	95.69	76.91	--
	Max	95.48	101.59	101.86	104.85	--
Grid Seven	Mean	100.36	101.18	100.57	92.13	--
	Std Dev	--	0.96	2.40	12.31	--
	Min	100.36	99.20	95.43	72.56	--
	Max	100.36	102.33	102.81	105.16	--

Table 9. Summary Statistics, Seven Grids, Medium Base Price, by Quality Group and Plant (in $/dressed cwt)

		Plant – Southern Plains 2 Quality Group (% Choice)				
Price	Statistic	0-19	20-39	40-59	60-79	80-100
Grid One	N	1	17	13	10	0
	Mean	97.84	98.05	97.96	102.65	--
	Std Dev	--	2.27	6.90	0.95	--
	Min	97.84	91.90	76.20	101.00	--
	Max	97.84	101.30	102.63	104.39	--
Grid Two	Mean	97.53	97.03	96.88	103.51	--
	Std Dev	--	3.74	11.15	1.03	--
	Min	97.53	86.75	60.75	101.66	--
	Max	97.53	102.20	103.70	105.37	--
Grid Three	Mean	95.51	96.02	96.31	101.87	--
	Std Dev	--	2.70	7.57	1.05	--
	Min	95.51	89.37	72.93	99.95	--
	Max	95.51	99.67	101.65	103.71	--
Grid Four	Mean	98.29	98.58	99.12	103.44	--
	Std Dev	--	1.96	5.56	0.86	--
	Min	98.29	93.48	81.54	101.94	--
	Max	98.29	101.57	103.04	105.17	--
Grid Five	Mean	98.18	98.21	97.20	103.15	--
	Std Dev	--	2.73	9.61	1.14	--
	Min	98.18	90.29	66.30	100.93	--
	Max	98.18	102.03	103.04	105.01	--
Grid Six	Mean	98.04	98.43	97.95	103.38	--
	Std Dev	--	2.40	8.33	0.87	--
	Min	98.04	91.65	71.22	101.73	--
	Max	98.04	101.57	102.99	105.01	--
Grid Seven	Mean	99.69	99.88	97.84	103.55	--
	Std Dev	--	2.16	9.70	1.14	--
	Min	99.69	92.95	66.60	101.38	--
	Max	99.69	102.23	103.27	105.33	--

Table 10. Frequency Distribution of the Range in Prices Across Seven Grids within Each Plant

Price Range ($/dressed cwt)	Northern Plains 1	Northern Plains 2	Southern Plains 1	Southern Plains 2	Total
		(Number of Sale Lots)			
Less than 2.00	12	7	1	11	31
2.00-3.99	31	14	14	19	78
4.00-5.99	4	1	6	7	18
6.00-7.99	3	0	1	3	7
8.00 or More	2	0	3	1	6
Total	52	22	25	41	140

Recall each sale lot was priced with seven alternative grids for each base price. The following assumes a constant base price. Therefore, variation is attributable for each sale lot to alternative grids and to cattle attributes. Table 10 shows a frequency distribution of the range in prices across the seven grids within each plant for all sale lots. The price range for over half the sale lots (55.7 percent) ranged from $2.00 to $3.99/dressed cwt or $15 to $31/head. Those sale lots which ranged in excess of $8.00/cwt may have included dairy animals or had other carcass characteristics that were discounted severely. While readers might discount the results for these lots as being unrepresentative of most cattle sold with grids, sale lots in the $4.00 to $7.99/cwt range (or $31 to $62/head) are not likely data anomalies. These lots, 17.9 percent of the total, contained sufficient numbers of carcasses that were discounted in grids to widen the range in mean prices across grids. Thus, marketing a given sale lot of cattle on any given day can result in wide differences in prices due to the premium-discount grid used *and* cattle quality.

Regression results emphasize the importance of cattle quality on mean prices and price variation across premium-discount grids. Note for this analysis, the base price was associated with Choice YG 3 carcasses. Average premiums and discounts were shown in Table 1 but are worth repeating here (in round numbers/dressed cwt). Premiums were associated with %Prime ($0.06), %YG1 ($0.02), and %YG2 ($0.01) carcasses. Thus, premiums were relatively small. Discounts were more important. Discounts were associated with %Select ($0.10), %Standard ($0.20), %YG4-5 ($0.19), %Light ($0.20), %Heavy ($0.20), and %Out ($0.32) carcasses. Discounts clearly exceeded premiums. *The message is that mean price variation across grids was strongly affected by those cattle characteristics which are discounted severely.*

Results in Table 11 are for the regression model in which carcass characteristics were included to explain the variation in standard deviation of prices for each sale lot across the seven grids. Overall, the model explained 94 percent of the variation in the standard deviation of grid prices for each sale lot across seven grids. All carcass characteristics except %Light carcasses significantly added variability to grid prices. Since there were relatively few %Light carcasses, these results are not surprising. Characteristics contributing the most to variability were %Prime and %Out carcasses. As the percentage of those characteristics increase in a sale lot, more variability can be expected across grids. Thus, the two most extreme carcasses characteristics (%Prime and %Out) contributed most to the variability of grid prices for a given sale lot across the seven grids.

The other two models estimated attempted to group all carcass characteristics that typically receive premiums and all characteristics which are discounted. Results in Table 12 show that all carcass

characteristics typically receiving premiums contribute far less to variation in the price level and to variability (standard deviation) across grids than do all the carcass characteristics which are discounted.

The contribution to mean price from positive carcass characteristics was $0.02/dressed cwt, while the negative contribution from carcass characteristics which are discounted was $0.19/cwt. Discounted characteristics also contributed significantly to variability, while characteristics which receive premiums did not.

Recall that Choice YG 3 carcasses were the base for this analysis and that some packers use other carcass specifications as the base or standard. Coefficient signs and magnitudes would differ with another set of base specifications, such as Select YG 2 or a floating base between Choice and Select.

Table 11. Regression Results on Standard Deviation of Grid Prices from Carcass Characteristics and Alternative Grids

Dependent Variable Standard Deviation of Mean Price	
Independent Variable	Coefficient ($/dressed cwt)
Intercept	0.031
	(0.19)
%Prime	0.086*
	(3.77)
% Choice	Base
%Select	0.010*
	(4.25)
%Standard	0.033*
	(12.73)
%YG1	0.005*
	(3.14)
%YG2	0.004*
	(2.64)
%YG3	Base
%YG4-5	0.018*
	(3.60)
% Light	0.007
	(0.78)
%Heavy	0.026*
	(8.48)
%Out	0.047*
	(30.99)
n	140
R^2	0.94

[a] Absolute value of calculated t statistics are given in parentheses;
*Indicates 0.01 significance level.

Table 12. Regression Results on Mean Grid Prices and Standard Deviation of Grid Prices from Groups of Carcass Characteristics and Alternative Grids

Dependent Variable			
Mean Price		Standard Deviation of Mean Price	
Independent Variable	Coefficient [a] ($/dressed cwt)	Independent Variable	Coefficient ($/dressed cwt)
Intercept	109.31* (137.34)	Intercept	-0.054 (0.30)
%Premiums	0.025 (2.02)	%Premiums	0.002 (0.92)
%Discounts	-0.194* (18.32)	%Discounts	0.023* (9.46)
n	140	n	140
R^2	0.72	R^2	0.45

[a] Absolute value of calculated t statistics are given in parentheses; asterisk indicates 0.01 significance level.

Summary - Grid prices vary considerably more than the variation in live weight or dressed weight prices. However, such variation is essential in a value-based marketing system. All carcasses should not receive the same price because they are not of the same value to packers, retailers, and consumers. To achieve pricing accuracy and send clearer signals to producers, better quality cattle should be rewarded and poorer quality cattle should be discounted. Combined, that means increased price variation. Thus, price variation of this type is positive and essential to industry progress, not a negative result of grid pricing. However, cattlemen must be aware that greater variation exists with grid pricing.

With grid pricing, cattlemen must be aware of the variation in base price, whether from using plant averages or reported prices. From both base price sources *on the same day*, prices may vary $2/dressed cwt or more or about $15/head. Considerable variation also exists across premium-discount grids. *For the same cattle, on the same day, with the same base price*, the variation was $2 to $4/cwt ($15 to $30/head) over half the time in the sale lots studied here. For sale lots with a high percentage of cattle whose carcass characteristics were severely discounted (Standard, YG 4-5, Heavy, and Out carcasses), the variation was considerably more than $4/cwt. These lower quality carcass characteristics need to be avoided if producers want to experience higher overall prices with grid pricing compared with live weight or dressed weight pricing. From an industry standpoint, these lower quality groups of cattle need to be eliminated from the market mix, through genetic selection, feeding practices, improved handling, or other methods.

Conclusions

This research was intended to examine the variability in grid pricing that can occur within a given day or week for a given set of cattle. Data for one day's slaughter from four plants revealed considerable variation in cattle brought to slaughter by cattle feeders. Within-day, within-plant and between-plant variation is likely not appreciated fully by cattle producers. The variability is only one element of the broader problem the industry faces regarding quality and consistency of final products for consumers.

Examining live weight and dressed weight pricing reveals one reason both feeders and packers continue to use them. Price variability is low and poorer quality cattle bring almost as much as better quality cattle, even across sale lots.

Several sources of variation exist in grid pricing. *Base prices can vary $2/dressed cwt, or $15/head, whether using plant averages or formulas tied to reported cash-market prices.* Prices across grids can add another $2-4/cwt of variation, another $15 to $30/head. In addition, variation in carcass characteristics contributes significantly to the variation in grid pricing, especially discounted characteristics such as Select and Standard carcasses, Yield Grade 4-5 carcasses, light and heavy carcasses, and non-conforming or "out" carcasses. *Relatively large numbers of carcasses with discounted characteristics alone can double the amount of variation arising from grid pricing.*

Grid pricing is a step towards value-based pricing when used correctly. Cattlemen can learn much about the cattle they market with grid pricing and can then use the information to make genetic and management improvements. However, simply trying to match a given sale lot of cattle to the best grid, while potentially beneficial from a short-run price, revenue, and profit perspective, is *not* moving the industry to value-based marketing. *Only when genetic and management changes result from grid pricing information can long-term value-based marketing be achieved.*

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