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Merits of Value Discovery Alternatives for Fed Cattle and Carcasses

Clement E. Ward, Ted C. Schroeder, Tommy L. Wheeler,

James Mintert, and James S. Drouillard

Professor of Agricultural Economics at Oklahoma State University, Professor of Agricultural Economics at Kansas State University, Research Food Technologist at the USDA Meat Animal Research Center, Professor of Agricultural Economics at Kansas State University, and Professor of Animal Sciences and Industry at Kansas State University.

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Fed cattle pricing methods are changing rapidly. Live-weight and dressed-weight pricing, where the same price is paid for all cattle in a sale lot, are being replaced by grid pricing, where each animal or like groups of animals in a sale lot are priced separately (Schroeder et al. 2002). In 1996, 82% of fed cattle were marketed on a live or carcass-weight pricing method and 16% were sold using grids. By 2001, comparable percentages were 53% and 45%, respectively. By 2006, expected percentages are 33% and 62%, respectively, according to cattle feeder respondents.

Grid pricing of fed cattle enhances value signaling from packers to cattle feeders and is thought to more accurately reflect wholesale value than either live weight or carcass weight pricing (Schroeder and Graff). Higher quality animals no longer subsidize lower quality animals, as is the case with live- or dressed-weight average pricing. Research also has shown that as pricing methods change, from live weight pricing to carcass weight pricing, to grid pricing, prices *on average* increase (Feuz, Fausti, and Wagner). This occurs in part because the risk for carcass attributes shifts from packers to cattle feeders. And in economics, risk acceptance is associated with the increased possibility, though not necessarily probability, of higher returns.

However, grid pricing in its current form has some inherent weaknesses and some assumptions surrounding grid pricing are questionable. This paper addresses these weaknesses and considers possible alternatives.

Base Prices in Grids

Grid pricing consists of a base price and a set (matrix or grid) of carcass premiums and discounts. Several different methods could be used to determine or discover the base price. These different methods have advantages and disadvantages.

Local Cash Market or Plant-Average Formula Base Prices

The current, most common method of discovering the base price is predominantly a formula tied to another price (Schroeder et al. 2002). The base may be a market price quote reported by USDA for a given, predetermined time period and location; or a plant average price (i.e., packer cost) for a predetermined time period at the packing plant where cattle being priced will be harvested. Advantages of this type of pricing method include:

- Formula pricing in this manner is an easy, low cost way for the parties to determine the base price,
- In the case when the local cash market price is used as a base, that price is reported by an independent third party (the USDA).
- This type of base price will be similar to and closely follow local cash market fed cattle prices; which, if local prices are reflective of market conditions, assures that the base price is representative of current market fundamentals.

However, concerns with base prices tied to cash or plant averages are formidable:

- Feeders are tying the price for their cattle to a price packers have a natural, normal, economic incentive to keep as low as possible. After all, fed cattle prices represent a large component of total input costs to packers.
- Better quality cattle tend to be priced using a grid and poorer quality cattle are priced on a live-weight basis. This creates a "lemons" problem. Poorer quality cattle are serving as the "standard" quality for the base price for higher quality cattle. As more higher quality cattle are priced via grid, lower quality cattle comprise the base cash market price. Thus, over time, the cash market price to which the base price is tied could be expected to decline, *ceteris paribus*.
- Price signals may be skewed because cattle marketed to a given plant are being compared to the average of cattle marketed through that plant. Sometimes, better quality cattle can receive lower prices than poorer quality cattle under this pricing system.
- Whether packers do or do not have sufficient market power to influence the base price (whether it is a plant average or cash market quote), the perception that they

might, especially at times when cash market trade is thin, may be sufficient concern to try to avoid using these prices for a base in formula trades.

Live Cattle Futures Market Base Prices

An alternative to using local cash market or plant average prices as a base price is to use live cattle futures. Some alliances have used live cattle futures prices as a base. Using live cattle futures has some of the same advantages as using local cash market prices as well as a few others:

- This method of formula pricing is easy and low cost.
- The futures arena is a national market in which individual firms do not have market power to appreciably influence the price.
- Futures price quotes are readily available on a continuous basis during trading hours and interested parties have easy access to the public price quotes.
- Tying base prices to futures price quotes would reduce basis risk (for the base price) and thereby enhance producer and packer opportunities for price risk management.

Using live cattle futures market as a base price also has problems:

- Basis risk in live cattle markets is substantial. Basis often has a $4-$6/cwt swing in a fairly short time frame. Some of this is seasonal variation but considerable basis variability over time is not predictable.
- In essence, packers would absorb basis risk and would most likely incorporate the cost of that risk into the futures price formula. In other words, the producer would ultimately pay for the basis risk reduction through a lower base price.

- Any material change in futures market contract specifications would require renegotiation of the base price formula.

Negotiated Base Prices

Cattle feeders have expressed a preference for using negotiated base prices (Schroeder et al. 2002). This method of determining the base price is akin to traditional negotiated cash market fed cattle trade where the base is negotiated between the cattle feeder and the packer. Advantages to this method of price discovery are:

- The cattle feeder and the packer are each actively involved in the negotiation process contributing to overall price discovery in the market.
- The cattle feeder maintains the opportunity to reject a base price bid.
- The feeder knows the base price prior to agreeing to deliver the pen of cattle to a particular packer.

Disadvantages to negotiated base prices include:

- The absolute small number of packers with which to negotiate can make negotiating a challenge. Compounding that is the limited number of potential buyers in any given geographic region that are in the market for unpriced, uncommitted cattle at any one time.
- Transaction costs associated with price discovery are present with base price negotiation, i.e., costs of information collection and synthesis, contacting potential buyers, and time costs associated with the negotiation process.
- If the targeted buyer is decided well in advance of the sale date, the seller has little leverage in the negotiation process. Packers have grids with quite different premium/discount schedules. As such, the grid premiums and discounts may

influence more which packer a particular seller is targeting and negotiating the base price is less productive.

- Many packers are reluctant to negotiate base prices with individual feedlots. Thus, an organization representing several feedlots may be more successful, e.g., Consolidated Beef Producers, the Texas Cattle Feeders Association affiliate.

Wholesale Boxed Beef Base Prices

Economists have gone on record advocating tying fed cattle price to the wholesale boxed beef cutout price (Schroeder et al. 1997; Ward and Butcher). The advantages of such a base price are:

- The wholesale market is one step closer to consumers, and as such sends a clearer consumer demand signal to producers.
- Packers and producers both have an incentive for the boxed beef price to be high.
- Composite wholesale boxed beef price reports are readily available and reported by an independent third party (USDA).

However, there are problems here as well.

- USDA reports currently a broader-based boxed beef cutout value than prior to September 2002, which is believed to be a closer composite representation of the wholesale value of beef products than previously. It includes export products and more domestic retail and food service products and USDA estimates it includes about 65% of all traded boxed beef products. However, the reported price is an aggregate composite with the volume-weighted mix of different quality grades that traded during that week and no Choice to Select price spread can be derived from this series.

- The difference between the wholesale price and the live cattle price is the packer margin. This margin fluctuates over time and this is perhaps the most difficult obstacle to deal with in using a wholesale boxed beef price as a base. In particular, the gross margin has increased in recent years. What factors have contributed to this increasing packer gross margin? Before a viable base price based upon wholesale boxed beef prices can be developed, a better understanding of changing packer gross margins is critical.

Retail Beef Base Prices

Retail beef is yet another possible source for base prices and a seemingly easy solution for some. Certainly, the motivation for wholesale base pricing, moving closer to consumers, is a major motivation for retail base prices. Ultimately, if beef alliances with branded products are developed, using retail price as a base this may be a natural evolution. Historically, retail beef price reporting was not sufficient to use as a reliable base price. However, beginning in October 2002 USDA began reporting a volume weighted-average retail beef price series that offers more promise for using retail price for a base. However, the issues regarding variability in margins over time as noted for boxed beef prices are multiplied several magnitudes when trying to use retail prices as a base in commodity grids. Therefore, although not being dismissed for the future, at the present retail base prices would be difficult to make operational in a contract with packers in most settings.

Base Price Recommendation

As can be discerned from the previous discussion, no single base price method is without disadvantages. The search for a suitable method for discovering the base price

must continue. However, in the meantime, what must be weighed is the magnitude of the advantages relative to disadvantages across the various base pricing systems. Ultimately, the cash-market fed cattle price may go the way of farm-level broiler prices and be non-existent or inconsequential except for a small percentage of fed cattle traded. This, together with the noted problems with using this method for base prices, should raise concerns for continued use of cash fed cattle market prices as a base. Overall, we advocate continued investigation of tying base prices to wholesale boxed beef prices. The significant concern of variability in gross margins over time needs additional attention. Future work should focus on ways to address this issue in a way that both beef producers and packers could agree is an equitable compromise. Crucial in such a formula pricing system would need to be vested incentives for both parties to seek innovations to continued efficiency enhancements to the vertical beef production and marketing chain.

Carcass Premiums and Discounts

The current system of carcass premiums and discounts is a significant improvement, arguably "modification", of the former grade and yield pricing method of three decades ago. Premium-discount grids are based on quality grades and yield grades. These are overlaid on hot carcass weight and considerably lower-value carcasses, often referred to as "outs". Grid pricing offers significant price premiums for certain quality attributes and substantial discounts for others. As such, it is much more discriminating with regard to beef carcass quality traits than average live- or dressed-weight pricing. Despite these benefits, grid pricing is not without concerns. Carcass quality traits that are contained in most grids, stark discounts for subtle differences in carcasses, and subjective measures of quality attributes are among the concerns with present grid pricing systems.

This section examines grid premium and discount schedules and reviews the current and future status of more objective measures of meat yield and quality factors.

Most grids being used today start with a base price and adjust that price for each carcass according to USDA quality and yield grades, carcass weight, and any "out" types (e.g., dark cutters, stags, etc.) of carcasses. Quality grades are intended to represent eating quality or satisfaction by consumers. However, research indicates current quality grades do not predict eating satisfaction effectively (Wheeler, Cundiff, and Koch). A second difficulty with current premiums and discounts for quality grade is the discrete nature of grades and the substantial differences in value small differences in subjective grading can make. A subjective error in evaluating one component of the official quality grade can make a significant difference in value. Different graders could easily judge the extent of marbling in the rib eye differently and assign a different quality grade to a carcass. Since a large number of carcasses border the Choice/Select demarcation, differences in subjective assessments can result in large differences in grades and value. Some lumpiness in premiums and discounts may be appropriate if packer, retailer, or food service marketing programs are focused on specific quality grades with virtually no chance of substituting other quality grades, e.g., a Prime program, Certified program, or Choice program. In other cases, where some substitutability exists, lumpiness may be less justified.

Yield grades are a continuous measure but they are grouped into discrete whole numbers for most grids. Official USDA yield grades range from 0.1 to 5.9 but are typically reported as whole numbers for determining premiums and discounts in grids, i.e., yield grades 1, 2, 3, 4, or 5. Like quality grades, some price differences can be large.

Carcasses that are not significantly different in fact, can be significantly different in value.

Hot carcass weights also are continuous but usually grouped into discrete categories for most grids. Typical groups might be carcasses less than 550 pounds, 550 to 950 pounds, and over 950 pounds. Substantial discounts are often associated with carcasses that fall into the light and heavy weight categories (often $20/cwt or more). At the margin, an insignificant change in carcass weight can result in a significant change in value.

Why have these discrete weight range discounts become industry standards? While convenience and convention may be the answer, overall economic efficiency of such a step-wise discount structure is questioned.

Explaining Current Prices and Potential Modifications

To model the current grid pricing system as described above, or to explain variation in fed cattle prices from grid systems, a model would be comprised largely of discrete variables. Assuming the model was intended to explain variation in value for a pen or pens of fed cattle with the same base price, i.e., cross section data, the model might be

(1) $\text{Value} = f(\text{quality grade}_i, \text{yield grade}_i, \text{hot carcass weight}_i, \text{out}_i)$

where i is the discrete category for each value influencing variable. To capture market dynamics, a model would need to incorporate the changing base price and any changes in premiums and discounts.

Alternatively, some of the lumpiness of the current grid pricing system might be removed with specific changes. One modification would be to use continuous variables where possible in lieu of the discrete variables. For example, the model might be

(2) Value = f (quality grade, yield grade, hot carcass weight, out_i).

Quality grade could be a continuous variable where Standard =5, Select = 4, … , Prime = 1. Yield grade would be the calculated, continuous yield grade in tenths, i.e., 1.8, 4.2, etc. Hot carcass weight would be actual hot carcass weight. The outs variable would remain a discrete variable. Alternative specifications of the model would be to use squared or cubic variables for quality grade, yield grade, and hot carcass weight.

The above is essentially tinkering with the current grid system. Any improvement in more accurately valuing fed cattle would likely be marginal in the aggregate, though significant for some sale lots. Larger changes are likely needed to make significant improvements. The following is one alternative.

Since quality grade does not accurately predict eating satisfaction and since objective tenderness measures are not being used in most commercial plants, an alternative is to rely on marbling as a quality measure. Marbling scores could be grouped into categories, e.g., in increments of 100 as tends to occur now to arrive at quality grades, or could be a continuous measure.

Red meat yield is a more accurate measure of the meat available for sale than yield grades. Red meat yield can be measured objectively with video systems, thus eliminating the subjective element of assigning yield grades. Red meat yield could be grouped into categories or could be a continuous measure.

Then, instead of the current quality grade and yield grade grid, this alternative might entail a grid consisting of marbling score and red meat yield. Such a grid might be in lieu of and an interim step toward a tenderness and red meat yield grid.

Hot carcass weight could be grouped into categories, e.g., 50-pound increments, or could be a continuous variable. Out carcasses would likely remain discrete variables as is currently the case.

Potential models would be similarly specified as with the current system, but with the alternative variables. A discrete variable model would be

(3) Value = f (marbling$_i$, red meat yield$_i$, hot carcass weight$_i$, out$_i$)

and the continuous variable version would be

(4) Value = f (marbling, red meat yield, hot carcass weight, out$_i$).

Schroeter et al. (2003) provides examples of estimated models with research data. However, data were limited thus limiting the usefulness of the estimated models to a demonstration only. More research with industry data is needed.

Technologies for Objective Measurement of Carcass Value Attributes

Beef Carcass Yield

Numerous technologies have been studied for their potential use as an on-line prediction of beef carcass yield (Jones et al.). The 1994 NCBA sponsored National Beef Instrument Assessment Plan Symposium identified video image analysis and ToBEC as the most promising technologies and initiated a comparison of them with expert yield grade. Dolezal et al. concluded that ToBEC was not easily adapted to measuring carcass sides at commercial chain speeds, but image analysis had potential.

There are now three, image analysis systems commercially available for prediction of beef carcass yield. CVS Computer Vision System (Cannell et al. 1999), VIAscan (Cannell et al. 2002), and VBG2000 (Shackelford, Wheeler, and Koohmaraie) have all been shown to be sufficiently accurate to be useful to the industry. Excel Corporation has implemented CVS systems in many of their beef plants and Tyson, Inc. has implemented VBG2000 into one beef plant so far with others planned.

Beef Quality

Tenderness – The amount a processor can spend on identifying "guaranteed tender" products depends on several factors such as the amount of premium that guaranteed tender products will generate, the proportion of carcasses that will qualify, potential reduction in value of non-qualifying product, and the weight and number of products from each carcass that can be marketed as enhanced in tenderness. The method selected to identify "guaranteed tender" must be accurate enough to create a product that is recognizable by consumers as superior in tenderness. Furthermore, it would seem likely that tenderness certification would be applied to USDA Select and Low Choice carcasses because USDA Prime carcasses and most of the carcasses within the upper two thirds of Choice already receive premiums in the market. Thus, USDA Select and Low Choice carcasses would be logical candidates for increased value by identifying those that are "tender".

Many attempts to identify instrumental, objective methods for predicting meat tenderness were intended for laboratory research tools and varied widely in their efficacies. In more recent investigations of objective predictions of meat tenderness, the goal has been to develop on-line systems for grading carcasses based on tenderness. The

ideal system would involve an objective, non-invasive, tamper-proof, accurate, and robust technology. Technologies evaluated for their potential as on-line tenderness grading tools include Tendertec (Belk et al., 2001), connective tissue probe (Swatland, Brooks, and Miller), elastography (Berg et al.), near-infrared spectroscopy (Park et al. 1998), ultrasound (Park et al. 1994), image analysis (Li, Tan, and Shatadal), colorimeter (Wulf and Page), BeefCam (Belk et al. 2000), and slice shear force (Shackelford, Wheeler, and Koohmaraie; Schackelford et al. 2001). A majority of these have been shown to lack sufficient accuracy in predicting meat tenderness to be useful. The three that appeared to be most promising (BeefCam, Colorimeter, and Slice Shear Force) were recently compared directly in the same study (Wheeler et al.).

The high level of accuracy of slice shear force at 2 or 3 days postmortem for sorting carcasses into tenderness groups was confirmed by Wheeler et al. In addition, it appears that accurate early-postmortem longissimus tenderness classification also would enable one to market sirloin and round cuts based on tenderness (Tatum et al.; Wheeler, Schackelford, and Koohmaraie; Wheeler et al.). However, BeefCam and Colorimeter, which are indirect, non-invasive methods to predict meat tenderness based primarily on lean color were not sufficiently accurate to warrant their use (Wheeler et al.). Thus, the direct method to predict meat tenderness, slice shear force, is significantly more accurate than currently available non-invasive methods, allows certification of a greater proportion of carcasses, creates a "guaranteed tender" product that consumers recognize as superior, and enables marketing of multiple muscles, not only the longissimus, as superior in tenderness. When this accuracy is combined with estimates of the premium a "guaranteed tender" beef product could command in the marketplace (Boleman et al.;

Lusk et al.; Shackelford et al.), it appears that the direct approach of slice shear force would be superior for identifying guaranteed tender beef compared to other methods tested to date.

The National Cattlemen's Beef Association (NCBA) recently convened a committee on National Beef Instrument Assessment Plan II–Tenderness (NCBA). This committee evaluated currently available technology and concluded that the only technology accurate enough to be used was slice shear force. The committee recommended that the industry proceed with implementing this technology and collect baseline data to determine the level of variation in tenderness that exists so that sources of this variability can be identified and approaches developed to improve consistency. The committee also recommended that development efforts continue for non-invasive technologies. Some non-invasive technologies to predict meat tenderness may eventually have merit. The most researched of these is near infrared (NIR) spectroscopy and several institutions continue to work on this technology.

Marbling – Image analysis systems have the most promise for predicting marbling score. Three systems are currently commercially available. CVS Computer Vision System and VIAscan and VBG2000. It does not appear that any of these systems are accurate enough at predicting marbling to replace the AMS on-line grader (Shackelford, Wheeler, and Koohmaraie). Furthermore, even if they were, no instrumental method has yet been developed for measuring carcass maturity so that quality grade could be completely automated.

Lean Color – Image analysis systems have the most promise for measuring lean color. Three systems are currently commercially available: CVS Computer Vision System,

VIAscan, and VBG2000. Theoretically, it appears that these systems should be able to detect differences in lean color that would be associated with different dark-cutter discounts. The accuracy of this process has not been demonstrated.

Beef Valuation System for the Future

This paper has highlighted challenges with current and prospective fed cattle valuation systems. In particular, establishment of base prices, grid premium-discount schedules, and evolving objective yield and quality measurement technologies have been examined. From this information a few key conclusions are noteworthy.

- Base prices based on cash fed cattle markets and plant averages are not in the best interest of producers as they need to move closer to the ultimate consumer market. Wholesale boxed beef prices are an intermediate step in this process, but additional work is needed regarding how to most effectively deal with variation in the farm to wholesale gross margin before wholesale prices will be viable base prices for any sizeable portion of the industry.
- Grid premiums and discounts need to more accurately reflect the continuous nature of value differences across animals. Some lumpiness may always exist but pricing accuracy can be improved by reducing lumpiness where possible.
- Image analysis appears to offer the most promise for predicting red meat yield. Measuring tenderness with an objective, non-invasive, tamper-proof, accurate, and robust technology is the ideal. Current technology for measuring tenderness has a tradeoff between accuracy (shear force is most accurate) and being invasive. The industry needs to continue to strive for development of more objective,

accurate, continuous, discerning meat quality and yield measures related to end-product value.

As the industry moves forward and develops an improved valuation system for fed cattle, continued focus on consumer demand is essential. An informal survey of several food service firms via telephone provided interesting insights. The following observations can be drawn from the responses received:

1. Long term price stability is of great interest. Food service firms prefer to price some (or in some cases a substantial portion) of their purchases 12 months or more ahead of use. Input price stability allows them to focus on managing the rest of their business (i.e., menu preparation, promotion, etc.). Respondents indicated it was difficult to get one-year commitments from beef processors.

2. Nearly all food product purchases by food service firms are formula based according to these survey respondents. Formulas typically use either USDA Blue Sheet or Urner-Barry price quotes to establish base prices. The firms surveyed do not routinely negotiate prices, nor do they want to.

3. Firms indicated they relied on USDA quality grades for quality specifications, often using USDA grades as a base supplemented with their own in-house specifications that go beyond USDA grades. In the future, they generally expected quality specifications to become more important, focusing on quality attributes that are not directly addressed in USDA's quality specifications.

4. Firms responding tended to use preferred suppliers for product purchases. Motivations were their desire to have longer-term price contracts and a desire to have more control over quality of meat. Food safety concerns were also mentioned as

important determinants of which firms these companies would do business with in the future.

5. Respondent firms were not directly involved with alliances. This was due in part because food service firms only purchase a small portion of the carcass and an alliance with producers may require marketing the remainder of the carcass to other firms.

6. Not all firms responded to question regarding how they price their products. One firm indicated that beef costs are a small enough component of total costs, that they do not routinely adjust sale prices for changes in beef input costs. Other firms indicated that once a menu price is established that other factors, such as competitor prices, were used to establish menu prices. Only one firm in the survey indicated they routinely look at beef costs to adjust prices. This firm, not surprisingly, indicated that it adjusts prices more frequently than the other firms in the sample.

While based on a small sample of food service providers, insight was gained for future fed cattle valuation systems. Long-term supply contracts for beef products that offer necessary product volume with assured quality attributes, food safety protocols, and that has relatively low transaction costs are in demand. Competing meats, particularly poultry are apparently more effective than the beef industry at providing these product characteristics. Whatever fed cattle valuation methods the beef industry develops and adopts, it is essential that the system possess mechanisms and participant incentives that directly address these demands.

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