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Value-Based Marketing: A Discussion of Issues and Trends in the Slaughter Cattle Market

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Pricing and technological innovation are discussed within the context of the beef industry's value-based marketing initiative. Cash and contract marketing practices for fed cattle are addressed with respect to slaughter volume and pricing methods (live, dressed, and grid). A methodology for estimating grid market share of weekly slaughter volume, based on USDA market reports (2004–2009), is introduced. Weekly grid market shares for the cash and contract markets are derived. Summary statistics indicate that grid pricing has become an important pricing mechanism, but has not surpassed average pricing with respect to slaughter volume market share.

Key Words: cattle imports, fed cattle, grid pricing, slaughter volume, value-based marketing

The goal of a value-based marketing (VBM) strategy for a producer or a firm is to market the right products to the right consumer cohort at the right price to maximize profit and growth. The role of a value-based pricing mechanism is to reward the producer or firm for its decision to adopt a VBM system. The beef industry has been promoting the adoption of VBM strategies since the early 1990s [Value-Based Marketing Taskforce (VBMTF), 1990]. VBMTF recommendations for the industry include adoption of instrument grading, identification of genetic markers that influence carcass quality, and the adoption of a value-based pricing system. A value-based pricing system should not only reward producers for producing higher quality cattle,[1] it should also provide transparent price signals along the entire production supply chain. Grid pricing emerged as the industry's value-based pricing mechanism in the mid-1990s.

Grid pricing mechanisms are but one component of a VBM system for slaughter cattle. One way to evaluate how successful the beef industry's value-based initiative

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[1] Higher or superior quality cattle in the context of a generic pricing grid would meet a minimum criterion of quality grade choice, yield grade less than 4, and a hot carcass weight ranging from 600 to 900 pounds. The USDA/Agricultural Marketing Service (AMS) Market News Service indentifies this as the minimum benchmark for beef carcasses to not receive a discount by the packer. Carcass quality exceeding this minimum benchmark is usually rewarded with a premium.

has been is to analyze changes in grid market share of weekly slaughter volume. Prior to 2004, it was not possible to derive reliable estimates of grid market share. We provide an estimation procedure, using publicly reported data, to generate weekly estimates of grid market share of fed cattle slaughter.[2]

The objectives of this research are to (*a*) document trends in VBM for fed cattle, (*b*) develop a procedure using public data to measure changes in grid market share, (*c*) provide a review of the economic literature pertaining to the beef industry's VBM initiative, and (*d*) provide a discussion of the pertinent issues associated with the initiative.

Evolution of Value-Based Marketing for Fed Cattle

The beef industry's motivation for embracing the concept of VBM was driven by a desire to improve beef's competitive position in the red meat industry and reverse the dramatic decline in beef demand from 1979 to 1998 (Mintert, 2006).[3] Declining demand signaled to the beef industry that it had failed to produce the right product at the right price to meet consumer demand for meat products. The beef industry's perceived need for a VBM system for slaughter cattle was articulated in a National Cattleman's Beef Association (NCBA) taskforce report, "The War on Fat" (VBMTF, 1990).

The VBMTF provided recommendations for transforming the production and marketing system for beef in the United States into a system vested in the practice of VBM principles. These recommendations were framed as a set of eight consensus points calling for industry action along the entire beef supply chain (see Cross and Savell, 1994). Specific recommendations included development of instrument grading systems, improved packaging systems to meet merchandising demands, greater understanding of consumer preferences across market segments, the development of a carcass quality-based pricing system for slaughter cattle, and the identification of genetic traits of desired carcass attributes.

The VBMTF's consensus points 4, 6, 7, and 8 have received considerable attention in the academic literature. The academic discussion on the development of a VBM system first appeared in the animal science and meat science literature (Thonney, 1990; Cross and Whittaker, 1992; Cross and Savell, 1994; Smith et al., 1995). In the agricultural economics literature, Schroeder et al. (1998) reported results from a survey designed to address issues facing the beef feedlot industry, and recommended a broad research agenda on VBM.

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[2] Publicly reported data on grid market share only became available beginning in 2004. Thus, deriving a reliable estimate for grid market share prior to 2004 is not possible using public data sources.

[3] Kansas State University's Annual Choice Retail Beef Demand Index indicates that retail beef demand in the United States declined by approximately 50% (1979–1998), with most of the decline occurring in the 1980s. From the trough in 1998, annual retail beef demand increased until it peaked in 2004, and then declined by 15% from 2005 to 2008.

Consensus Point 4

The VBMTF (1990) called for the beef industry to become more responsive to consumer demand: "There is currently inadequate data to clearly understand, and therefore respond to, varying consumer demands for quality" (p. 3). The VBMFT clearly concluded the beef industry needed to recognize that there is more than one market for beef. Recently published studies indicate branding has become a VBM tool for the fed cattle and retail beef niche markets. Citing data from the Grain Inspection, Packers and Stockyards Administration's (GIPSA's) *Livestock and Meat Marketing Study* prepared by Muth et al. (2007), Liu et al. (2009) noted that branding and certification of fed cattle averaged 19.6% of fed cattle transactions in the 2002–05 period. The *2007 National Meat Case Study* (NCBA, 2007), sponsored by meat industry groups and conducted by Texas Tech University, found the percentage of branded retail package beef cuts increased from 42% in 2004 to 51% in 2007.

These recent studies suggest the retail beef industry has made significantly more progress in developing brand recognition as a VBM tool than fed cattle producers. One can speculate that branded/certified fed cattle are more likely to be marketed on a grid to meet program quality benchmarks. An example of one such program is Certified Angus Beef™. On the consumer side, numerous consumer preference studies have been conducted to better understand consumer demand for specific beef product attributes commonly associated with branded beef (e.g., Umberger, 2007; Umberger, Thilmany-McFadden, and Smith, 2009).

Consensus Points 6 and 8

Consensus point 6 called for the development of instrumentation for carcass merit evaluation. Consensus point 8 called for the identification of genetic markers for carcass merit attributes. Studies focusing on technological advancements in beef production due to genetic and ultrasound research associated with carcass merit have been published in the animal science literature (e.g., Geary et al., 2003; Brethour, 2000; Smith et al., 1995).

As a result of this animal science research, an emerging branch in the agricultural economics literature on VBM technologies has evolved—investigating the potential economic benefits from implementation of these new technologies as a tool to minimize the over- or underfeeding of cattle. This research suggests these technologies have potential to become an important component in a producer's VBM strategy.

For example, Lusk et al. (2003) and Koontz et al. (2008) demonstrate the effectiveness of using ultrasound technology to reduce production inefficiency by sorting feedlot cattle into more homogeneous groups. Both studies use a grid pricing mechanism to measure the economic gains that can be captured by adopting a sorting mechanism during the feeding stage of production. DeVuyst et al. (2007) and Lusk (2007) demonstrate the effectiveness of using gene markers

Table 1. Summary of Economic Literature on Technological Innovation in Cattle Marketing

Author(s) and Year	Technological Innovation	Data Source	Marketing Channels Compared	Number of Head/Pens	Variables of Interest
Lusk et al. (2003)	Ultrasound Technology	Simulation, Ultrasound Readings, Slaughter Data	Live, Dressed, Grid	163 head	Revenue per head across marketing alternatives based on sorting mechanism
Lusk (2007)	Genetic Marker Technology	Simulation, Ultrasound Readings, Slaughter Data	Grid only	1,668 head	Selection of genetic markers to enhance production and marketing efficiency
DeVuyst et al. (2007)	Genetic Marker Technology	Simulation, Ultrasound Readings, Slaughter Data	Grid only	3 pens, 590 head	Selection of genetic markers to enhance production and marketing efficiency
Koontz et al. (2008)	Ultrasound Technology	Simulation, Ultrasound Readings, Slaughter Data	Grid only	100 pens, 7,173 head	Returns to sorting resulting from gains in production and marketing efficiency

to select and market cattle. The economic value of sorting and marketing slaughter cattle based on genetic markers is determined by using a grid pricing mechanism. These recent studies document the economic value of VBM technologies for producers willing to adopt value-based systems. An abbreviated summary of relevant literature is provided in table 1.

Consensus Point 7

As recommended by the Taskforce (VBMTF, 1990), "Fed cattle should be valued on an individual carcass basis rather than an average price basis" (p. 4). Consensus point 7 indentified the traditional practice of selling pens of fed cattle at an average price as a weakness in the beef supply chain and an impediment to the transmission of consumer preferences for particular beef product characteristics consumers highly valued (e.g., Feuz, Fausti, and Wagner, 1993; Cross and Savell, 1994).

The VBMTF's recommendation to sell fed cattle on an individual carcass basis encouraged the U.S. beef packing industry to begin developing prototype grid pricing systems in the early 1990s. These prototype systems expanded carcass premiums and discounts beyond the traditional "Grade & Yield" individual carcass pricing system.[4] One example of a prototype appearing in the early

[4] The Grade & Yield pricing system determined carcass values based on dressed weights, and the system discounted carcasses that did not achieve quality grade choice or yield grade less than 3. A typical grid assigns a market value to an individual beef carcass based on yield grade, quality grade, and carcass weight.

literature was the Excel Corporation's muscle scoring system (Feuz, Fausti, and Wagner, 1993). By the end of the 1990s, both the number and variety of grid pricing mechanisms being used by the packing industry had grown substantially (Feuz, 1999).

In October 1996, the USDA/AMS began publishing weekly grid premium and discount price reports: "National Carcass Premiums and Discounts for Slaughter Steers and Heifers." The AMS decision to publicly report grid premiums and discounts validated the grid pricing option as an important fed cattle pricing alternative for producers and packers. The AMS designed the structure of the weekly report to mirror the premium and discount structure of an additive pricing grid consistent with industry protocols (Fausti, Feuz, and Wagner, 1998).[5] The AMS weekly survey collects information on (*a*) yield-grade and quality-grade premiums and discounts; (*b*) heavy- and light-weight carcass discounts; and (*c*) discounts for carcass defects, such as injection lesions, dark cutters, etc. (Fausti, Feuz, and Wagner). In April of 2001, the Livestock Mandatory Reporting Act of 1999 went into effect. This legislation requires large firms in the meat packing industry to report grid premium and discount information to the AMS.

The first publication to empirically evaluate the economics of grid pricing appeared in 1998 (Fausti, Feuz, and Wagner, 1998). Subsequently, the findings of numerous research studies have been published which focus on investigating the economic implications of grid pricing as an important pricing mechanism for fed cattle. A literature summary can be found in table 2.

Common issues addressed in this branch of the VBM literature include (*a*) average per head revenue differentials, (*b*) average per head profit differentials, (*c*) variability of per head revenue and profit, and (*d*) the role carcass characteristics play in determining individual carcass values.[6] A number of common threads appear in this branch of the literature concerning pricing characteristics associated with the grid pricing mechanisms. Grid pricing mechanisms appear to have a discount bias; premiums have a significant positive effect on profit only in the case of high-quality cattle.[7] Studies comparing multiple grids or utilizing time-series data show that pricing signals vary across grids and over time. This variability seems to be the result of (*a*) a lack of uniformity across grid premium and discount structures used in the industry, (*b*) grid base price selection, (*c*) seasonality, and (*d*) market conditions at the local or plant level.

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[5] A grid-determined carcass price per cwt can be developed using an additive process. It should be noted that not all packer grid mechanisms are strictly additive.

[6] This particular approach for investigating price efficiency issues in the slaughter cattle market was introduced in a series of papers dealing with transaction price efficiency in the cash market for slaughter cattle (Feuz, Fausti, and Wagner, 1993, 1995; Fausti and Feuz, 1995).

[7] Yield grade discounts refer to excessive external fat deposits which reduce the proportion of the carcass that can be used for boneless retail cuts. Quality grade discounts refer to the lack of intramuscular fat content (meat marbling). A more detailed discussion of carcass yield and quality grade measurement criteria and the associated grid premiums and discounts can be found in Fausti, Feuz, and Wagner (1998).

Table 2. Summary of Grid Price Efficiency Literature

Author(s) and Year	Obs. Unit (pen or individual animal)	Number of Grids	Cross-Sectional or Pooled Time-Series Data Analysis	Marketing Channels Compared
Fausti, Feuz & Wagner (1998)	Individual	One	Cross-Sectional	Grid vs. Dressed Weight
Feuz (1999)	Individual	Three	Pooled Cross-Sectional	Multi-Grid Comparison
Schroeder & Graff (2000)	Pen	One	Time Series	Grid vs. Dressed vs. Live
Anderson & Zeuli (2001)	Pen	One	Time Series	Grid vs. Live
Fausti & Qasmi (2002)	Pen	One	Time Series	Grid vs. Dressed Weight and High- vs. Low-Quality Cattle
McDonald & Schroeder (2003)	Pen	Two	Pooled Cross-Sectional	Multi-Grid Comparison
Johnson & Ward (2005)	Individual	One	Cross-Sectional	None
Johnson & Ward (2006)	Individual	One	Cross-Sectional	High- vs. Low-Quality Cattle on Single Grid

(extended . . . →)

A Discussion of Grid Market Share and Beef Quality Trends

The general consensus in the literature is that the primary goal of the VBM initiative is to improve product quality along the entire beef supply chain. The beef industry aspiration for the adoption of grid marketing, as a value-based pricing option, is to increase the proportion of beef carcasses that conform to or exceed the industry criteria of yield grade less than 4, quality grade choice or better, and a hot carcass weight ranging between 600 and 900 pounds. To achieve this goal, the widespread adoption of value-based pricing mechanisms such as grid pricing is a necessary but not a sufficient condition for the industry to minimize inefficiencies responsible for the production of cattle that do not meet the minimum industry benchmarks. An increase in production efficiency will only occur when a majority of beef producers have adopted VBM technologies into their production system and are then consistently rewarded for their efforts by the market.

Table 2. Extended

Author(s) and Year	Number of Pens / Head	Date of Grid Pricing Data	Variables of Interest
Fausti, Feuz & Wagner (1998)	2 / 3,000	Apr. 1997	Per head average revenue and revenue variability
Feuz (1999)	85 / 5,520	Dec. 1996 to Feb. 1998	Grid premium or discount per cwt / carcass attributes
Schroeder & Graff (2000)	71 / 11,703	Weekly 1997	Per head average revenue and revenue variability; potential of sorting
Anderson & Zeuli (2001)	6 / 500	Oct. 1996 to May 2001	Per head average revenue and revenue variability
Fausti & Qasmi (2002)	2 / 3,000	Jan. 1997 to Dec. 2000	Average per head price differential (grid – dressed weight); seasonality and trend
McDonald & Schroeder (2003)	4,494 pens	1992–1998	Carcass attributes; production cost effect on profit per head
Johnson & Ward (2005)	18,267 head	Single weekly grid based on two-year average for premiums and discounts, 1996–1998	Per head grid revenue; carcass attributes affecting revenue variability
Johnson & Ward (2006)	18,267 head	Single weekly grid based on two-year average for premiums and discounts, 1996–1998	Per head grid revenue; carcass attributes affecting revenue variability

The views expressed in the grid pricing literature on progress made toward achieving widespread adoption are mixed. The literature has demonstrated that marketing fed cattle on a grid (relative to average pricing) increases price variability. The grid pricing alternative is also perceived by some producers to have a discount bias. These two attributes have been discussed in the literature as potential "barriers to adopt" for producers considering the grid marketing option (Fausti, Feuz, and Wagner, 1998; Feuz, 1999; Anderson and Zeuli, 2001; Fausti and Qasmi, 2002). Other researchers conclude that grid pricing is gaining market share and providing the proper incentives to meet the goals of a VBM system for the cattle industry (Schroeder et al., 2002; McDonald and Schroeder, 2003). Johnson and Ward (2005), however, raise the issue of whether greater attention needs to be given to efficacy of grid marketing with respect to beef quality by economists.

Schroeder et al. (2002) conducted a regional feedlot survey covering Iowa, Nebraska, Kansas, and Texas. Based on their survey results, 16% of cattle marketed by these feedlots were sold on a grid in 1996, and 45% in 2001. The authors

report that feedlot operators expect future grid market sales to increase and reach 62% of total sales by 2006. Both academic and private industry publications have cited these statistics to show a rapid increase in grid market share of total fed cattle slaughter (e.g., Smith, 2005).

In the *2005 National Beef Quality Audit* (NBQA), however, it was reported that only 34% of slaughter cattle were sold on a grid (NCBA, 2006, table 14). In a recent study published by Muth et al. (2007), grid market share of slaughter volume was found to average 43% during the 2002–2005 period.[8] These studies suggest grid pricing has gained market share, but has not become the dominant pricing mechanism in the slaughter cattle market.

The empirical estimates cited above reveal that grid pricing has gained market share over the last 10 years. The positive trend in market share implies pricing inefficiency in the fed cattle market should be declining and the industry should be experiencing an increase in average carcass quality and a decline in carcass quality inconsistency. Yet, a recent study released by Certified Angus Beef™ (CAB) reported that the percentage of heifers and steers grading prime or choice declined from 58% to 54% and 48% to 44%, respectively (Corah and McCully, 2007).[9] The 2005 NBQA raised a concern that the industry is still struggling with recurring marketing and production issues which have plagued the industry since the 1980s. Specifically, the audit cited (*a*) excess fat production, (*b*) inconsistent meat quality, (*c*) the need for clearer market signals, and (*d*) inconsistent carcass quality.

The beef quality issues have also been raised in the industry press (Harpster, 2007) and in the beef extension literature (Ward and Vanoverbeke, 2007). Ward and Vanoverbeke reviewed beef demand and carcass quality issues highlighted in the 2005 NBQA report and concluded that improvements in beef demand and beef carcass quality have been slow.

Beef carcass quality issues have been at the center of meat science, agricultural economics, and animal science research activities for decades. The general consensus across this broad spectrum of literature is that carcass quality variability is as important as the improvement in average quality to the economic health of the U.S. beef industry. The 2005 NBQA specifically addressed carcass outliers. Savell (2007) summarized the following results from the audit: (*a*) 5% of cattle marketed had a carcass weight over 950 pounds, (*b*) 1.9% were dark cutters, (*c*) 11.8% of carcasses were yield grade 4, (*d*) 2.3% were yield grade 5, and (*e*) 5.4% of carcasses had a quality grade of standard or lower. Koontz et al. (2008) reviewed the animal science and agricultural economics literature discussing carcass quality variability. They report it is estimated "that out carcasses are

[8] This estimate is based on data collected during the USDA Grain Inspection, Packers and Stockyards Administration's 2007 *Livestock and Meat Marketing Study*. The data set contains approximately 58 million head sold during the 2002–2005 time frame.

[9] The CAB empirical estimates are based on data collected from 1999 to 2005 on approximately 19.8 million carcasses. (Our table 7 indicates the percentage of choice carcasses has been increasing since the CAB results were released.)

persistent and that approximately 15% of animals are overfed and 10% are underfed to the point of being discounted in the pricing systems" (p. 897).

A central issue addressed in "The War on Fat" report (VBMTF, 1990) was the negative consequences for the industry associated with the production of nonconforming (out) carcasses (e.g., no-rolls, dark cutters, hard-bone, yield grade greater than 4, etc.). The beef industry's value-based initiative set in motion a series of ongoing changes in the production and pricing of fed cattle to increase production efficiency through adoption of VBM technologies. Grid pricing is the pricing system that has evolved for rewarding producers who make the decision to adopt these innovative technologies. However, as shown by Fausti and Feuz (1995), there is a financial risk associated with marketing on a grid if producers are unsure about the quality of the cattle they are selling.

The literature indicates a natural complementary relationship between the adoption of grid pricing and the adoption of VBM technology. However, the cost of implementation combined with the risk of marketing on a grid may pose a barrier for some producers. If the increase in the market value of a carcass resulting from the adoption of a value-based production and marketing system does not cover the cost of system adoption, then increased carcass market value will not translate into increased profit. New fed cattle production technologies are expensive, such as ultrasound or genetic testing, and therefore the necessary economies of scale may make the adoption of these new technologies cost prohibitive for small producers.

Given the relationship between value-based pricing and technology, grid market share should provide a reasonable estimate for the producer adoption rate of a VBM strategy. Accurate estimates of grid market share over time will provide the industry with a benchmark upon which to gauge the progress of the beef industry's VBM initiative.

Marketing Channel Options for Fed Cattle

To understand the impact of the beef industry's VBM initiative on the market for fed cattle, it is necessary to discuss the marketing channel alternatives for finished cattle. Producers can sell fed cattle in the cash (spot) market or on contract for future delivery. The cash market alternatives are auction sales and direct sales to packers. Direct cash market sales are often referred to as negotiated sales. The contract market alternatives are forward contracts and formula pricing (also referred to as marketing or supply agreements). Procurement volume across these alternatives varies over time. Ward (2009) reported that over a seven-year period (2002–2008), on average, negotiated sales and formula pricing accounted for 44.4% and 38.6% of the total slaughter volume, respectively. Packer ownership, forward contracts, and auction sales accounted for the residual.

The passage of the Livestock Mandatory Reporting Act enabled the AMS to gather and provide the market with a wealth of data on contract sales (Diersen, 2004). In 2004, the AMS began publishing weekly grid slaughter volume data for

fed cattle. These new data sources can be used to analyze grid slaughter volume patterns for the cash and contract marketing channels. Prior to the AMS making this data publicly available, it was not possible to accurately estimate grid market share using public data sources.

AMS Grid Market Volume Data

The introduction of livestock mandatory price reporting regulations has enabled the AMS to provide weekly reports on the volume of cattle slaughtered that were purchased on contract, in the spot market, and on negotiated grids. The AMS began providing this information on April 11, 2004. The information can be found in the weekly market reports LM_CT154 and LM_CT151, and the daily market report LM_CT106.

The Livestock Marketing Information Center (LMIC) provides a weekly aggregated report derived from the LM_CT106. Weekly domestic slaughter volume data from April 2004 to mid-December 2009 were collected from this LMIC series (297 weekly observations). This LMIC report also provides weekly contract volume information on cattle imports, derived from the LM_CT152 report. However, import data on slaughter volume only contain 211 weekly observations because the bovine spongiform encephalopathy (BSE) import ban did not end until 2005.

Our analysis of grid market share utilizes data on weekly domestic cattle slaughter volume. However, imported cattle volume data are included in the analysis to determine if imports have affected grid market share. The LMIC data reflect approximately 136.8 million head of slaughter cattle marketed during this period. Slaughter cattle marketing channel categories are listed in tables 3 and 4. Summary statistics for weekly domestic slaughter and total cattle slaughter (domestic plus imported) are provided in tables 5 and 6.

Defining Marketing Channel Categories

The AMS reports the negotiated cash, formula, negotiated grid, and forward contract sales as four completely separate transaction types. Across various AMS reports, a group of cattle will never change transaction classification. The AMS defines a cash transaction as a negotiated sale for a delivery date within 14 days. This assumption regarding the relationship between marketing channel and pricing mechanism selection is based on a series of discussions with an AMS market reporter.[10]

With respect to contract sales, we assume that formula dressed sales are grid sales, and all other contract sales are pen-level sales. The AMS reporter expressed a more conservative view on formula pricing. For live transactions, a majority will have a general premium or discount applied to the lot as a whole; however, there are still many instances where this is not true (e.g., buyers may discount heavy

[10] Information provided by the AMS market reporter was confirmed on March 26, 2009, via e-mail correspondence.

Table 3. Finished Live Cattle Markets Data Series Available in AMS Reports

Market Description	Pricing Method
A. Negotiated Live & Dressed Weight Cash	
A.1 Negotiated Sales–Live Weight	by Pen
A.2 Negotiated Sales–Dressed Delivered	by Pen
B. Negotiated Grid Cash	
B.1 Negotiated Grid Sales–Live Weight	by Individual Animal
B.2 Negotiated Grid Sales–Dressed Weight	by Individual Animal
C. Forward Contract [a]	
C.1 Forward Contract–Live Weight	by Pen
C.2 Forward Contract–Dressed Weight	by Pen
D. Formula Pricing [b]	
D.1 Formula Pricing–Live Weight	by Pen
D.2 Formula Pricing–Dressed Weight	by Individual Animal [c]
E. Imported Slaughter Cattle	
E.1 Cash–Live and Dressed	by Pen
E.2 Negotiated Cash Grid–Live and Dressed	by Individual Animal
E.3 Forward Contract–Live and Dressed	by Pen
E.4 Formula Contract–Live	by Pen
E.5 Formula Contract–Dressed Weight	by Individual Animal

Note: Includes animals to be delivered within seven days, and excludes packer-owned cattle. Marketing channel categories A, B, C, D, and E are defined and discussed in the text narrative.

[a] Assumed as livestock economists generally agree that forward contract transactions are conducted at the pen level at an average price per cwt.

[b] Assumed as livestock economists generally agree that formula live-weight sales are pen-level sales at an average price per cwt, but may also have an average pen quality price incentive associated with live-weight transaction.

[c] Assumed as livestock economists generally agree that the preponderance of dressed-weight formula transactions are individual carcass grid-based sales.

animals or individual animals over 30 months old). For dressed transactions, the pen frequently receives a premium for being age and source verified, hormone free, or meeting a certain grading threshold. These types of premiums are common. Still, in many circumstances, the final price a producer receives may depend on individual carcass characteristics.

It should be noted that the AMS does not break down formula sales by pricing mechanism (grid vs. pen). A complete description of marketing channel categories with respect to the pricing mechanism generally used to conduct the transaction (grid vs. pen) is given in table 3. Below is a list of the marketing channel categories:

A. Negotiated Live & Dressed Weight Cash: Defined as the sum of weekly live and dressed weight cattle sold by the pen in the cash market.

B. Negotiated Grid Cash: Defined as the sum of weekly cash market slaughter volume sold on a grid (with a negotiated base), and is the sum of "negotiated grid net sales delivered live" and "negotiated grid net sales dressed weight" categories.

C. Forward Contract: Defined as the sum of the weekly volume series "forward contract live weight" and "forward contract dressed weight."

D. Formula Pricing: Defined as the sum of the weekly volume series "formula pricing–live weight" and "formula pricing–dressed weight." It is assumed that cattle slaughter reflected in the formula pricing–live weight series are purchased at an average price per pen while those reflected in the formula pricing–dressed weight series are individual carcass grid-based sales.

E. Imported Slaughter Cattle: Importation of slaughter cattle was disrupted due to the BSE quarantine by the United States (imposed August 2003). In December 2005, delivery of imported slaughter cattle to U.S. packing plants resumed. (The marketing channel alternatives for imported cattle are listed in table 3.)

Defining Slaughter Volume Variables

Cattle marketing data series defined in table 3 were utilized to derive slaughter volume accounting identities for marketing channel categories reported in table 4. Total domestic slaughter volume (F.1 in table 4) was estimated by adding weekly domestic fed cattle delivered for slaughter across the following categories: (*a*) negotiated cash live and dressed weight, (*b*) negotiated grid cash, (*c*) forward contract, and (*d*) formula pricing. Weekly cash market volume estimates were obtained by adding the negotiated live & dressed weight cash and negotiated grid cash series (F.2). The accounting procedure for estimating weekly forward contract and formula pricing marketing channels was obtained by adding forward contract and formula pricing series (F.3). Total domestic slaughter volume sold on a grid was estimated by adding together the negotiated grid cash and formula pricing dressed weight series (F.4). Finally, each market share estimate for domestic cattle was obtained by dividing these series by weekly total domestic cattle slaughter (series G in table 4).

Total cattle slaughter (H.1) was derived by adding imported cattle volume (sum of categories in E) to total domestic slaughter (F.1). Similarly, total weekly cash, contract, and grid slaughter volumes and market shares were estimated by adding the imported cattle component to the appropriate domestic cattle categories and then dividing by total cattle slaughter (series I). Table 4 also defines the ratios used for comparing weekly slaughter volume for total cattle slaughter relative to total domestic cattle slaughter (series J).

Methodology and Empirical Results

Market share analysis of marketing channel selection for domestic cattle slaughter, imported cattle slaughter, and total slaughter (domestic and imported) will utilize summary statistics and a simple time-series plot of cash and contract grid market shares. Market shares of weekly domestic U.S. slaughter volume for the cash and

Table 4. Calculated Market Share Data Series

F.	Domestic Weekly Cattle Slaughter Volume
F.1	Total Domestic Weekly Cattle Slaughter = A + B + C + D
F.2	Domestic Cash Market = A + B
F.3	Domestic Forward Contract and Formula Market = C + D
F.4	Domestic All Grid Slaughter = B + D.2
G.	Domestic Weekly Marketing Channel Market Share
G.1	Domestic Negotiated Live & Dressed Cash Weight Market Share = A / (A + B + C + D)
G.2	Negotiated Grid Cash Market Share = B / (A + B + C + D)
G.3	Cash Market Share = (A + B) / (A + B + C + D)
G.4	Formula Pricing Market Share = D / (A + B + C + D)
G.5	Formula Pricing Grid Market Share = D.2 / (A + B + C + D)
G.6	Forward Contract Market Share = C / (A + B + C + D)
G.7	Forward Contract & Formula Market Share = (C + D) / (A + B + C + D)
G.8	Grid Slaughter Market Share = (B + D.2) / (A + B + C + D)
H.	Domestic Plus Imported Cattle Slaughter Volume
H.1	Total U.S. Weekly Cattle Slaughter = A + B + C + D + E
H.2	Total U.S. Cash Market = A + B + E.1 + E.2
H.3	Total U.S. Contract Market = C + D + E.3 + E.4
H.4	Total U.S. Grid Market = B + D.2 + E.2 + E.5
I.	Domestic Plus Imported Cattle Marketing Channel Share
I.1	Total U.S. Cash Market Share = (A + B + E.1 + E.2) / (A + B + C + D + E)
I.2	Total U.S. Contract Market Share = (C + D + E.3 + E.4 + E.5) / (A + B + C + D + E)
I.3	Total U.S. Grid Market Share = (B + D.2 + E.2 + E.5) / (A + B + C + D + E)
I.4	Negotiated Cash Grid Market Share = (B + E.2) / (A + B + C + D + E)
I.5	Contract Grid Market Share = (D.2 + E.5) / (A + B + C + D + E)
J.	Ratio of Total U.S. Cattle to Domestic Cattle Weekly Slaughter Volume
J.1	Ratio of Total to Domestic Grid Volume = (B + D.2 + E.2 + E.5) / (B + D.2)
J.2	Ratio of Total to Domestic Slaughter Volume = (A + B + C + D + E) / (A + B + C + D)

Notes: Data series A, A.1, A.2, B, B.1, B.2, C, C.1, C.2, D, D.1, D.2, E, E.1, E.2, E.3, E.4, and E.5 are defined in table 3. Accounting identity categories F, G, H, I, and J are discussed in the text narrative.

contract marketing channels are reported in table 5.[11] Domestic plus import marketing channel slaughter volume is reported in table 6. To simplify the discussion of the summary statistics in tables 5 and 6, the accounting identities defined in tables 3 and 4 are cited in the discussion of the summary statistics. Analysis of cattle marketing patterns will be used to provide insight on the progress of the beef industry's VBM initiative.

For the 2004–2009 interval, weekly combined negotiated live and dressed weight domestic slaughter volume averaged 224,500 head (A). Negotiated grid slaughter volume averaged 42,700 head (B). These channels accounted for 49.5% (G.1) and 9.4% (G.2), respectively, of total domestic cattle slaughter. In the cash market, the combined volume of these two categories averaged 267,260 head per week (F.2), representing 58.9% (G.3) of total domestic cattle slaughter.

[11] Note that packer-owned cattle are not included in these data, and all reported values are rounded to the nearest 100 head.

Table 5. Summary Statistics: Domestic Cattle Slaughter by Market Type, April 11, 2004 – December 13, 2009 (*N* = 297 observations)

Variable	Mean	Std. Dev.	Min.	Max.	Coeff. of Variation
Weekly Volume in 1,000s of Head:					
Total Domestic Cattle Slaughter (F.1)	452.22	44.37	325.26	652.44	9.8%
Negotiated Live & Dressed Weight Cash (A)	224.53	42.02	118.25	392.07	18.7%
Negotiated Grid Net Cash (B)	42.73	11.26	21.28	100.91	26.4%
Cash Market (F.2)	267.26	48.22	157.33	444.52	18.0%
Forward Contract (C)	32.86	14.70	8.81	79.36	44.7%
Formula Pricing Net, Live Wt. & Dressed Wt. (D)	152.10	27.81	88.09	223.61	18.3%
Formula Pricing Grid, Dressed Wt. Only (D.2)	128.15	21.41	81.44	180.82	16.7%
Forward Contract & Formula (F.3)	184.96	33.96	112.01	267.68	18.4%
All Grid Slaughter, Cash & Contract (F.4)	170.89	21.00	121.65	239.02	12.3%
Weekly Market Share as % of Total Domestic Slaughter:					
Negotiated Live & Dressed Wt. Cash (G.1)	49.47%	6.62%	27.71%	63.77%	13.4%
Negotiated Grid Net Cash (G.2)	9.44%	2.27%	4.73%	20.13%	24.0%
Cash Market (G.3)	58.91%	7.54%	39.73%	74.87%	12.8%
Forward Contract (G.6)	7.29%	3.20%	1.71%	18.18%	43.8%
Formula Pricing Net, Live Wt. & Dressed Wt. (G.4)	33.80%	6.30%	20.94%	51.83%	18.6%
Formula Pricing Grid, Dressed Wt. Only (G.5)	28.48%	4.87%	17.31%	42.34%	17.1%
Forward Contract & Formula (G.7)	41.09%	7.54%	25.13%	60.27%	18.4%
All Grid Slaughter, Cash & Contract (G.8)	37.92%	4.28%	24.93%	51.35%	11.3%

Data Source: USDA/AMS Report LM_CT106 (various issues, 2004–2009).

Weekly forward contract slaughter averaged 32,860 head (C) and accounted for 7.3% (G.6) of total domestic cattle slaughter. Weekly formula pricing of slaughter cattle averaged 152,100 head (D) and represented 33.8% (G.4) of total domestic cattle slaughter. Forward contract and formula pricing marketing channels accounted for 41.1% (G.7) of total domestic cattle slaughter. As stated elsewhere, all formula contract live weight transactions are assumed to be pen-level transactions, and all formula contract dressed weight transactions are assumed to be on a grid. Weekly dressed-weight formula pricing volume averaged 128,150 head (D.2) and accounted for 28.5% (G.5) of total domestic cattle slaughter.

Domestic slaughter volume associated with grid transactions is estimated by summing together slaughter volume for negotiated grid net cash and dressed-weight formula marketing options. This aggregate slaughter volume estimate is referred to as *total grid slaughter* (cash & formula). Weekly total grid slaughter (cash & formula) averaged 170,890 head (F.4), or 37.9% (G.8) of total domestic slaughter.

The domestic market share coefficient of variation for the cash, contract, and total grid slaughter data (G.2, G.5, G.8) exhibits an interesting pattern. The cash grid marketing alternative has the highest variability, followed by the contract grid marketing alternative, while the market share of total domestic grid volume

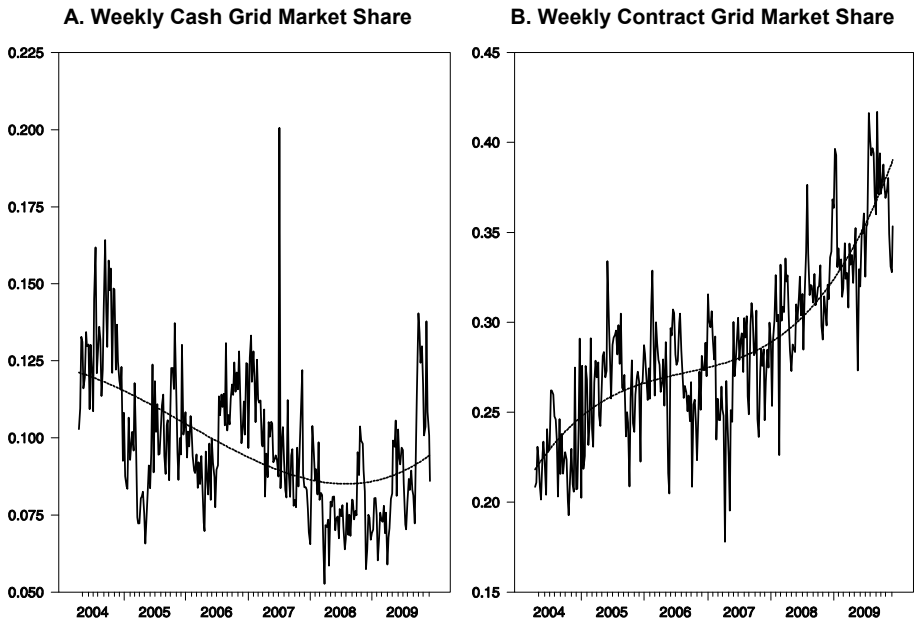

Figure 1. Time series plots

has the lowest variability. These findings imply that fluctuations in the cash and contract grid market shares are negatively correlated.[12] Figure 1, panels A and B, are time-series plots for cash and contract grid market share, respectively. The data presented in these graphs also support this conclusion, revealing a pattern that raises an interesting research issue: Why should the cash and contract grid marketing channel options be substitutes?

This statistical finding is of particular interest because, when examining the literature on VBM for the beef industry, the goal for a fed cattle value-based pricing system is to supplant average pricing by the pen. Therefore, one would assume a positive correlation between these two marketing channels as grid pricing gains market share.

As reported in table 5, domestic slaughter volume coefficients of variation for the contract (F.3) and cash (F.2) marketing alternatives are similar: 18.4% and 18.0%, respectively. However, this is not the case for market share (G.7 vs. G.3), with respective coefficients of variation of 18.4% and 12.8%. This implies the weekly market share of cattle slaughtered in the cash market has been relatively more stable than in the contract market, suggesting contract market share is more

[12] These grid market share variables were found to be nonstationary. The first difference was taken and Spearman correlation coefficients were generated using SAS (SAS Institute, Inc., 2003). The estimated Spearman correlation coefficient is −0.185 and is significant at the less than 1% level, thus providing empirical support for this statement (Newbold, 1995).

Table 6. Summary Statistics: Imported Cattle Slaughter, Ratio of Domestic Plus Imported Cattle Slaughter to Domestic Cattle Slaughter, December 2005–December 13, 2009 (*N* = 211 observations)

Variable	Mean	Std. Dev.	Min.	Max.	Coeff. of Variation
Weekly Import Volume in 1,000s of Head:					
Negotiated Live & Dressed Cash Imports (E.1)	1.43	1.45	0.00	6.72	101.2%
Negotiated Cash Grid Imports (E.2)	3.23	2.38	0.05	10.03	73.5%
Import Forward Contract Live & Dressed (E.3)	3.10	1.88	0.07	9.59	60.7%
Import Formula Live Imports (E.4)	0.07	0.18	0.00	1.14	262.9%
Formula Dressed Imports / Contract Grid (E.5)	3.77	2.71	0.17	9.76	71.9%
Total Slaughter Cattle Import (E)	11.60	4.57	1.23	21.25	39.4%
Total Imported Grid (E.2 + E.5)	7.00	4.25	0.25	17.18	60.8%
Ratio of Domestic Plus Import Slaughter Volume to Domestic Slaughter Volume:					
Ratio of Total to Domestic Grid Volume (J.1)	104.00%	2.80%	100.14%	110.90%	—
Ratio of Total to Domestic Slaughter Volume (J.2)	102.60%	1.00%	1.00%	1.05%	—
Marketing Channel Share of Total Slaughter (Domestic plus Imports):					
Net Cash Market Share (I.1)	55.50%	6.00%	39.50%	70.50%	10.8%
Contract Market Share (I.2)	44.50%	6.40%	29.50%	60.40%	14.4%
Negotiated Cash Grid Market Share (I.4)	9.20%	1.90%	5.30%	20.00%	20.7%
Contract Grid Market Share (I.5)	30.00%	4.30%	17.80%	41.70%	14.3%
Total Grid Market Share (I.3)	39.20%	4.20%	25.90%	51.20%	10.7%

sensitive to changes in total slaughter volume than cash market share. These grid market share variables were found to be nonstationary. The first difference was taken and Spearman correlation coefficients were generated using SAS (SAS Institute, Inc., 2003). The estimated Spearman correlation coefficient for contract grid market share (G.5) and slaughter volume (F.1) is 0.41 and is significant at the less than 1% level. The Spearman correlation coefficient for cash grid market share (G.2) and slaughter volume is −0.12, significant at the less than 5% level. It appears the level of slaughter volume affects grid market share in the cash and contract markets, and correlation estimates are consistent with an inverse relationship between cash and contract grid market shares.

The summary statistics reported in table 6 are based on December 2005 to December 2009 data. Cattle imports increased average weekly combined negotiated live and dressed weight volume by 1,434 head (E.1). Imports, however, increased cash grid volume by 3,233 head (E.2). This implies that, on average, the majority of cattle imported for slaughter and sold in the cash market were sold on a grid. Imports increased weekly contract grid volume by 3,766 head (E.5). Given the difficulties in separating contract grid transactions, the upper-bound estimate for the average weekly total contract grid market share of U.S. slaughter is 30% (I.5, 2005–2009).

Table 6 provides insight as to how imported cattle have affected slaughter patterns relative to the marketing pattern for domestic cattle since the BSE ban was lifted (a 211-week period). Imports increased average weekly total grid slaughter volume by 7,000 head (E.2 + E.5), and increased total U.S. grid slaughter volume by 4.00% (J.1). Imported cattle increased the market share of total grid slaughter in the United States by 0.50% to 39.2% (I.3) for December 2005 to December 2009.[13] Imports increased total U.S. slaughter volume by 2.6% (J.2). The data indicate that approximately 60% of cattle imports were sold on a grid after the BSE import ban ended.

Trends in Grid Market Share and Carcass Quality

Grid market share, as reported earlier, averaged 37.9% of domestic slaughter for the 2004–2009 time interval. Since the lifting of the BSE import ban, grid market share of domestic and imported cattle slaughter averaged 39.2% (I.3). Figure 1 shows that contract grid market share has been increasing steadily since 2004, and the cash grid market share has fluctuated around the 10% level. To gain additional insight on the trend in cash and contract grid market share, the data were divided into yearly periods. Summary statistics (table 7) were generated for the cash and contract markets and for the percentage of choice and yield grade 4 and 5 carcasses on a weekly basis. Carcass attribute data are published by the USDA/AMS in a weekly report: "National Steer & Heifer Estimated Grading Percent: NW_LS196." These data were obtained from the LMIC for the April 2004 to December 2009 time interval.

The data indicate that steer and heifer grid market share increased from 35.8% in 2004 to 44.3% in 2009. The growth in grid market share during this period was generated by contract marketing on a grid. Overall, these statistics are consistent with the data reported by the NCBA in its 2005 NBQA. Grid market share for 2009 is at approximately the same level as reported by Muth et al. (2007) for 2002–2005. Muth et al. also reported on the distribution of yield and quality grade across marketing channel options. Their findings show the distribution of carcass quality is similar across the negotiated, forward contract, and formula marketing options. Based on our data, the percentage of cattle grading choice has increased 6% over the six-year period, but yield grade 4 and 5 carcasses continue to account for about 10% of cattle slaughtered. While grid pricing has gained market share, the problem of nonconforming carcasses persists, as noted in the literature. This result is not unexpected, as 55.7% of slaughter volume was not priced on a grid in 2009. The data also suggest that producers still have not incorporated VBM practices into operations at a level necessary to significantly reduce production inefficiencies.

[13] Grid market share of domestic slaughter in the post-BSE ban period averaged 38.7%.

Table 7. Summary Statistics: Grid Market Share and Beef Quality, by Year, 2004–2009

Description	2004	2005	2006	2007	2008	2009
No. of Observations	38	52	53	52	52	52
Cash Grid:						
Mean	0.130	0.098	0.101	0.099	0.078	0.089
(Std. Deviation)	(0.016)	(0.016)	(0.015)	(0.201)	(0.012)	(0.020)
Minimum	0.093	0.066	0.070	0.069	0.053	0.059
Maximum	0.164	0.137	0.131	0.200	0.104	0.140
Contract Grid:						
Mean	0.228	0.264	0.271	0.273	0.310	0.354
(Std. Deviation)	(0.022)	(0.026)	(0.025)	(0.029)	(0.025)	(0.031)
Minimum	0.193	0.203	0.205	0.178	0.226	0.273
Maximum	0.291	0.334	0.329	0.316	0.376	0.417
% Choice:						
Mean	53.299	52.964	51.682	52.803	56.228	59.704
(Std. Deviation)	(1.296)	(1.731)	(1.492)	(1.287)	(1.279)	(1.269)
Minimum	50.470	49.830	48.560	50.070	54.220	57.930
Maximum	55.630	56.490	54.040	55.570	59.050	63.240
% Yield Grade 4–5:						
Mean	7.599	8.299	10.639	9.922	8.557	9.638
(Std. Deviation)	(1.501)	(1.434)	(1.751)	(1.778)	(1.111)	(1.627)
Minimum	4.660	5.530	7.890	6.810	6.210	6.300
Maximum	9.250	10.530	13.150	12.990	10.060	12.110

Summary and Research Recommendations

Efficacy of grid pricing as a value-based pricing mechanism within the beef industry's wider VBM initiative was evaluated using government data and industry-based reports. An accounting procedure is suggested for deriving grid market share estimates based on publicly reported data.

It is suggested here that grid market share is linked with the level of producer adoption of VBM tools. As the literature has demonstrated, managing the genetic traits of production stock, and the use of ultrasound technology to sort and determine marketing decisions, has the potential of increasing profit by reducing inefficiency in a producer's operation when cattle are sold on a grid. The adoption of VBM technology and marketing on a grid are therefore complementary activities.

Our findings reveal that grid pricing has not become the dominant pricing mechanism for fed cattle. This suggests the beef industry's value-based initiative may need to focus on increasing the level of producer integration of VBM technologies into their operations. At the industry level, a significant reduction in production and marketing inefficiency will occur only when VBM practices become the industry standard. Otherwise, the beef industry will continue to struggle with many of the issues it faced when its value-based initiative began.

The following empirical findings of this study provide insight on the current status of the beef industry's VBM initiative:

- Grid pricing has become an important marketing alternative, but average pricing of slaughter cattle by the pen is still the dominant pricing mechanism for the industry.
- Carcass quality issues continue to affect industry performance, even though approximately 40% to 45% of slaughter cattle are marketed on a grid.
- Innovative VBM technology has been shown to reduce production inefficiency and improve profit. Technology adoption has the potential to significantly reduce carcass quality issues.
- Grid pricing and the adoption of VBM technologies are complementary strategies for the producer.
- The cash and contract grid marketing channels appear to be substitute marketing alternatives and are related to slaughter volume.
- Barriers to producer adoption of a VBM strategy include technology cost and marketing risk.
- Grid market share estimates can be derived from public price reports.
- Grid market share can be used as a proxy measure to track the progress of the beef industry's VBM initiative.

Each of these stylized facts raises questions needing further research. Answers to these questions have the potential to improve the beef industry's competitive position. Until selling cattle by the pen, at an average price, is marginalized by the market, pricing inefficiency will persist and carcass quality issues will continue to afflict the industry. If this is the case, then it is unlikely the beef industry will be able to produce the right product at the right price to meet consumer demand.

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