

Fed Cattle Price Discovery Issues and Considerations



E-1053

**Division of Agricultural Sciences and Natural Resources
Oklahoma State University**



EXTENSION

Fed Cattle Price Discovery Issues and Considerations

Derrell S. Peel, Chair

Breedlove Professor of Agribusiness and Extension Livestock Marketing Specialist
Oklahoma State University

David Anderson

Professor and Extension Livestock Marketing Specialist
Texas A&M University

John Anderson

Professor and Head, Department of Agricultural Economics & Agribusiness
and Director, Fryar Price Risk Management Center of Excellence
University of Arkansas

Christopher Bastian

Professor and Paul Lowham Professorship
University of Wyoming

Scott Brown

Professor and Extension Livestock Marketing Specialist
University of Missouri

Stephen R. Koontz

Professor and Extension Livestock Marketing Specialist
Colorado State University

Josh Maples

Assistant Professor and Extension Livestock Marketing Specialist
Mississippi State University

Preface

This report was commissioned by the National Cattlemen's Beef Association to provide guidance in support of cattle industry policy considerations, especially related to price discovery in fed cattle markets. The task force of agricultural economists that produced this report collectively have more than 120 years of experience as cattle industry economic analysts and researchers. In about three weeks' time, this task force assembled, considered, synthesized and summarized available research, information and knowledge about the economics of the cattle industry.

Some will be disappointed that we are unable to provide more specific, simple answers to industry questions. While we try not to make things harder or more complicated than necessary, we recognize that making things simpler than they actually are is very dangerous. The U.S. cattle and beef industry is arguably the most complex set of markets on the planet. This report provides guidance to the industry to understand the economic forces that have shaped the industry and the implications of policies that would propose to change industry structure and/or behavior.

In the end, the industry must decide on policy direction for itself, and that is as it should be. Our responsibility is to make sure industry participants are as informed as possible about the implications of policy proposals.

Every member of this task force is committed to supporting the cattle and beef industry through turbulent times and the coming challenges and opportunities of dynamic global protein markets. We look forward to continued collaboration with producers in research and education to ensure the success of the U.S. cattle and beef industry.

Executive summary

The massive and unprecedented shocks that have buffeted the cattle and beef industry since August 2019 have resulted in understandable anger and frustration among cattle producers. It also has revived many long-standing concerns about price discovery, competition and potential impacts of market concentration. Specifically, there is much industry interest surrounding the volume of negotiated fed cattle trade. The industry is currently considering proposals that will dramatically alter the future of the industry. Some proposals would take the industry away from the free-market philosophy that has guided the industry throughout its history to this point. This report is a comprehensive review of beef and cattle market issues with a primary focus on issues surrounding price discovery.

Summary Conclusions

- Improved price discovery may improve knowledge of market conditions for sellers and buyers but will not, by itself, change overall market price levels. Current price pressures are largely related to fundamental changes in the balance of supply and demand in the industry. These changes are neither the result of, nor can they be fixed by, changes in price discovery.
- Price discovery is impacted by a number of factors other than just the volume of trade. Overweighting the importance of volume in proposed changes to price discovery, both mandated and voluntary options, could have unintended consequences resulting in market inefficiency.
- Research confirms alternative marketing arrangements (AMAs) provide significant economic benefits to AMA users, and thus, significant disincentives to participate in cash price discovery.
- Much of the improvement in cattle and beef quality in the past two decades is largely attributable to the increased use of AMAs.
- Reported negotiated prices appear to be valuable to the majority of market participants and are used informally as well as formally (in AMAs). It is not known how much sellers and buyers value cash prices and if participants are willing to incur additional costs to improve them. Additional research is needed.
- Cash price discovery represents a public good nature in that the industry values price discovery, but individuals have incentives not to participate in price discovery. Eventually, this type of market failure can result in less price discovery than is optimal and may require intervention.
- Any mandatory or voluntary intervention will result in higher costs to the entire industry. Trade-offs exist between better price discovery and the cost of better price discovery. Higher costs are born by all market participants including cow-calf producers.
- Most research shows that relatively small percentages of high-quality cash trades are sufficient to ensure good price discovery in many cases.
- Price discovery interventions in which market participants retain the ability to choose how to respond to market conditions will have the least negative impact on the industry.
- Prescriptive solutions, such as mandates of fixed behavior, compromise market efficiency, will impose higher costs on the industry and greater negative impacts on market price than voluntary solutions. Moreover, mandated solutions stifle creativity and innovation and will likely inhibit the industry's ability to grow and respond to dynamic competitive environments.
- Current Livestock Mandatory Price Reporting (LMPR) transaction type definitions are not designed to regulate volume among types. If industry participants are forced to increase "negotiated" trades at the expense of "formula" trades, market participants will (1) find ways to meet the "negotiated" definition while minimizing the cost of doing so; (2) packers and feeders with the best relationships will be better positioned to minimize such costs; and (3) the percentage of negotiated trade would increase but the value of the negotiated price report would be diminished due to the presence of what are really formula trades.
- Impacts of concentrated industry structure are largely separate from price discovery issues. Research shows market power in fed cattle markets has small negative impacts on prices that are offset by substantially larger cost efficiencies to the benefit of cattle producers and beef consumers.

Summary Recommendations

Negotiated transactions and the price discovery they support benefit everyone in the market and sensible efforts to increase the volume of negotiated transactions in the fed cattle market are well-founded and worth supporting. The most promising route to this goal is through voluntary industry initiatives. Viable strategies are readily identifiable. The first step toward any of these strategies will be to identify reasonable volume targets. Since even a small number of representative transactions can lead to effective price discovery, these targets do not have to be large. The industry should consider voluntary initiatives to define consensus-based volume targets for negotiated transactions in the neighborhood of 5% to 10% of all transactions. Targets will need to be defined regionally and perhaps seasonally, with enough flexibility to allow deviations from targets over shorter time frames (e.g., certainly weekly and perhaps even monthly). Possible mechanisms for facilitating negotiated transactions include a voluntary market-maker program or electronic exchange to which feeders offer cattle for negotiated sale each week. Either would require industry buy-in and ongoing support.

Of course, once a negotiated transaction target has been agreed upon, some may perceive the logical approach to implementation would be through regulatory channels instead of through voluntary, industry-led action. Such a simplistic approach is unlikely to be effective and would almost certainly degrade the quality of price discovery in the fed cattle market because the current price-reporting system is not suited to a regulatory role. Clearly and cleanly distinguishing bona fide negotiated transactions from bona fide formula transactions will be next to impossible. The quality of reported information, across all transaction types, could be seriously compromised, with negative implications not only for fed cattle market participants, but also for the industry as a whole.

Even without a volume mandate for particular transactions types, the quality of data in LMPR reports could be improved. Improvements in the information available from these reports, by itself, could contribute to significant improvement in price discovery and help confirm reasonable levels of mandated levels by transaction type. Three specific changes are recommended:

- Revise confidentiality restrictions so more data can be reported.
- Provide more detailed reporting on formula transactions.
- The industry should consider asking for yield data to be a mandatory report.

Regional Market Maker Programs could be used to encourage more voluntary price discovery. The program recognizes that AMA sellers benefit from price discovery, but do not participate in price discovery. A program, such as described in the report, increases incentives for cash trade among all fed cattle sellers. As with any program that attempts to change market participation behavior, the details of a program like this are critical to its success. These voluntary approaches also could create unintended effects, but would likely provide the needed flexibility to be adjusted more quickly and easily as the industry evolves. Additional details of a sample market maker program structure are included in the full report.

A basic possible structure of such a program is presented below:

- Fed cattle sellers who market cattle using non-cash (i.e. other than negotiated cash or grid base) methods, i.e. AMAs would be subject to a per head assessment.
- When the level of cash trade drops below threshold levels, fed cattle sellers who engage in negotiated cash trade may receive payments, based on the AMA assessments as incentives for additional negotiated trade.

A market maker program similar to this allows for larger market-based outcomes because individual firms are free to participate or not and figure out the most efficient way to do it. The program would have to be administered after the fact, i.e., based on previous trade (weekly or monthly). This means possible assessments and payments would not be known during the trading week, thus, would minimize distortions in negotiated prices. Careful consideration would be needed to not make the program incentives too strong, which could lead to inefficient results similar to those from a volume mandate.

Finally, price discovery also could be improved through enhanced use of transparent, technology-based trading platforms, such as the Fed Cattle Exchange. A relatively small volume traded consistently in such a transparent fashion can contribute significantly to price discovery. There are no doubt some costs to using electronic trading; otherwise it would be more heavily used today. Overcoming the existing disincentives to participate in price discovery means success of an electronic exchange will require a commitment and willful action of market participants to regularly use this mechanism.

Fed Cattle Price Discovery Issues and Considerations

Until the 1990s, the feedlot industry priced fed cattle largely as commodities with very little differentiation of value by carcass quality attributes. Fed cattle were priced on average with perhaps slight differences across regions based on average quality but little variation across or within pens. In that world, sellers and buyers recognized that pricing fed cattle to better differentiate quality was costly in time and trouble, and both sellers and buyers had little incentive to incur the costs for such quality and price differentiation. It was common for feedlots to sell, and packers to buy, entire show lists at a single average price. Cattle producers with better-than-average cattle had little means to benefit from higher quality, thus, little incentive to improve cattle. Simultaneously, low-quality cattle usually received an average price, thus, ensuring low-quality cattle would continue to be produced and marketed.

In the 1990s, the industry became increasingly aware the lack of quality signals and rewards was a dead-end for the industry. Beef demand was declining, quality-grading percentages were low and stagnant and the beef industry was losing competitiveness in protein markets. Numerous initiatives were put in the category of “value-based marketing.” Grid pricing developed and, for the first time, cattle quality was differentiated and fed cattle producers were rewarded for producing high-quality cattle.

Grid pricing improved price signals but the transaction costs of differentiated pricing were immediately apparent. Both sellers and buyers had incentives to reduce transaction costs, manage volumes and reduce risk. Driven by cost considerations, grid pricing concepts were incorporated into forward contract and formula price arrangements, which often use a cash price as a base. In the 2000s, industry concerns turned to the impact of “captive supplies.” Livestock Mandatory Price Reporting (LMPR) was initiated in 2001 to provide more information to market participants and others. These concerns culminate today in the debate over alternative marketing arrangement (AMAs), as they are known, and the thinness of cash trade in fed cattle markets. While there is no doubt improved quality signals have increased beef demand and beef industry competitiveness, cost efficiencies of AMAs have led to thinning fed cattle negotiated trade and concerns about the viability of price discovery in fed cattle markets. Price discovery concerns are sometimes compounded by USDA-AMS price reporting limitations.

The lesson of fed cattle market history is that the business practices predominating today occur for strong economic reasons that are not new and have impacted fed cattle markets in one way or another for many years. Legitimate concerns about the viability of cash fed cattle markets and price discovery, and solutions proposed to address them, must consider and incorporate these incentives into any proposed changes.

Problem Statement

Fed cattle markets use a combination of negotiated cash and alternative marketing arrangements (AMAs) to price fed cattle. AMAs typically rely on cash market prices to drive formula and grid prices. The incentives and benefits of AMAs have increased the use of AMAs to a point where the reduction in negotiated cash trade has been sufficient to raise legitimate concerns about adequate price discovery. The value of negotiated cash trade to the industry is greater than the individual incentives to participate in the price discovery process. Price discovery in fed cattle markets, therefore, has a public good nature and can eventually be underprovided in freely operating markets.

Recent NCBA policy is based on a desire to maintain market-based trading and the ability of sellers and buyers to pursue preferred and beneficial business methods while simultaneously encouraging voluntary participation in sufficient negotiated cash trade to ensure robust price discovery in fed cattle markets. Allowing market participants to determine how best to increase negotiated cash trade will minimize costs to firms and to the industry. The policy calls for developing triggers or benchmarks by which to monitor and evaluate the success of voluntary trading and the adequacy of price discovery in the industry.

Objectives

- 1) Develop guidelines the industry can use to specify appropriate triggers or benchmarks to monitor and evaluate the success of voluntary market trading to ensure adequate levels of negotiated cash trade and robust price discovery. These guidelines will address regional considerations, seasonality and other relevant market factors to evaluate the adequacy of price discovery in the short- and long-term time frames.
- 2) Prepare a comprehensive report summarizing available research and economic principles related to incentives for market participants to choose

various trading methods; the costs versus benefits to individuals and the industry of alternative pricing methods; and the role of pricing methods in providing incentives for quality improvement in the industry.

- 3) Provide an assessment of the current competitive environment in the fed cattle industry and summarize research related to the impacts of market concentration.

Summary of Fed Cattle Pricing

Figure 1 shows how fed cattle pricing methods have changed through time. During the 2002-2011 decade, negotiated cash trade declined and formula trading increased. From 2012 to the current, negotiated cash trade has not changed significantly. During the last decade, formula pricing was mostly steady but did show slight growth recently (Table 1). Fed cattle pricing methods vary widely by region (Table 2).

The Need for Price Discovery

In a market where all participants have perfect information, there is no need for price discovery – everyone knows all information about the market. Perfect information is, of course, an abstract concept. Freely

Table 1. Fed cattle pricing, average monthly % by method.

	<i>Jan 2012- Jul 2020</i>	<i>Jan 2017- Jul 2020</i>
	<i>Domestic % of Domestic Total</i>	
Negotiated Cash	23.8	23.8
Negotiated Grid	4.85	3.98
Formula	59.7	62.4
Forward Contract	11.63	9.78

operating markets often rely on prices to reveal information useful to market participants in making decisions that achieve the efficient allocation of resources for which markets are known and valued. Lack of information is, therefore, a hindrance to market efficiency.

Fed cattle markets, as they operate today, utilize and value market information in the form of publicly revealed prices. However, price discovery is not costless. Sellers and buyers that negotiate cash price information for the market incur transaction costs, higher fixed costs and additional risk. Therefore, sellers and buyers have an individual incentive to utilize mar-

Table 2. Fed Cattle Pricing, Region by Type, Jan 2017- July 2020.

<i>Region</i>	<i>Negotiated Cash</i>	<i>Negotiated Grid</i>	<i>Formula</i>	<i>Forward Contract</i>
	<i>% of Total</i>			
Texas/Oklahoma	6.50	2.61	86.74	4.36
Kansas	16.38	1.24	78.31	4.14
Nebraska	36.78	3.90	48.21	11.11

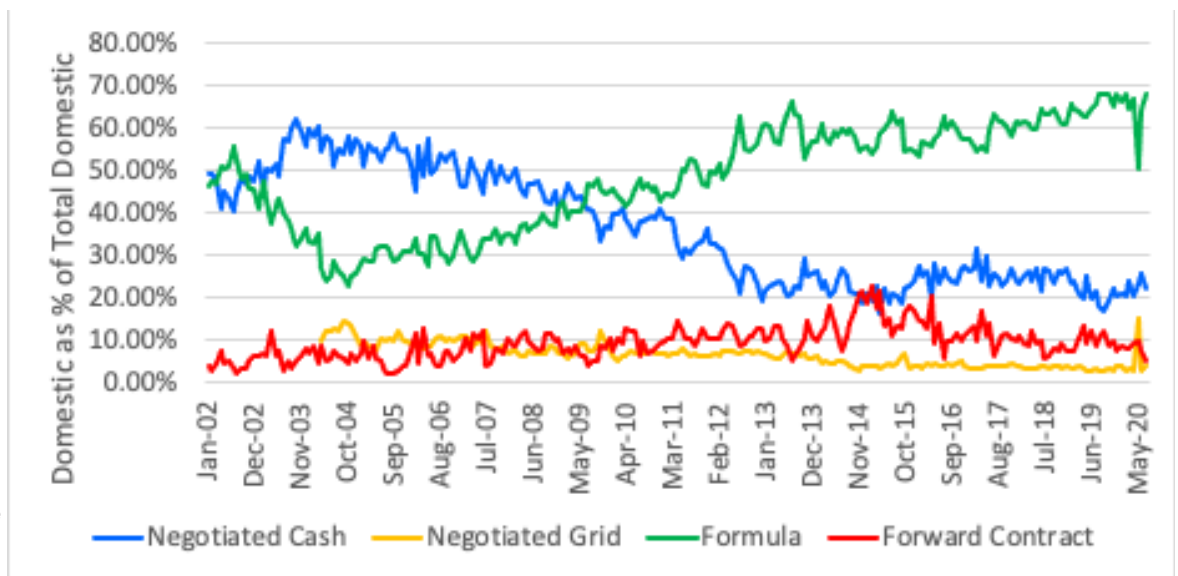


Figure 1. Fed cattle pricing.

ket prices but not contribute to the discovery of those prices. Some market participants are therefore “free riders” who utilize a product (i.e., market prices) without paying for it. Price discovery is, in economic terms, a public good. Public goods have the characteristics of non-rivalry (meaning one’s of the product does not preclude another’s use of the product) and non-excludability (meaning that one cannot keep another from using the product) (Varian, 1992). In the case of fed cattle prices, this means one may contribute to price discovery, but cannot keep another from using those prices (and the information contained therein) for free, and one’s use of fed cattle prices does not preclude another’s use. The result is a freely operating market can provide less price discovery than is optimal for the market. This could eventually continue to a point where market prices no longer have value to the industry.

Price Determination versus Price Discovery

The terms “price determination” and “price discovery” are used interchangeably in a great deal of non-technical communication about markets. However, these are scientific terms with specific meaning and refer to different, but related concepts relevant to any discussion of commodity pricing. It is helpful to clearly distinguish between these concepts to productively assess the impacts of changing institutional arrangements in the fed cattle market on price behavior.

Price determination refers to how the forces of supply and demand for a particular product or commodity interact to produce an equilibrium price. It is concerned not with the outcome of any particular transaction, but rather with the general price level that prevails based on fundamental conditions in the broader market. Price discovery, on the other hand, refers to the means by which a buyer and a seller arrive at a price on a specific transaction. It is concerned directly with the mechanics by which individual transaction prices (and other terms of trade) are established rather than with broader, and generally more theoretical, issues of how supply and demand fundamentals affect the general price level (Tomek and Kaiser 2014). In effect, price determination represents a macro-level perspective on the equilibrium price, while price discovery represents a micro-level perspective on the variability of prices around that equilibrium.

With respect to the present situation in the cattle market, it is worth noting clearly what improving price discovery can and cannot do. Most importantly, improving price discovery cannot be expected to change the overall level of prices if prevailing supply

and demand fundamentals are consistent with the low or high prices existing at the time. More than 20 years ago, Schroeder et al. (1998a) noted the tendency for price discovery concerns to proliferate in a low-price environment. Current conditions in the cattle and beef industry are challenging for all market participants, and it is understandable dissatisfaction with market outcomes is widespread. Improving price discovery is a worthwhile goal. It has the potential to benefit all market participants – both producers and consumers; but it will not provide higher prices when market fundamentals do not support higher prices.

Factors Affecting Price Discovery

It is important to understand the factors affecting price discovery for two reasons. First, such knowledge helps us understand what impacts buyers and sellers as they interact in the market. Second, for the purposes of this report, it puts in perspective the potential impact the volume of trade has on the price discovery process and the determination of average, or equilibrium, prices.

What are the factors that affect price discovery? Simply put, anything that impacts a buyer’s and/or seller’s behavior when making bids and/or offers affects the agreed upon transaction price. Both research and economic theory offer insights into a number of factors that affect buyers and sellers when negotiating price.

Factors affecting price discovery include the type of trading institution, risks such as advance production risk, matching risk, negotiation failure risk, risk preferences of the individuals involved in the transaction and information used to form expectations about the value of the cattle being traded. These factors will be discussed in more detail in this section as well as several of the following sections including: Price Discovery, Risk and Incentives to Use Marketing Agreements; The Impacts of Market Information and Expectations of Value on Price Discovery; and Trade Volume and Market Thinness: How Thin is Too Thin?

One of the more important factors that impacts price discovery is the trading institution. Trading institution refers to the set of rules in place defining how buyers and sellers may interact when making bids and offers (Davidson and Weersink, 1998). Research indicates that trading institution alone can impact price discovery to the point that price determination results in very different equilibrium or average price levels (Menkhous, Phillips, and Bastian, 2003). The research finds prices discovered in an English Auction are 17% higher than the predicted equilibrium. The double auc-

tion (same institution as fed cattle futures) yielded just slightly more than predicted equilibrium price levels, and a market where price discovery occurred with individual buyers and sellers being paired and privately negotiating prices yielded average prices nearly 10% below equilibrium.

What accounts for the substantial differences in price across trading institutions? Buyers compete in an ascending bid process in the English Auction, and as that occurs, buyers know their bids as well as those of the other buyers. Sellers are passive in the price discovery process, resulting in the highest price level being determined in an English Auction. The Double Auction allows all buyers and sellers to make bids and offers, and all market participants see those bids and offers, resulting in prices being discovered relatively quickly and reaching the predicted level for a competitive equilibrium. Research indicates privately negotiated transactions, however, resulted in the lowest price levels even though the number of buyers, number of sellers and underlying supply and demand conditions were the same as the other two institutions. Can the conclusion be, on the basis of the lower resulting price, that the price discovery process was broken in private negotiation? No; the different result is because of a number of factors impacting the behavior of buyers and sellers in this institution, particularly advance production risk, matching risk, negotiation failure risk and risk preferences of individual traders. These factors affect price discovery and trader incentives regardless of market information and trade volume.

Price Discovery, Risk and Incentive to Use Alternative Marketing Agreements

One important set of factors impacting price discovery relates to actual or perceived risks faced by participants in the market. Research indicates what is termed advance production risk, matching risk and negotiation failure risk greatly impact trader behavior when transactions are privately negotiated, which is primarily how prices are discovered for negotiated cash trades in fed cattle markets (Menkhaus et al., 2007; Sabasi et al., 2013; Jones Ritten et al., 2020). The avoidance of these risks are a major factor or incentive explaining the use of alternative marketing arrangements.

The tremendous growth in the use of AMAs in the fed cattle market clearly represents a significant change in trader behavior. It is reasonable to conclude risk, and market participant perceptions of that risk, have played a role in the change. In fact, the advantages of AMAs for both feeders and packers with respect

to risk mitigation have been widely documented over years of study. For example, Ward et al. (1996a) identified risk mitigation as a significant motivation for AMA utilization by both packers and feeders. Similarly, a 2003 Congressionally-mandated study on the impact of captive supplies on the cattle market documented that AMAs substantially reduced costs for both feedlots and packing plants and the long-run cost to the cattle and beef industry of a loss of AMAs would amount to almost \$50 billion (Koontz, 2010). Such cost savings largely derive from the fact that these arrangements reduce the non-price risks – that is, advance production risk, matching risk and negotiation failure risk – associated with fed cattle marketing. Understanding these risks is essential to understanding the ongoing evolution of pricing methods in the fed cattle market.

What is advance production risk? Simply put, having invested in the production of fed cattle (i.e., purchased the feeder animal, paid ongoing feed costs, investment in the feedyard, etc.), sellers generally feel pressure to make sure they come to a negotiated price with a buyer because they risk not covering those costs, or incurring more costs, if a deal is not struck. This phenomenon similarly applies to buyers if they feel pressure to meet the volume requirements of a plant.

This advance production risk is then coupled with what has been called matching risk. This is the risk of being matched with someone in the market who is better at bargaining, or who has already made trades, thus feels less pressure to trade. For example, if you are matched with a buyer less interested in your cattle, they may bid less aggressively, making it harder to come to an acceptable price agreement. This also can occur if a buyer matches with a seller who has already sold what they planned to that period. This risk creates a potential cost for the trader to attempt to find someone else interested in trading. Again, traders affected by this risk are more willing to make concessions when they bargain in order to ensure a trade is made rather than risk being matched with someone they are unable to trade with at all.

Matching risk also is somewhat related to another risk termed negotiation failure risk. Negotiation failure risk is the risk of not coming to agreement. Time and effort is spent bargaining but no price or terms of trade are agreed upon (Jones Ritten et al., 2020). If such a risk is realized, the persons involved must search for someone else to make the trade. At that point, valuable time has been lost, increasing the chance the next trading partner has either acquired or sold what they need to; that is, matching risk increases. In the case of the fed cattle market, this realized risk could result in sell-

ers having to keep cattle longer, incurring more costs until a willing buyer can be found.

Cattle producers in a focus group in Wyoming reported they generally felt they had to accept a buyer's terms rather than risk a failed negotiation (Bastian et al., 2018). Generally speaking, advance production, matching and negotiation failure risks all tended to affect sellers more than buyers when transactions are privately negotiated. Thus, private negotiation led to price discovery contributing to price determination that resulted in lower prices than the predicted equilibrium even though supply, demand and market structure were the same as in tests of other trading institutions (Menkhaus et al., 2003; Menkhaus et al., 2007; Sabasi et al., 2013)¹.

Risk preferences also impact bargaining behavior and the resulting price discovery process. Those agents who are more risk averse (buyers or sellers) tend to bargain in a manner that results in less advantageous transaction prices and lower individual earnings (Muthoo, 1999; Krishna, 2010). Jones Ritten et al. (2020) test risk preferences across groups that first participate in a privately negotiated market experiment, then a risk experiment and those that just participate in a risk experiment. The authors found those who participated as a seller in the market experiment had significantly higher loss aversion compared to buyers, and those with higher loss aversion earned significantly less in the market.

The Impacts of Market Information and Expectations of Value on Price Discovery

The above factors, trading institution, various risks and risk preferences all interact with other factors traditionally discussed in regard to price discovery in fed cattle markets. These traditional factors generally can be thought of as factors affecting expectations of value when buyers and sellers enter into a transaction. One factor affecting expectation of value is quality. Expectation of value generally increases as perceived quality increases. Increased quality in turn

alters the levels at which bids and offers and resulting transaction prices occurs (Jones et al., 1992; Ward et al., 1996b; Ward, 1992).

Related to expectation of value for a specific quality of a commodity is market information. Research indicates several sources of market price information affect price discovery and price determination for fed cattle. These market price sources include negotiated cash prices, boxed beef prices and live cattle futures prices (Jones et al., 1992; Matthews et al., 2015; Ward et al., 1996b; Ward, 1992; Ward, 1981). These market prices are typically one day to one week old when traders enter into negotiation. Thus, these prices give traders a general idea of price level, but this information is augmented with additional current information relevant to the value of cattle in the current week. For example, let's say the number of cattle coming out of feed yards in a given week is expected to be lower than the prior week. This signals that current supplies could be less than last week, so bids and offers should reflect that newer information. Perhaps recent news indicates an increase in demand for beef in the near future. Again, this signals to traders that current supply and/or demand conditions are changing compared to last week. Thus, the price discovery process is impacted by past price information, but traders also are adding any other new knowledge or updated expectations to their bids and offers. In this way, individual knowledge of current supply and demand is incorporated into the bid and offer price, thereby impacting agreed upon transaction prices.

It is important to note if only old prices are used when discovering this week's price, average price levels and market signals this week will almost certainly omit important current supply and demand information. This, in turn, would create prices that are not adjusting quickly to new information. Thus, past price information and its accuracy is important, but overweighting its importance with prescriptive policy or mandate could have unintended consequences and cause market inefficiency.

In a market with effective price discovery, the price discovery process becomes dynamic, with traders constantly updating past information with new and incorporating all of it into individual transaction prices. It is important to recognize all the other factors discussed previously also are affecting price discovery along with market information and current supply and demand information. Different individuals with different risks and risk preferences in different market institutions are using that information, weighting its importance, forming expectations and making bids and offers to discover price.

1 These results come from laboratory market studies. Some have criticized that typical subject pools used in such experiments do not behave the same as agricultural producers. Nagler et al. (2013) test behavior in laboratory market experiments across students and agricultural professionals containing primarily agricultural producers. They find the same treatment effects across the two subject pools. Bastian (2019) examines bargaining behavior across market experiments using students and agricultural professionals and generally finds no difference across the bargaining strategy variables tested.

In technical terms, when price discovery works effectively, prices are efficient. Again, the term – efficiency – has a specific meaning. A market is efficient if prices reflect all available information (Fama, 1970). Janzen and Adjemian (2017) note that effective price discovery accomplishes the task of reflecting underlying information in a timely manner and does so via “bona fide transactions or standing bids and offers whose prices are known to all market participants” (p. 1192). Unfortunately, the question of how many bona fide transactions are sufficient to support effective price discovery is rather difficult to answer.

Trade Volume and Market Thinness: How Thin Is Too Thin?

A market in which negotiated transactions during a given period of time are not sufficient to support efficient price discovery is a thin market (Anderson et al., 2007). Typically, three problems are associated with thin markets: prices don’t reflect supply and demand conditions (either because of insufficient volume or transactions that are not representative of market values), prices are more volatile and the incentive for market manipulation increases. In financial literature, thin markets are characterized slightly differently as low trading volume, high price volatility and large bid-ask spreads. What these thin market problems amount to is that prices become a less reliable guide to actual value as supported by underlying market fundamentals. (Adjemian, Saitone, and Sexton, 2016).

As an empirical matter, defining a thin market versus a market with sufficient trade volume is difficult. Despite a great deal of research, a definitive standard for objectively defining a market as thin does not exist. What empirical research has shown is the number of transactions needed to achieve a competitive price outcome can be quite small (see, e.g., Tomek, 1980). In light of this, it is important to consider other factors beyond just volume are important in identifying and assessing the performance of thin markets.

As discussed earlier, price discovery is a dynamic process involving individual bid and ask (offer) behavior. This process is impacted by a number of factors including trading institutions, risks traders face, risk preferences of traders and expectations of value formed via multiple sources of old and current market information. Increased volume of negotiated cash trades is expected to improve accuracy of last week’s reported prices, but those prices are only one of many factors affecting price discovery and related price determination. Thus, any interventions in the price dis-

covery process that focus solely on trade volume may not have the expected impact and may well entail negative unintended consequences as traders still have the incentive to reduce risks or transactions costs they face.

Evaluation of thin markets is further complicated because thin markets may arise from a number of factors that may represent legitimate, even desirable, market developments. For example, market differentiation has been a factor in creating thin cattle markets. Several characteristics have led to increased differentiation. One is regional fed cattle markets. While related, each regional fed cattle market has unique characteristics, including small farmer-feeders, very large feeders with relatively high turnover and varying USDA quality grade by region. These characteristics often represent a rational and efficient response to incentives in the regional market area. Moving to quality, or value, based pricing and away from average pricing during the last 30 years also has contributed to market differentiation and increased value in fed cattle markets.

Differences in the type or quality of cattle traded by negotiated cash arrangement compared to formula cattle could be evidence of adverse effects of thin markets. It appears there is little evidence of differences in cash and formula prices. More than just monitoring the volume of cash transactions, this means evaluating the difference between the quality of cattle traded by each method may be necessary. It is important the cattle traded in the cash market are “representative” of cattle traded by other methods. USDA quality grade might be one measure. Another important measure is yield. Yield has become a more important “quality” measure of cattle in pricing cattle in the Southern Plains compared to other regions. If the cattle traded by each method are generally consistent in terms of characteristics affecting value then the market may not be too thin, even with a relatively small volume of negotiated transactions.

Thin markets also may be indicative of changing or evolving markets. There are many examples of agricultural markets that have changed. Today, most hogs are sold using carcass prices, compared to live prices not long ago. Numerous futures contracts for agricultural commodities have disappeared including potatoes, live hogs, and pork bellies. Yet, clearly those commodities are still produced, bought and sold. There is evidence of price discovery occurring in futures markets in addition to underlying cash commodity prices and that information being used by traders. Cheese markets offer a case in point.

Price Discovery and Free Riders in Cheese Markets – A Case Analysis with Implications for Fed Cattle

Although nearly every agricultural commodity market could be described as thinly-traded, the dairy industry often is mentioned first when discussing a thinly-traded market. The National Cheese Exchange (NCE) operated as the national market for cash-traded cheese until April 1997 when the cash-traded cheese market moved to the Chicago Mercantile Exchange (CME).

Although the weekly determined NCE cash-traded cheese price represented less than 2% of national cheese production in the early 1990s, nearly all cheese produced in the nation was sold through formulas based off the NCE reported cheese price. The lack of volume traded on the NCE relative to national production led to many comments about manipulation of NCE prices.

Many dairy economists who analyzed the NCE cheese market failed to conclude price manipulation was an issue even though it was very thinly traded. Hamm and March (1995) conclude that, “While the Exchange market has been described as “thin” and the industry concentrated, experience has shown that any firm attempting to buy or sell cheese at levels which differ from that of the general consensus of the industry must be prepared to buy or sell large quantities of cheese in order to raise or lower the market.” They further conclude, “The relevant issue is not whether the Exchange represents a small volume but whether it does reasonably reflect the supply and demand conditions in the U. S. cheese industry. If members reflect national market conditions in their transactions, then the Exchange performance is acceptable.”

The movement of the NCE to the CME did not solve the issue of a thinly-traded cash cheese market. The CME cash cheese market still operates today and most trading sessions result in very few transactions. In fact, the CME is even more thinly traded than the old NCE. The addition of mandatory price reporting of cheese prices provided information on cheese transactions from processors with annual capacity of 1 million pounds or more and provides the average price across all transactions and can be compared to the thinly traded CME cash price.

The cheese example provides insight that even an extremely low volume or thinly-traded market (only 16 train carloads of cheese were sold on Aug. 31, 2020 at the CME) can be seen as an adequate price discovery mechanism, especially with the addition of mandatory price reporting that shows how all cheese was priced.

The cheese market provides evidence of the cost of price discovery and the public nature of price discovery allows free riders to avoid the cost of price discovery yet take advantage of the market information provided. Important to these free riders is the thinly traded cash market correlates with their own beliefs about the level and movement of prices.

The analysis of cash cheese markets can help focus the research on cattle markets and adequate levels of negotiated trade. Perhaps the most pressing question to answer is whether cattle market participants can enter the negotiated cattle market when they observe prices different from their own observations about market level and direction.

If others can easily enter the negotiated fed cattle market in periods where they feel market prices are too high or too low, then it may provide an indirect check-and-balance system to what is a thinly-traded market. There may exist constraints or costs in cattle markets that do not allow new buyers and sellers to easily enter and affect price discovery relative to the experience found in cheese markets.

It remains important to focus on whether more negotiated cattle trade would provide better price discovery. That is, would prices found with additional negotiated trade better reflect underlying supply and demand fundamentals? Adequate price discovery should not be confused with whether a particular feedyard has a buyer(s) willing to purchase cattle on a regular basis. The latter may have more to do with the cost of assembly of fed cattle supplies and avoidance of risk and less to do with price discovery.

Although legislative or regulatory approaches can be used to correct problems in price discovery, the dairy industry can provide good examples of unintended consequences with this approach. The end-product pricing used throughout much of the federal milk marketing order system today has only generally moved the pricing discussion from one of price discovery to one of adequate margins needed at each market level. Regulatory approaches can lack needed robustness to changing market conditions, which results in continual adjustment to the regulatory approach. Regulatory approaches can be slow and hard to change over time. For example, the lack of dairy product innovation often has been correlated with the regulatory approach taken in the industry.

Research Indications about Fed Cattle Negotiated Cash Trading Volume

To discover a fed cattle price, the industry needs to trade fed cattle - and needs to trade enough cattle so

the price is representative of market conditions across the different grades of cattle as well as reveal different conditions across different regions. In this context, the fed cattle price is needed. A single price – or a combination of prices for the various important grades and regions of cattle – efficiently communicates the measure of fed cattle value to buyers and sellers and to upstream and downstream market participants.

However, there is a balance in this argument, concept and idea. There is a need for a cost/benefit perspective. Discovering price consumes resources. It takes time and effort that could be used elsewhere to potentially more productive ends. Price negotiations run the risk of the trade failing and cattle subsequently having to be marketed later and potentially sub-optimally. Having price information allows efficient communication. What were fed cattle worth the week prior to Aug. 31, 2020? The answer from the LM_CT150 for Live FOB Steers and Heifers is between \$105.04 and \$105.09 per hundredweight. This is precise and informative. Having that information allows a business to compare its performance to others in the marketplace. Having this information allows assessment of the profitability of the industry and individuals within the industry. Further, information across regions within the U.S. is informative with respect to regional competitiveness or simply regional relative supply and demand.

At some point in time, the market may no longer need a fed cattle price. The largest portion of fed cattle may be procured based on underlying beef product values. Other significant portions of supply may be produced under forward contract. Fed cattle may be priced due to differences in the value of appropriate end use and may be valued in wholesale or retail terms. Cash fed cattle prices communicate efficiently, but more detail may be needed in the future. Innovation in valuation needs to be considered – or at least not pre-empted.

Ultimately, some volume of negotiated cash trade is needed, but it also is important to recognize the volume needed may be highly variable and dependent on a number of other market conditions. This was discussed earlier. The number of factors that impact the price discovery process is large. Volume is but one factor.

The volume recommendations reported in Koontz (2017) were clear from the 2002-2015 mandatory price reporting data. There was a relationship between the volume of negotiated cash fed cattle trade and the amount of price discovery. Larger volumes were associated with more price discovery. However, in hindsight, the supply and demand events in this time

period were somewhat narrow. Early in livestock mandatory price reporting the market shock from the BSE events in North America occurred. These events created substantial uncertainty, price volatility and price discovery during 2004. However, the main phenomena during this time period were the gradual improvement in beef demand, gradual recovery of international trade in beef and declining supplies of cattle and beef. During this time period, there is an ever-declining volume of cash trade and less price discovery was occurring. Gradual changes in demand, trade and supply predominated over the market shocks needed to create opportunities for price discovery. There was a decline in the negotiated cash trade volume especially in the Southern Plains. This resulted in gradual declines in the objectively measured amounts of price discovery occurring in regional fed cattle markets.

Updating the price discovery analysis with data including 2016 through 2019 reveals changes in the price discovery and volume of cash trade relationships. Substantially more price discovery is found in the post-2015 period, and this is a time period with continued low levels of negotiated trade. The underlying supply and demand events create the need for price discovery and price discovery occurs. Volume recommendations must recognize that many other factors than volume impacts price discovery. Volume continues to have a positive relationship with price discovery – increased cash volumes are associated with more price discovery. However, volume is not the only nor the main driver of price discovery.

Market events post 2015 included the rebuilding of the domestic cattle herd and a price decline from record highs. Also during this time period, it emerged that packing capacity was much more in line with available fed cattle supplies. These fundamental changes to cattle and beef supply and demand create the uncertainty needed for significant and robust price discovery to emerge - and it does so with little underlying negotiated cash volume.

There remains a statistically significant relationship between volume and price discovery, but there also are substantial differences across regions. The general level of discovery varies in each of the rolling window samples. There is a trend in price discovery that less is done each successive time period, but there is substantial variation in price discovery driven by overall market events: specifically, during the BSE time period and the fall and subsequent volatility after establishing record high prices. The volume recommendations in recent time periods is considerably less than needed during the 2002-2015 time period.

Volume is informative and important, but it is not the main determinate of price discovery. Uncertainty in the supply and demand situation in fed cattle markets creates the observed price discovery. Therefore, desired levels of market participation need to be agreed to by market participants with an understanding of market conditions and expertise with respect to needs relative to costs and benefits. There are no clear research-determined “trigger” levels of negotiated cash trade where robust price discovery transitions from not occurring to occurring. Small levels of cash trade can result in substantial price discovery and historically large volumes of cash trade can result in little price discovery.

The question and issue is not as simple as volume. Volume contributes to price discovery. Other factors as discussed in this report also are important and at times substantially more important. This is the nature of measuring this phenomenon – price discovery. The process of price discovery is not analogous to applying fertilizer or water to a crop. Applying increased negotiated cash trade will increase price discovery, but there are other important and often more important ingredients.

Market Efficiency and Cost Reduction

AMAs reward quality and have led to reduced transactions costs in moving cattle from feeders to packers. They have streamlined volume management and led to greater efficiencies in production and processing. More efficient procurement and more efficient utilization of available packing capacity allows the spreading of significant packing plant fixed costs over more cattle. For packers, AMAs make it easier for plants to secure an adequate volume of cattle to operate efficiently. Economies of size in beef packing plants are significant (MacDonald et al., 2000). This means failing to maintain efficient throughput can significantly increase a plant’s per unit production costs (Anderson, Trapp, and Fleming, 2003).

If AMAs have led to the benefits in the supply chain above, then what might be the associated costs of reducing AMA use? There are a number of areas where cost efficiencies might be lost, or at least should be considered.

- What is the value of scheduling? Or, what is the cost of scheduling inefficiencies that result in unused packing plant space? Research has shown there are significant economies of size in packing (e.g., MacDonald et al., 2000). Scheduling that results in unused capacity may be thought of as reducing the capacity of a plant leading to higher per unit costs.

- Scheduling also is an important consideration for feedlots. Moving cattle out frees up feeding capacity for new placements, increasing throughput.
- Another way to conceptualize the impact is to consider the cost of a failed negotiation. A failed negotiation may result in cattle not moving until the next week, requiring additional feed costs, other feedlot costs and lost marketing opportunity of cattle at their most efficient finishing point.
- Opportunity cost of delayed placing of feeder cattle.
- More broadly, increasing costs through the beef supply chain results in higher beef prices relative to competing meats.

The most detailed research project related to the costs and benefits of AMAs was the USDA GIPSA RTI Livestock and Meat Marketing Study (LMMS). This study provided a detailed examination of feedlot and packer transactions and related costs, volume management and fixed costs and size economies in the fed cattle industry. In a recent synthesis of previous research, Koontz (2020) summarized the impacts of restricting AMAs:

“Limiting the use of AMAs by the cattle feeding and beef packing industries will decrease efficiency, will increase processing and marketing costs, and has the potential to reduce beef product quality. In today’s dollars, the impact is at least \$10 per head for the packer and at least \$25 per head for the cattle feeding industry. The dollar amounts in this summary are converting the LMMS impacts to today’s dollars and also placing them in context based on my continued communication with the cattle feeding and beef packing industries. In today’s dollars, the total direct impact to the marketing system ranges reasonably from \$35 per head to \$65 per head. The larger amount is based on recent communications. The costs at the industry level would potentially be over \$2.5 billion per year in today’s dollars, with the industry making economic adjustments and reducing in size, so that over a 10-year horizon the cumulative costs would be over \$16 billion. The majority of the impact would be borne at the cow-calf producer level by farms and ranches. Further, the impact is distributed substantially on the industry that does business or supplies those in the southern plains of the U.S.”

Alternative Marketing Arrangements are used in the industry for very strong economic reasons. The cost savings of AMAs benefit the entire industry in the

form of higher cattle prices than would otherwise exist. Any desired outcome or policy that seeks to reduce the use of AMAs must recognize the resulting increased costs, loss of efficiency and inevitable market impacts.

Price Reporting Issues

The first and most obvious priority is the reauthorization of Livestock Mandatory Price Reporting (LMPR). Regardless of any issues with current LMPR or needed adjustments, the data it provides is far preferred to reverting only to voluntarily reported data or, in the most extreme case, not having any public price data at all.

Second, and perhaps most importantly, it is imperative to recognize the current LMPR transaction types are not designed to enforce volume requirements. In particular, the definitions of the various transaction types are not sufficiently different to avoid relatively easy switching between “formula” and “negotiated” without material changes to how the transaction occurred. In other words, nothing in the LMPR definitions would prevent participants from legitimately recording current “formula” transactions as “negotiated” transactions with minor, pro forma changes to their current trading relationship. The full definitions are (Greene, 2019):

- **Negotiated purchase:** a cash or “spot” market purchase by a packer of livestock from a producer under which the base price for the livestock is determined by seller-buyer interaction and agreement on a delivery day. Cattle are delivered to the packer within 30 days of the agreement.
- **Negotiated grid purchase (cattle):** the negotiation of a base price, from which premiums are added and discounts are subtracted, determined by seller-buyer interaction and agreement on a delivery day. Cattle are usually delivered to the packer not more than 14 days after the date the livestock are committed to the packer.
- **Forward contract:** an agreement for the purchase of livestock, executed in advance of slaughter, under which the base price is established by reference to publicly available prices. For example, forward contracts may be priced on quoted Chicago Mercantile Exchange prices or other comparable public prices.
- **Formula marketing arrangement:** the advance commitment of livestock for slaughter by any means other than a negotiated or negotiated grid purchase or a forward contract using a method for calculating price in which the price is determined at a future date.

The primary difference between negotiated and formula trades is negotiated trades involve a seller-buyer interaction to determine price and agree on delivery day. Specific characteristics of formulas are not publicly available; however, anecdotal evidence suggests many formulas use some adjustment of the previous week’s negotiated price for their region. Currently, there is not an obvious incentive for participants to misrepresent their trades to fit one transaction type over another.

Now, consider that an incentive did exist to report more negotiated trade (e.g. required negotiated trade levels) instead of formula trades. Current formula traders would need to either; 1) negotiate more cattle or 2) figure out a way to make current formula trading practices fit within the negotiated transaction definition. Due to the significant cost advantages, current formula traders would find option 2 preferable to option 1 if it is feasible. The question becomes, can slight modifications of current formula trading practices allow these trades to be reported as negotiated trades – without actually having to incur the cost of negotiation?

Consider one such “workaround” where buyers and sellers with an existing formula relationship communicate and “agree” each week on using last week’s price for the cattle sold this week. It might even be possible to informally “signal” how many of these “disguised formula” cattle to expect through the use of actual formula trades. For example, the number of formula cattle agreed on one week (even if it is a small amount) might contain information about how many “disguised formula” cattle to expect the following week. The most likely opportunity for such an agreement would be current well-founded formula relationships between packers and feedlots because it would require trust that a “normal” amount of cattle would continue to flow from the feedlot to packer even without officially agreeing on quantity until the week of trade. A “formula yard” with a strong existing connection to a packer potentially would be best positioned to achieve this definition shift from formula to negotiated while still relying heavily on last week’s negotiated price. Sellers without such strong relationships would be at a disadvantage.

The advantage of pursuing such a workaround is clear: both buyers and sellers can avoid the costs of negotiation. The implication for the market is that some cattle currently reported as formula would instead be reported as negotiated – without a true increase in negotiated trade. These formula trades disguised as negotiated trades could flood the negotiated market with prices from the prior week – leading to persistent prices and compressing the impact of supply and demand

forces. Under this set of incentives, the weekly negotiated price reported could be significantly less valuable in helping the market find the true value of cattle (i.e. weakened price discovery would limit price determination).

There are likely other creative ways in which sellers and buyers could get around LMPR definitions if faced with an incentive to do so. Again, recall the current LMPR transaction types were designed solely for reporting purposes: their purpose is to describe the industry, not to regulate it. Redefining transaction types to avoid this incentive would be difficult if they are used to regulate volume. The nature of how the majority of live cattle are traded (one-on-one discussions between buyers and sellers instead of an auction) creates significant complexities in better differentiating between “negotiated” and “formula” in the presence of incentives (or mandates) to qualify for one or the other.

Put simply, if forced to check the “negotiated” transaction box more often instead of the “formula” box, rational participants will; 1) find ways to meet the “negotiated” definition while minimizing the cost of doing so; 2) the packers and feeders with the best relationships will be best positioned to minimize such costs; and 3) the value of the negotiated price report would be diminished due to the presence of formula-type trades. Given the current volumes of formula versus negotiated transactions in some regions, it seems highly likely that such de facto formula transactions could significantly outnumber true negotiated transactions in the negotiated transactions category. This would constitute a significant misrepresentation of the information communicated by those transactions, with potentially serious implications for price discovery.

Confidentiality

One more obvious improvement to LMPR from an economic information standpoint is the relaxation of confidentiality requirements. Confidentiality requirements reduce the amount of prices reported and this issue is likely to continue to increase in the future. The current 3/70/20 guidelines require:

- At least three reporting entities need to provide data at least 50% of the time during the most recent 60-day time period,
- No single reporting entity may provide more than 70% of the data for a report during the most recent 60-day time period,
- No single reporting entity may be the sole reporting entity for an individual report more than 20% of the time during the most recent 60-day time period.

Source: (<https://www.ams.usda.gov/rules-regulations/mmr/lmr/generalinfo>)

These guidelines lead to the collection of LMPR data that is “suppressed” or never released (<https://www.ams.usda.gov/sites/default/files/LMRConfidentialityGuidelinePresentation.pdf>).

For example, the weekly weighted average live cattle prices in Colorado have been rarely reported since 2018 because often there are no “three reporting entities.” Relaxing or removing the 3/70/20 rule would allow for more complete and transparent prices. There also may be an opportunity to obtain more detail about the types of formulas used. A better understanding of the types of formulas used (e.g., whether the base price is a live, futures or wholesale meat price) could lead to improved price discovery.

The need for confidentiality is more of a legal issue than an economic one. Since the goal of this report is to focus on economic concepts, it is acknowledged legal reasons and questions exist, but the focus was simply on the economic implications. It is worth noting that confidentiality rules have been changed in the past from the original “3/60” rule to 3/70/20. The primary potential unintended economic consequence of shifting discussed in the 2001 Congressional Research Service Report RS20079 about LMPR were that the 3/70/20 rule would “make small and medium-sized packers vulnerable to their competitors” and it “could allow two packers to communicate through publicly reported information, creating the possibility of collusion and price fixing.” While this potential might exist if confidentiality is further relaxed or removed, it likely does not offset the potential benefit of more complete and transparent information for price discovery and price determination.

Finally, the industry should consider asking for yield data to be a mandatory report. A key question in the evaluation of fed cattle pricing issues is whether or not negotiated transactions are representative of formula transactions. More detailed data on relevant animal characteristics would allow more effective evaluation and monitoring of this issue.

Overall, the relaxation of confidentiality requirements combined with a better description of formula trades and yield data has the potential to benefit price discovery. In a setting where all proposed prescriptions to improve price discovery likely exhibit increased costs and/or unintended consequences, relaxing confidentiality and improving descriptions of formula trades might lead to the largest net benefit as compared to other proposals. This is likely especially true for cattle producers who would benefit from better price discovery without absorbing the costs associated with other proposed prescriptions.

Quality Incentives in Fed Cattle Pricing - How has Use of AMA's Impacted Quality Incentives and Beef Demand?

The ability to send quality signals through the beef cattle supply chain is critical to the overall success of the industry. The quality of beef produced and ultimately consumed is impacted by decisions made by cattle producers at all levels. Low and inconsistent quality was likely one factor impacting beef market share erosion in the mid to late 1900s (Purcell, 1989; Schroeder, Ward, Mintert, & Peel, 1998). Market organization affects how signals are sent. In vertically integrated sectors such as poultry, production decisions are easily sent up the supply chain because the animals never change ownership. This is not the case for beef cattle production where cattle may change ownership many times prior to processing.

The beef cattle industry depends on market signals to incentivize quality and these signals are different depending on transaction type. Much research has focused on quality signals and transaction types. For negotiated live trade, buyers must build quality estimates into their bids. Grid-based pricing sends more direct signals to producers about their cattle quality. AMA transactions typically send quality signals for production of improved quality cattle through a long-term relationship between the buyer and seller. Previous research has shown that cattle procured through AMAs were of better and more consistent quality than direct trade cattle (Liu et al. 2009) and that average beef quality increased as AMA use increased (Muth

et al., 2007). These studies need to be updated with more recent data, but the expectation is that the results would be similar. Figure 2 shows the continued improvement in Choice and higher grading in recent years. The primary reason is the use of AMAs has aided in the development of tighter relationships between buyers and sellers of live cattle. These relationships incentivize improved quality over time.

Correct Interpretation of the Impact of “Captive Supplies” on the Negotiated Cash Market Price

Captive supplies – or alternative marketing arrangements – are the fed cattle that packers procure through channels other than the negotiated cash market. For the fed cattle industry, these are primarily formulas and forward contracts. At the national level 20% to 30% of the monthly volume for fed cattle transactions are negotiated cash trades and about 5% are negotiated grid. 60% to 70% of the monthly volumes are formula and 10% to 20% are forward contracts. Forward contract transactions are priced greater than 30 days prior to delivery – and these often are basis contracts where cattle feeders and packer buyers then make use of hedging with futures. Formula trades are by definition priced using some observed market price – almost exclusively the USDA AMS regional price where the cattle are fed is used. For example, formula cattle fed in Texas are priced using the USDA AMS TX-OK-NM cash fed cattle price.

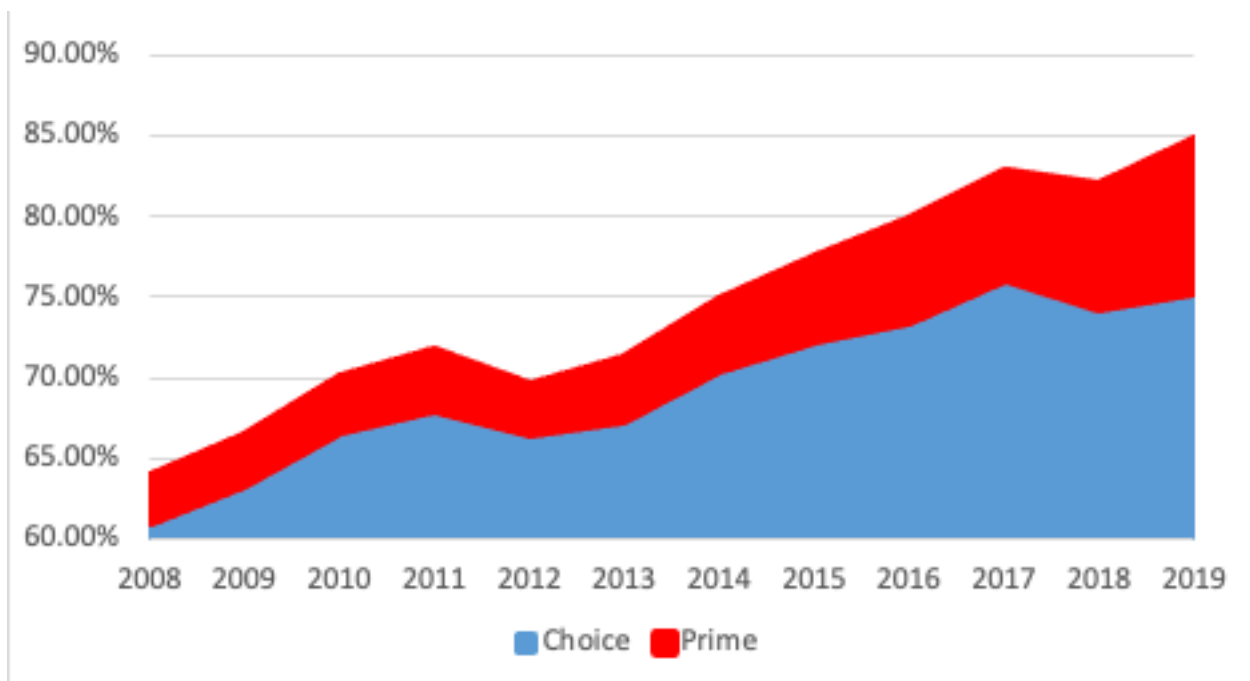


Figure 2. Choice + Prime Grading.

Regionally, the proportions can be rather different. The region with the smallest negotiated cash trade is in the southern plains and is the USDA AMS reporting region of TX-OK-NM. Historically, 90% of the fed cattle trade is formula priced, 5% to 8% is negotiated cash, 1% to 2% is negotiated grid and 1% to 2% is forward contracted.

Opponents of AMAs often use the following argument illustrating the negative impact that AMAs have on the negotiated cash market. Supplies of captive cattle allow the packer to not bid in the cash market and thereby reduce demand in the cash market and depress price in the cash market. This is the argument used with policy makers and in legal settings to mandate negotiated cash trade. This remains an incomplete argument as it ignores the supply side of the market. If the packer does not have to bid on the cattle, then it also is true and one-for-one that the cattle feeders do not have to offer the cattle for sale. AMAs do not change the market fundamentals – do not change the total supply nor total demand. AMAs only change the channel in which animals are marketed.

Furthermore, formula cattle are not “captive.” The cattle feeding organization decides the week the cattle will be marketed, communicates that to the packer - and it is usually not a surprise as communication between the seller and buyer is ongoing - and the packer decides the day of the week cattle will be delivered. The marketing decision belongs to the cattle feeders. Packers cannot call the cattle and almost all formula cattle are grid marketed and thus received premiums and discounts. Marketing cattle early can result in discounts to the cattle owner on those animals.

Table 3 illustrates how to think about AMA cattle in a manner accounting for both demand and supply impacts on the market. The top three rows, after the row headings, are the feedlot availability of animals from an example region. Round numbers are used to illustrate. In the first column after the column headings, the cattle feeding sector in this region has 100,000 head

of fed cattle available in a given week. The feeders will market 40,000 head through formulas and 60,000 head through negotiated cash trade. The last three rows are the packing sector’s needs for a given week in this example region. Also in the first column, the packers need 100,000 head and by definition will procure 40,000 head through formula and 60,000 head through cash. It is by definition because the methods are agreed upon and used by both the cattle feeding businesses and packing businesses. Whatever the packers’ formula purchases are, they must match the formula sales from feedlots. Formulas cannot be used to depress demand as formula cattle are pulled from feedlot availability.

The first column illustrates a low-AMA scenario, and the second column illustrates a high-AMA scenario. Packers procure 80,000 head per week through formula and the cattle feeders market exactly that amount also through formula. The remaining purchases are 20,000 head through cash trade. In both of these scenarios, the market is in balance as the availability of cattle from feedlots is the same as the packer needs. This illustrates that AMAs do not change market fundamentals. High versus low AMA use does not create a disadvantage or advantage for either buyers or sellers.

The issue emerges when supply and demand are out of balance. This is when cattle availability is low relative to packer demand or when cattle availability is high relative to packer demand. These two examples are illustrated in the third and fourth columns. In the third column, the packer has incentives to purchase 110,000 head that week but there are only 100,000 head available. Competitive pressure across packing firms would cause them to bid aggressively to secure a larger portion of 20,000 head that is available to satisfy a demand for 30,000 head. This is close to the actual fed cattle and beef market scenarios in many years prior to 2016. Formula use was high and the demand for the remaining cash cattle was aggressive. The time period was characterized by excess capacity in the packing industry along with increasing returns to scale. Pack-

Table 3. A Correct Example of AMAs.

	<i>Low AMA</i>	<i>High AMA</i>	<i>Excess Demand</i>	<i>Excess Supply</i>
Feedlot Availability:	100,000	100,000	100,000	110,000
Formula	40,000	80,000	80,000	90,000
Cash	60,000	20,000	20,000	20,000
Packer Needs:	100,000	100,000	110,000	100,000
Formula	40,000	80,000	80,000	90,000
Cash	60,000	20,000	30,000	10,000

ers bid aggressively for fed cattle and this impact spills over into the valuation of formula cattle. High or low use of AMAs does not create this market scenario.

In reverse, the same arguments hold for the excess supply scenario. This is the fourth column of Table 3 and it is a reasonable facsimile of the fed cattle and beef market since late 2016 and early 2017. The packer has incentives to purchase 100,000 head that week but there are 110,000 head available. There is little competitive pressure across packing firms and cattle can be secured with relative ease. Further, it is likely there would be additional formula cattle, for example, 90,000 head per week. Formula cattle are valued no different than cash. In the end, more cattle are available than are needed and the cause of the issue is this supply/demand imbalance and not the use of formulas. In this market environment, there are considerably more animals available than needed. Cattle prices have to be lowered and beef prices also lowered to encourage the processing of the excess supplies. Again, negotiated cash trade feedlots may go weeks without a bid in this environment. But the problem is not how the available supply is split across marketing methods.

Beyond Price Discovery

Much of the cattle industry frustration and concern currently attributed to price discovery is more correctly related to underlying supply and demand conditions and the dynamics of the industry in recent years. Certainly, the twin shocks of the August 2019 Tyson packing plant fire and COVID-19 in 2020 have subjected the industry to unprecedented market volatility and price pressure.

More fundamentally, market outcomes in recent years have revealed how overall industry conditions have evolved during the past three decades or more. The primary packing infrastructure of the industry was mostly built in the 1980s. MacDonald, et. al, (2000) document the rapid expansion of large beef packing plants. Most plants have been remodeled and some expansion has occurred but no major addition has been made to packing infrastructure in many years. Average cattle inventory in the early 1980s was 113 million head. Cattle inventories declined from that period, interrupted by a single major cyclical expansion in the early 1990s (with a peak inventory of 103.5 million head in 1996) to a low of 88.2 million head in 2014. Three decades of chronic excess capacity led, albeit slowly, to downsizing of the packing industry. In 2000, a ConAgra packing plant in Garden City, Kansas burned down and was not rebuilt. Later plant closings included Tyson (Emporia), 2007; Cargill (Plainview),

2013; and National (Brawley), 2014 along with smaller plants in 2006 and 2015. Figure 3 shows the estimated industry packing capacity decreased by nearly 21% from 2000 to 2016. Decreases in the number of plants, along with persistent labor challenges, have effectively capped beef packing industry capacity in recent years.

The total inventory of cattle and calves at the low in 2014 was roughly 22% smaller than cattle inventories in the early 1980s. Cyclical herd expansion began in 2014 and peaked in 2019 increasing cattle inventories from 88.2 million head to 94.8 million head. The combination of packing capacity decreases and cyclical herd expansion has switched the balance of demand and supply in the fed cattle industry since about 2017 (Figure 3). This represents a fundamental change in industry economics that has not existed in more than 35 years. Depending on demand growth, primarily export market potential, the industry could be ready for significant investment in packing infrastructure in the coming years.

Producers have expressed concern about industry structure and competition in the cattle and beef industry for at least a century. The cattle and beef industry has evolved much like many industries in the U.S. economy driven by pervasive economic forces. The economic forces that have resulted in current levels of large-scale cattle feeding and beef packing are, in general, no different than the reasons for large-scale retailers or a few large automobile or airline companies.

All industries evolve through time. Regardless of product type or sector, industries can look sharply different from inception to maturity. There is a wealth of research on how industries evolve. Various factors such as production systems, technological change, product differentiation, geographical footprint and resources and transaction costs, among others each influence the speed and trajectory of industry change. Different segments or regions of an industry can evolve separately in response to reducing inefficiencies.

During the span of any industry's long-term life cycle, innovations will allow or require participants to reduce inefficiencies to remain competitive. Participants do not have to appreciate or even accept the direction of an industry's evolution. However, any shift is likely to be against economic forces and may require participants to absorb reduced profits through time. There are no quick fixes or sweet spots to combat evolution of an industry. Voluntary disruption of an industry's trajectory likely involves a coordinated industry response and the acceptance of additional costs by participants. Such a task will never be complete and will require constant effort. Within this industry life model, eliminating or reducing free riders will not lead

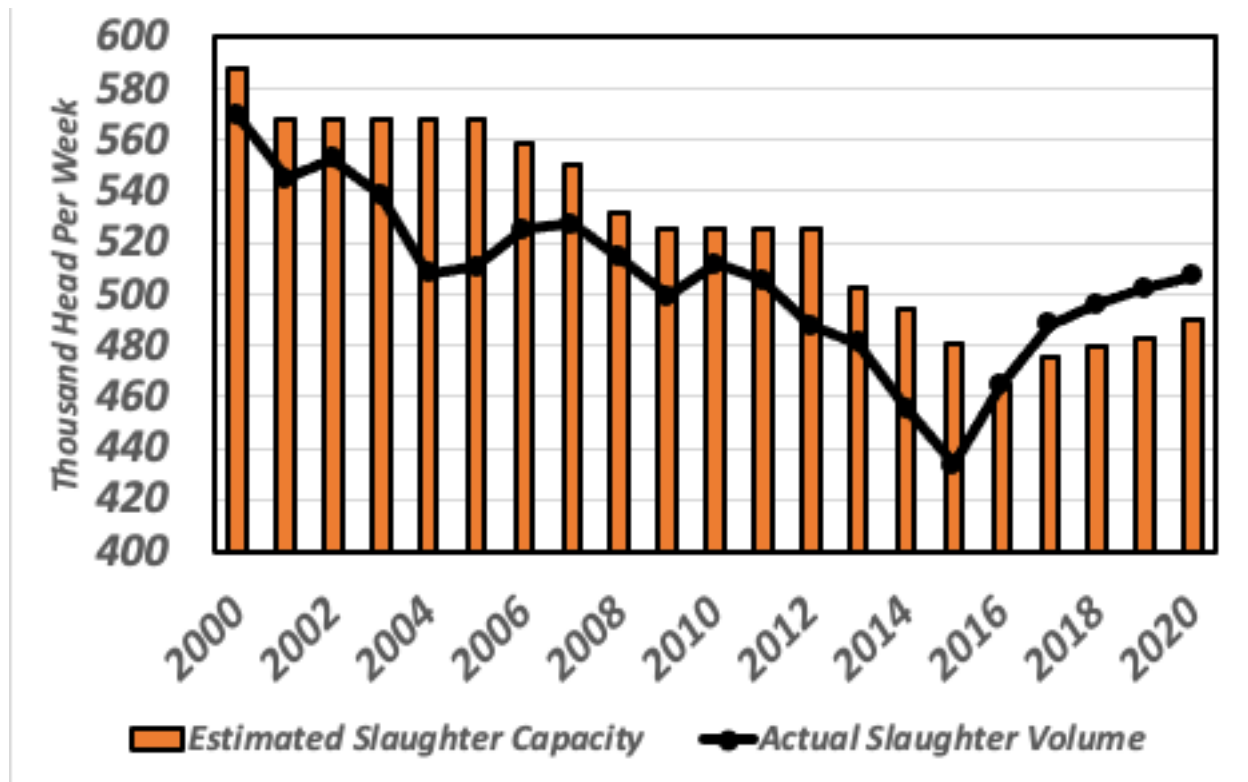


Figure 3. Weekly actual USDA fed steer and heifer slaughter and weekly estimated packing capacity. Source: USDA and CattleFax

things back to a traditional or “the way things used to be” market setting. Economic incentives will still exist to find more efficient and cost-reducing innovations.

Industrial evolution is complex and nearly impossible to fully comprehend without the benefit of hindsight. This complexity can lead to frustration and an urge to find short-term fixes that may do more damage than good. Iammarino and McCann (2006) summarized that “technological regimes, industrial structures and organizational practices, as well as their dynamics, are often overlooked in favor of simplified and stylized constructs, which appeal to consultants or government policy-makers wishing for easy answers to complex problems.”

Much of the current discontent among producers is likely associated with the evolution of the cattle industry in response to economic incentives. The question of the legality of highly concentrated industry structure is the domain of the Department of Justice. Agricultural economists recognize the potential for market power to be expressed in highly concentrated industries. The cattle and beef industry, and the beef packing industry in particular, has been researched in multiple studies to understand the impacts of market concentration. The evidence shows 1) market power does negatively impact fed cattle prices but the impact is small and 2) the cost savings due to size economies

are at least 10 times greater than the negative market power impacts. Cattle producers and beef consumers receive net benefits from the cost efficiencies of the current market structure in the form of higher cattle prices and lower beef prices than would exist in a less efficient industry. Producer concern about industry structure and competition will no doubt continue and agricultural economists will continue research to determine and monitor the impacts of concentration in cattle and beef market.

Key Findings and Conclusions

- Price determination and price discovery are different concepts. The general levels of market prices is determined by dynamic demand and supply forces. Price discovery is the process of revealing prices from market transactions.
- Improved price discovery may improve knowledge of market conditions for sellers and buyers but will not, by itself, change overall market price levels. A good deal of the current concern about price discovery is borne out of the price pressures related to fundamental changes that have occurred in the balance of supply and demand in the industry. These changes are not the result of, nor can they be fixed by, changes in price discovery.

- Price discovery, a transaction price found through bid and ask (offer), is impacted by a number of factors, including trading institution, risks faced by buyers and sellers, risk preferences of buyers and sellers and market information. Volume of trade only impacts the accuracy of past negotiated cash price information in the price discovery process, overweighting its importance in policy prescriptions could have unintended consequences resulting in market inefficiency.
- Current LMPR information is valuable for the industry. However, current LMPR transaction type definitions are not designed to regulate volume among types and attempts to use them to regulate transaction types could have unintended consequences. The use of LMPR volumes for mandated trade by type or even aggressive monitoring (which carries the threat of regulatory action) creates strong incentives to disrupt the LMPR trade types and could result in less effective cash trade and reduced price discovery.
- If industry participants are forced to increase “negotiated” trades at the expense of “formula” trades, market participants will 1) find ways to meet the “negotiated” definition while minimizing the cost of doing so, 2) the packers and feeders with the best relationships will be better positioned to minimize such costs and 3) the percentage of negotiated trades would increase but the value of the negotiated price report would be diminished due to inclusion of what are really “formula” trades but now reported to meet mandate obligations as “negotiated.”
- The relaxation of LMPR confidentiality requirements combined with a better description of formula trades has the potential to benefit price discovery. In a setting where all proposed prescriptions to improve price discovery likely exhibit increased costs and/or unintended consequences, relaxing confidentiality and improving descriptions of formula trades might lead to the largest net benefit as compared to other proposals.
- Reducing the use of AMAs does not change the overall supply and demand balance in the market, thus, does not affect price determination and overall price levels.
- Reported negotiated prices appear to be valuable to the majority of market participants and are used informally as well as formally (in AMAs). It is not known how much sellers and buyers value cash prices and if participants would be willing to incur additional costs to improve them. Additional research is needed.
- Research confirms that AMAs provide significant economic benefits to AMA users and thus significant disincentives to participate in cash price discovery. AMAs reduce transaction costs, fixed costs and help manage risk.
- Much of the improvement in cattle and beef quality in the past two decades is largely attributable to increased use of AMAs. The use of AMAs is related to improved cattle and beef quality due primarily to relationships formed between buyers and sellers. These typically longer-term relationships lead to the incentive for quality improvements with time.
- Cash price discovery represents a positive externality with a public good nature in which the industry values price discovery but individuals have incentives not to participate in price discovery. This type of market failure can eventually result in less price discovery than is optimal for the industry.
- The question of when markets become too thin does not have a precise answer. The amount of negotiated trade needed depends on many factors related to the quantity and quality of cash trading. Most research shows, however, that relatively small percentages of high-quality cash trades are sufficient to ensure good price discovery in many cases.
- Any intervention will result in higher costs to the entire industry. Tradeoffs exist between better price discovery and the cost of better price discovery. Most likely, higher costs are reflected in reduced cattle prices and ultimately passed on to cow-calf producers.
- Price discovery interventions in which market participants retain the ability to choose how to respond to market conditions will have the least negative impact on the industry.
- Preferred interventions to improve price discovery are actions to increase incentives to participate and/or reduce disincentives to participate but retain participants’ ability to choose how to respond to changed incentives.
- Prescriptive solutions, such as mandates of fixed behavior, reduce market efficiency; will impose significantly higher costs on the industry; and will have negative impacts on market price levels. Moreover, mandated solutions stifle creativity and innovation and will likely inhibit the industry’s ability to grow and respond to dynamic competitive market environments.
- Impacts of highly concentrated industry structure are largely separate from price discovery issues.

Even if the number of packers doubled or tripled, the incentives to use AMAs would still exist. The current cattle and beef industry structure has evolved for reasons similar to the evolution of most industries, driven largely by size economies and the need to capture cost efficiencies to remain competitive. Research shows market power in fed cattle markets has small negative impacts on prices, which are offset by substantially larger cost efficiencies to the benefit of cattle producers and beef consumers.

Recommendations

Long-established economic theory and a great deal of empirical work over many years and in many types of markets together affirm the notion that increasing the number of representative transactions can improve the price discovery process, increasing the accuracy of prices and improving the quality of information embedded in those prices. Such improvements benefit everyone in the market so that negotiated transactions and the price discovery that they support may rightly be considered public goods. Because public goods are available to all – even those who do not contribute to their provision – they tend to be provided at less-than-ideal levels by the market. For this reason, sensible efforts to increase the volume of negotiated transactions in the fed cattle market are well-founded and worth supporting.

The most promising route to a higher level of negotiated fed cattle trade is through voluntary industry initiative. Viable strategies for increasing negotiated trade through cooperative actions are readily identifiable. The first step toward any of these strategies, though, will be to identify reasonable volume targets. These targets do not have to be terribly ambitious to be effective – keeping in mind that a volume target is not an end, in and of itself, but rather a reasonable means to the desired end of more accurate and informative price signals for the market.

Past work on thin markets demonstrates the impossibility of defining acceptable price discovery in terms of a specific volume of transactions. However, research and practical experience in a variety of commodity markets confirm that even a small number of representative transactions can lead to effective price discovery. With these facts in mind, the industry should consider voluntary initiatives to define consensus-based volume targets for negotiated transactions. Such targets could be effective at even modest volumes – say, for example, 5% to 10% of all transactions – and will need to be defined regionally and perhaps seasonally, with enough flexibility to allow deviations from

targets over shorter time frames (e.g., certainly weekly and perhaps even monthly). A number of different mechanisms for facilitating negotiated transactions are worthy of consideration. A voluntary market-maker program or electronic exchange to which feeders offer cattle for negotiated sale each week are two possibilities that would seem to be feasible but would require industry buy-in and ongoing support.

Of course, once a negotiated transaction target has been identified and agreed upon by the industry, one apparently logical approach to implementation would be through regulatory channels instead of through voluntary, industry-led action. This is, in fact, the position represented in a number of current legislative proposals. Such an approach has the appeal of simplicity; however, like most simple solutions to complex problems, it is unlikely to be effective. It would, in fact, almost certainly degrade the quality of price discovery in the fed cattle market.

The recommendations offered here capture a dilemma the industry has faced for a number of years. Mandates run the risk of very high costs to the industry – to those that may or may not demand the action. Voluntary change risks a continued lack of action and places burdens on some more than others. There are individual businesses doing price discovery and others benefiting, but there also is quality improvement due to AMAs that benefit all. Mandates, while costly, are policy efficient with impacts potentially more evenly distributed. The costs from a mandate are at least \$35 per head for the number of animals impacted by the mandate. These costs will be reflected in value reductions across the industry. Benefits of improved price discovery are likely substantially less than this amount but certainly not zero. (There is a need for research to determine the value of price information.) The dilemma is understood and the authors encourage the industry to seek common ground and compromise outcomes. The industry needs to determine a solution between known costly mandates and no-change voluntary action. There is a lot of available ground between the two ends, and the industry needs to plan for long-term work to address this persistent issue.

The current price-reporting system is not designed for, and will not be easily adapted to, a regulatory role. Clearly and cleanly distinguishing bona fide negotiated transactions from bona fide formula transactions will be next to impossible. Introducing a regulatory stick into the market will create a strong incentive for participants to adopt strategies that will allow de facto formula transactions to fit the definition of negotiated transactions. The quality of reported information across all transaction types could be seriously

compromised, with negative implications not only for fed cattle market participants, but for the industry as a whole. These sorts of issues have been seen in other markets that have traveled the regulatory route. Such issues are generally addressed through further regulatory changes, which can ultimately lead to continual tinkering to try and address the problems arising from the original ill-considered regulatory approach.

LMPR provides valuable information to the industry and supports industry research. It is recommended the industry support LMPR reauthorization and consider some modifications suggested below. Even without a volume mandate for particular transactions types, the quality of data in LMPR reports is not as good as it could be. Improvements in the information available from these reports, by itself, could contribute to significant improvement in price discovery and help confirm reasonable levels of mandated levels by transaction type. Three specific changes are recommended.

First, revise confidentiality restrictions so more data can be reported. Ideally, transaction type data would be made available not just by region but by packer. Enhancing negotiated cash trade requires participation of both buyers and sellers. Reporting negotiated cash trades as a percent of total purchases for each packer would provide information on the extent to which packers are participating in price discovery. Even short of that, a relaxation of confidentiality rules to allow more detailed regional reporting would be helpful.

Second, provide more detailed reporting on formula transactions. Currently, all formula transactions are aggregated into a single report. It would be helpful to identify and separate information on different formula types (e.g., by base price). Something like this is already being done in LMPR hog reports, and it provides a great deal of useful information on transaction volumes and net price differences across formulas through time. This recommendation is related to the first, in that less aggregation of formula data makes redactions related to confidentiality more likely unless confidentiality standards are adjusted.

Finally, the industry should consider asking for yield data to be a mandatory report. A key question in the evaluation of fed cattle pricing issues is whether or not negotiated transactions are representative of formula transactions. More detailed data on relevant animal characteristics would allow more effective evaluation and monitoring of this issue.

Regional Market Maker Programs could be used to encourage more voluntary price discovery. The program recognizes that AMA sellers benefit from price discovery but do not participate in price discovery. A

program such as described below increases incentives for cash trade among all fed cattle sellers.

A basic possible structure of such a program is presented below:

- Fed cattle sellers who market cattle using non-cash (i.e. other than negotiated cash or grid base) methods, i.e. AMAs would be subject to a per head assessment. Industry chosen assessment levels would be determined by the level of cash trade in the market ranging from zero to a maximum level according to specified threshold levels.
- When the level of cash trade drops below threshold levels, fed cattle sellers who engage in negotiated cash trade are incentivized to increase cash trade as follows:
 - Cash sellers are eligible to receive a market maker cash bonus.
 - Sellers using non-cash (AMA) trading can reduce assessments by increasing the proportion of cash trading and can receive additional cash bonuses such that the combined value of reduced assessments and cash bonus equals the total value received by a cash-only seller.

Market Maker Example (all parameters for illustration only):

Market Thresholds and Assessments:

Critical:	< 6 % cash trade	AMA assessment \$1.00 per head
Marginal	6% to 12 % cash trade	AMA assessment \$0.50 per head
Adequate	> 12 % cash trade	AMA assessment \$0.00 per head

AMA assessments can be offset at 1:5, meaning sellers can offset assessments for five AMA head for each head sold for cash.

**Example: Weekly Market Volume with 1,000 head
5 % cash trade = 50 head cash, 950 head AMA; assessment level \$1.00 per head**

- If 50 head is from cash-only sellers, \$950 would be collected and cash sellers would receive \$19 per head
- If 50 head is from AMA sellers, total AMA assessments would be on 700 head (\$700), and those who sold cash would receive \$14 per head (+\$5 per head offset value).
- 50/50 mix: Total assessments paid on 825 head (\$825); cash-only sellers would receive \$19 per head; AMA sellers selling cash would receive \$14 per head (+\$5 per head offset value).
- Total cash trade could be any combination of cash-only and cash/AMA sellers.

10% cash trade = 100 head cash, 900 head AMA; assessment level \$0.50 per head

- If head is from cash only sellers, total assessment would be on 900 head, \$450 would be collected and cash sellers would receive \$4.50 per head.
- If 100 head is from AMA sellers, total AMA assessments would be on 400 head (\$200), and those who sold cash would receive \$2.00 per head (+\$2.50 per head offset value).
- 50/50 mix: Total assessments paid on 650 head (\$325); cash only sellers would receive \$4.50 per head; AMA sellers selling cash would receive \$2.00 per head (+\$2.50 per head offset value).
- Total cash trade could be any combination of cash-only and cash/AMA sellers.

>12% cash trade

- No assessments made

A market maker program will require regional leadership and commitment of market participants. The industry will determine the following parameters as appropriate in each region:

Threshold levels: critical, marginal or adequate.

These will vary by region, may change under varying market conditions and may need to be revised occasionally to reflect evolving industry needs. Economics provides only rough guidance but suggests that critical levels of trading needed may be as little as 5% or less in some market situations.

Threshold assessment levels \$/head by threshold level.

Assessment offset ratio

Administration: Industry would have to decide who and how the program would be implemented and administered.

A Market Maker program similar to this allows for larger market-based outcome because individual firms are free to participate or not and figure out the most efficient way to do it. The program would have to be administered after the fact, i.e., based on previous trade (weekly or monthly). This means possible assessments and payments would not be known during the trading week, thus less likely to distort negotiations. Cash sellers would have no assurance that they would be receiving any bonus. The program can be applied across the industry for all specified regions. For regions with adequate cash trade, the program would have no impact and would just reside in the background. Careful consideration would be needed to not make the program incentives too strong, which could lead to inefficient results similar to those from a volume mandate.

Finally, price discovery also could be improved through enhanced use of transparent, technology-based trading platforms, such as the Fed Cattle Exchange. Even a relatively small volume traded consistently in such a transparent fashion can contribute significantly to price discovery. There is no doubt some costs to using electronic trading, otherwise it would be more heavily used today. Overcoming the existing disincentives to participate in price discovery means success of an electronic exchange will require a commitment and willful action of market participants to regularly use this mechanism.

Summary

The frustration, fear and anger resulting from the unprecedented markets shocks in the past year have led to loud and increasingly insistent calls for action in the name of price discovery. The concerns extend well beyond price discovery and are not new to the industry. The incentives for fed cattle market participants to act as free riders on negotiated fed cattle trade leads to thinning markets, which is a legitimate concern and worthy of industry attention. However, this issue is complex and simple solutions are likely to have unintended consequences. Price discovery is a process and is an ongoing activity. Determining the quality of price discovery is a process. The industry needs to base decisions on what is known through scientific research and the experience of individuals; and engage in this process. There is not a clear research-based or factual answer. This report highlights the complex issues related to fed cattle price discovery; the state of knowledge as revealed by available research; additional research needs; and recommendations for industry consideration.

References

- Adjemian, M. K., T. L. Saitone, and R. J. Sexton. 2016. "A Framework to Analyze the Performance of Thinly Traded Agricultural Commodity Markets." *American Journal of Agricultural Economics* 98(2): 581–596.
- Anderson, J.D., Hudson D., Harri A., and Turner S. 2007. "A New Taxonomy of Thin Markets." Paper presented at the Southern Agricultural Economics Association Meeting, Mobile, AL, 4-7 February.
- Anderson, J. D., J. N. Trapp, and R. A. Fleming. 2003. "Estimated Impact of Non-Price Coordination of Fed Cattle Purchases on Meat Packer Processing Costs." *Journal of Agribusiness* 21(3): 183-196.
- Bastian, C. T., C. Jones Ritten, B. Feuz, A. M. Nagler, and S. Smutko. "Can Producers Bargain for Better Prices? Implications from Wyoming Focus Groups," *Journal of the American Society of Farm Managers and Rural Appraisers*. 81: 29-42.

- Bastian, C. T. 2019. "WAEA Presidential Address - Evolution Toward Private Negotiation as a Dominant Institution in Agribusiness Supply Chains: Implications, Challenges, and Opportunities," *Journal of Agricultural and Resource Economics*. 44,3(2019): 457-473.
- Davidson, J., and A. Weersink. 1998. "What Does it Take for a Market to Function?" *Review of Agricultural Economics*. 20(2): 558-572.
- Fama, E. 1970. "Efficient Capital Markets: A Review of Theory and Empirical Work." *Journal of Finance* 25(2), 383-417.
- Greene, J. 2019. "Livestock Mandatory Reporting Act: Overview for Reauthorization in the 116th Congress." Congressional Research Service Report R45777. Available online <https://crsreports.congress.gov/product/pdf/R/R45777>
- Hamm, L., and R. Marsh, 1995. "The National Cheese Exchange: Impacts on Dairy Industry Pricing." *Dairy Markets and Policy, Issues and Options*. No. M-7, February.
- Iammarino, S., & McCann, P. 2006. The Structure and Evolution of Industrial Clusters: Transactions, Technology and Knowledge spillovers. *Research Policy*, 35(7):1018-1036.
- Janzen, J. P. and M. K. Adjemian. 2017. "Estimating the Location of World Wheat Price Discovery." *American Journal of Agricultural Economics* 99(5):1188-1207
- Jones Ritten, C., C. T. Bastian, K. Hansen, A. Nagler, and O. R. Phillips. 2020. "Can Prospect Theory Explain Agricultural Producers' Disadvantage During Privately Negotiated Trading?" Working Paper. Dept. Ag. & Appl. Econ., University of Wyoming.
- Jones, R. T. Schroeder, J. Mintert, and F. Brazle. 1992. "The Impacts of Quality on Cash Cattle Prices." *Southern Journal of Agricultural Economics*. 24:149-162.
- Koontz, S. R. 2010. "What Does the RTI Study Say about Captive Supplies in the Cattle and Beef Industry?" *Agricultural and Resource Economics AMR 10-02*, Colorado State University. Fort Collins, CO.
- Koontz, S.R. 2017. "Price Discovery Research Project - What Volume of Cash Trade is Needed for Price Discovery?" Unpublished, Colorado State University. Available from the author.
- Koontz, S.R., 2020. "A Synthesis of the Costs and Benefits of AMAs to the Cattle and Beef Industry - White Paper." Unpublished, Colorado State University. Available from the author.
- Krishna, V. 2010. *Auction Theory*. 2nd ed. Burlington, MA: Academic Press.
- Liu, Y., Muth, M.K., Koontz, S.R. and Lawrence, J.D. 2009, "Evidence of the Role of Marketing Arrangements and Valuation Methods in Improving Beef quality." *Agribusiness*, 25:147-163.
- MacDonald J. M., M. E. Ollinger, K. E. Nelson, and C. R. Handy. 2000. Consolidation in U.S. Meatpacking. Washington, DC: U.S. Department of Agriculture, Economic Research Service, *Agricultural Economic Report* No. 785.
- Matthews, K. H., W. Brorsen, W. F. Hahn, C. Arnade, and E. Dohman. 2015. Mandatory Price Reporting, Market Efficiency, and Price Discovery in Livestock Markets. Washington, D. C.: U.S. Department of Agriculture, *Economic Research Service*. LDPM-254-01, September.
- Menkhaus, D. J., O. R. Phillips, and C. T. Bastian. 2003. "Impacts of Alternative Trading Institutions and Methods of Delivery on Laboratory Market Outcomes." *American Journal of Agricultural Economics*. 85(5):1323-1329.
- Menkhaus, D. J., O. R. Phillips, C. T. Bastian, and L. B. Gittings. 2007. "The Matching Problem (and Inventories) in Private Negotiation." *American Journal of Agricultural Economics*. 89(4):1073-84.
- Muth, M.K., Del Roccili, J., Asher, M., Atwood, J., Brester, G., Cates, S.C., et al. 2007. Washington DC: U.S. Department of Agriculture, Grain Inspection, Packers and Stockyards Administration and Research Triangle Park, NC: RTI International, *GIPSA Livestock and Meat Marketing Study*, Volume 3. Fed cattle and beef industries, January.
- Muthoo, A. 1999. *Bargaining Theory with Applications*. New York, NY: Cambridge University Press.
- Nagler, A. M., D. J. Menkhaus, C. T. Bastian, M. Ehmke, and K. T. Coatney. 2013. "Subsidy Incidence in Factor Markets: An Experimental Approach." *Journal of Agricultural and Applied Economics*. 45(1): 17-33.
- Purcell, W.D. 1989. Analysis of Demand for Beef, Pork, Lamb, and Broilers: Implications for the Future. Blacksburg, VA: Virginia Tech University, Research Institute on Livestock Pricing, Research Bulletin No. 1-89, July.
- Sabasi, D. M., C. T. Bastian, D. J. Menkhaus, and O. R. Phillips. 2013. "Committed Procurement in Privately Negotiated Markets: Evidence from Laboratory Markets." *American Journal of Agricultural Economics*. 95(5):1122-1135.
- Schroeder, T. C., C. E. Ward, J. Mintert, and D. S. Peel. 1998. "Beef Industry Price Discovery: A Look Ahead." Blacksburg, VA: Virginia Tech University, Research Institute on Livestock Pricing, Research Bulletin 1-98, March
- Schroeder, T.C., Ward, C.E., Mintert, J.R., & Peel, D.S. 1998. Value-Based Pricing of Fed Cattle: Challenges and Research Agenda. *Review of Agricultural Economics*, 20(1):125-134.
- Tomek, W. G. 1980. "Price Behavior on Declining Terminal Market." *American Journal of Agricultural Economics*. 62(3):434-444.
- Tomek, W. G. and H. M. Kaiser. 2014. *Agricultural Product Prices*, 5th Ed. Ithaca, NY: Cornell University Press.
- Varian, H. R. 1992. *Microeconomic Analysis*, 3rd Ed. New York, NY: W. W. Norton & Co., Inc.
- Ward, C. E. 1981. "Short-Period Pricing Models for Fed Cattle and Impact of Wholesale Carcass Beef and Live Cattle Futures Market Prices." *Southern Journal of Agricultural Economics* 13:125-132.
- Ward, C. E. 1992. "Inter-firm Differences Between Fed Cattle Prices in the Southern Plains." *American Journal of Agricultural Economics*. 74:480-485.
- Ward, C. E., S. R. Koontz, D. S. Peel, and J. N. Trapp. 1996a. "Price Discovery in an Experimental Market for Fed Cattle." *Review of Agricultural Economics*. 18:449-466.
- Ward, C. E., T. C. Schroeder, A. P. Barkley, and S. R. Koontz. 1996b. Role of Captive Supplies in Beef Packing. Washington, DC: U.S. Department of Agriculture, Grain Inspection, Packers and Stockyards Administration, GIPSA-RR 96-3.



EXTENSION