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Did the Mandatory Requirement Aid the Market?

Impact of the Livestock Mandatory Reporting Act

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Abstract

This study focuses on fed cattle markets to compare the mandatory price reporting system developed by USDA's Agricultural Marketing Service in 2001 with the previous voluntary reporting system. The study evaluates whether the mandatory system has improved the amount and quality of information available to the market. We find that prices received with formula purchasing arrangements, which were not comprehensively reported under the voluntary system, appear to closely match prices received with negotiated purchases. The trend toward formula purchases has slowed since mandatory price reporting was implemented, and the volume of cattle moving under negotiated purchases has increased. Futures prices did not seem to respond to prices under mandatory reporting; however, the mandatory data seem to better represent market conditions. Other market factors such as cyclically low cattle inventories and the discovery of BSE in North America may have influenced the shift back to negotiated cash transactions.

Keywords: Price reporting, mandatory price reporting, livestock, cattle

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Introduction

The Livestock Mandatory Reporting (LMR) Act of 1999 requires major meatpackers to report all transactions covering hog, cattle, and lamb purchases and commitments to the U.S. Department of Agriculture (USDA). The Act also requires packers to report the details of fresh wholesale beef and lamb transactions. USDA's Agricultural Marketing Service (AMS) uses the mandatory reports in its *Market News* reporting system. In implementing LMR, the Department intended that, "by making the reporting on market information mandatory, USDA will facilitate price discovery, make the market open, and provide all market participants with market information that can be easily understood" (*Federal Register*, 2000).

The current legislation for mandatory price reporting expires in the fall of 2005. This report examines several aspects of the implementation and effects of the Act. Specifically, our objectives are the following:

- Review the traditional voluntary system of USDA price reporting.
- Describe the economic forces that cast doubts about the effectiveness of the voluntary system and led to mandatory price reporting.
- Summarize and assess the information that LMR provides about prices and volumes in different types of cattle market transactions.
- Assess differences in prices reported for formula and negotiated transactions.
- Evaluate trends in cattle volumes moving through different types of transactions before and after implementation of LMR.
- Identify trends in reported cattle prices before and after implementation of LMR, particularly focusing on any changes in day-to-day variances in reported prices.
- Assess the impact of LMR on price discovery.

This report focuses on markets for fed cattle because that industry is the largest of the livestock industries affected by the Act and because we believe that events affecting fed cattle were a major force driving passage of the Act. Low hog prices at the time also contributed to the passage of the Act. LMR applies to packers who slaughter at least 125,000 cattle a year, and they are required to report, twice daily, volumes and terms of trade for cattle transactions and boxed beef sales. The language of the Act and the documentation for implementation can be found on the AMS website at http://www.ams.usda.gov/lsmnpubs/.

Background: Voluntary Price Reporting at USDA

Traditionally, agricultural product prices were determined in open spot markets, either in direct negotiation between individual buyers and sellers (or their agents) or in public auctions (which now include satellite and internet auctions), based on attributes observable in livestock or crops. In spot markets, commodity ownership is transferred from buyer to seller and payment is made shortly after the two agree on the terms of sale. Hence, key arrangements are made "on the spot" for immediate payment. Before electronic payments, these transactions were usually for cash (hence, the term "cash markets").

Transaction terms in spot markets, including prices, locations, and observable quality characteristics, are readily available and easy to record. Market participants use information from all transactions for production and trading decisions, which creates a demand for private or public organizations to collect, summarize, and disseminate the information.

Accurate, widely available market information serves two functions. First, the information causes prices in similar transactions to converge to a "market price" as buyers attempt to avoid paying unnecessarily high prices and sellers attempt to avoid accepting unnecessarily low prices. That is, information helps speed the discovery process for prices that equate demand and supply. While one would expect some trades where there are winners and losers, better information about prices paid in similar transactions leads to faster convergence of market-clearing prices. Moreover, accurate, reliable market information reduces risk and pricing errors, or pricing inaccuracy. Second, visible, accurate, and reliable market price information provides important signals, such as value differences, regional price differences, and quantities available to buyers and sellers. In turn, those signals guide production decisions, giving producers incentives to produce what buyers want. Prices are flexible, in the sense that they respond quickly and accurately to underlying changes in market conditions, and reported price information responds quickly to reflect actual price changes.

USDA has frequently tried to improve the operation of markets in agricultural products to facilitate price discovery as well as to improve the reliability and usefulness of reported prices. Early steps, which aimed to improve the honesty and reliability of commercial transactions, involved initiating rules to protect sellers in public markets from dishonest weighing and financial insolvency of marketing firms and to ensure fair yardage (feedlot) charges and services.

USDA has also provided agricultural market information to the public to facilitate price discovery and the dissemination of market information. The first USDA market news report was issued at Hammond, LA, in 1915, reporting the prices and movement of strawberries. Livestock prices were reported in various formats soon after.

Through the first part of the 20th century, producer distress about manipulative business practices found its way into legislation that aimed to curb

many of those practices (table 1). USDA was given responsibility to improve the production incentives built into traditional spot market systems by introducing quality and yield grades. Quality grades for produce were first introduced in 1916 to support more disaggregated and accurate price reporting but were soon used independently to support public and private procurement specifications. Quality grades for meat, also first formulated in 1916, have been revised frequently since, most recently in 1997, as USDA tried to make them more precise indicators of carcass quality on which to base price. Yield grades currently provide a numerical five-point scale for evaluating yields of beef from a carcass and are based on measurements of the amount of fat at different points on the carcass, carcass weight, and ribeye area. Each revision has been designed to more closely tie prices to easily measurable carcass characteristics in order to differentiate carcasses according to their different values in the marketplace.

Table 1
Landmarks and legislation affecting market transactions for livestock

Year	*Landmark or legislation*
1890	Senate Select Committee report on the Transportation and Sale of Meat Products
1913	Congress appropriated funds "to acquire and to diffuse among the people of the United States useful information on subjects connected with the marketing and distributing of farm products…"
1914	Appropriation Act established the Livestock and Grain Market News Branch
1916	Quality grades for meat established
1917	Food Production Act authorized inspection and market news service on farm products during World War I
1917	Market news service on dairy and poultry products begins
1917	USDA began developing grade standards for market hogs and slaughter lambs and sheep
1918	First livestock market news reports issued for Chicago
1920	Packers' Consent Decree on the issue of concentration (and resultant manipulative pricing)
1921	Packers and Stockyards Act
1923	Grades and standards were first published in mimeographed form to facilitate beef grading for the U.S. Shipping Board and Veterans Bureau Hospitals
1924	Agricultural Products Inspection and Grading Act authorized the Federal grading of livestock and meat
1926	Beef grades were promulgated by the Secretary of Agriculture as the Official United States Standards for Grades of Carcass Beef
1939	Agricultural Marketing Service (AMS) established
1946	Agricultural Marketing Act authorized Federal grading of agricultural products
1946	Livestock prices were reported through a voluntary livestock price reporting system developed by AMS
1985	Food Security Act, Section 1324, provides protection for purchasers of farm products against certain liens against these products
1999	Livestock Mandatory Reporting Act

The Packers and Stockyards Act of 1921 and the Packers' Consent Decree of 1920 addressed many issues related to trade practices and market concentration. Then, under the Agricultural Marketing Act of 1946, AMS provided regular reporting of livestock prices, quantities, and transaction characteristics from reports voluntarily supplied by market participants in its *Market News* program.

By the late 1990's, *Market News* was releasing 800 reports annually that covered the grain and wool industries as well as livestock and red meat industries. For the cattle and beef trade, *Market News* reporters collected information by telephone from producers, packers, feedlot operators, retailers, distributors, and brokers. Reporters were onsite at major livestock markets to gather firsthand information, and they visited the facilities of market participants. Reports were available to all interested parties and were widely used in the trade. Some *Market News* reports were highly localized, detailing the quantities of cattle of different types sold, within various ranges for weight, yield, and quality grades as well as the range of prices received for them, during a narrow period at an auction market. Other more aggregated reports summarized cattle or meat sales across a wide geographic area for a week, month, or year.

Questioning the Voluntary System

The voluntary system seemed to work reasonably well for many years, with substantial public and private investments in organizing transactions, certifying grades, and reporting terms and prices. However, some producer groups, packers, and retailers eventually began to look for alternatives to traditional spot market systems. As larger livestock volumes began to move through alternative marketing channels, traditional systems also became less effective at orchestrating reliable price discovery—the process of assembling a series of prices from distinct transactions into useful measures of market prices.

What were some of the factors that led to questions about the effectiveness of the voluntary price reporting system? Red meat demand began to slow and even decline after the mid-1970s, with corresponding price declines, in response to consumer changes in diet and in food preparation. These developing patterns were in sharp contrast to the 1960s and early 1970s, when a growing population, rising incomes, and an emphasis on family meals seemed to lead to growing demands for marbled beef.

Ward (2001) argues that beef and pork producers did not quickly respond to changes in consumer demand, which shifted strongly toward poultry and fish in the 1970s. Adding his voice to that of Ward, Purcell (2002) asserts that the one reason for the shift away from beef and toward poultry and fish was that the spot market pricing systems did not provide accurate price signals to producers to develop the types of products that consumers increasingly sought. In particular, Ward and Purcell argue that spot markets gave producers little incentive to produce lean or consistently high-quality products. Both further argue that this failure drove processors and other intermediaries to develop alternative means of coordinating market supplies

of livestock, such as vertical integration, alliances, grids, partnerships, producer-owned cooperatives, and contracts.[1]

Changes in consumer demand were not the only force buffeting the fed cattle industry during voluntary price reporting. Meatpacker concentration rose rapidly as plants got much larger even as slaughter volumes stagnated. By 2001, the four largest meatpackers handled 82 percent of all steer and heifer slaughter, up from 36 percent in 1980. As a result, in many parts of the country, sellers faced just a few (one to three) potential buyers for their cattle.

Cattle feeding also consolidated, shifting from small farmer-feedlots distributed around the country to much larger commercial feedlots concentrated in four states (Colorado, Kansas, Nebraska, and Texas). By 2001, large feedlots (at least 16,000 head capacity) in those States marketed well over half (57 percent) of all feedlot cattle, up from a quarter in 1974. The largest packers interact closely with large commercial feedlots. A survey (USDA, 1996) of over 200,000 transactions for fed cattle in 1992 found that feedlots selling at least 32,000 cattle annually sold two-thirds of their cattle to the largest packing plants. In contrast, small feedlots in the survey (less than 1,000 cattle sold annually) sold just over one-quarter of their cattle to the largest plants.

Flows of cattle between large packers and large feedlots were often managed through contracts, called marketing agreements, which fell outside the negotiated spot market transactions covered by AMS's *Market News* reports.[2] Marketing agreements could be constructed to provide stronger incentives for livestock quality, but packers also could apply such agreements to smoothing the use of large, capital-intensive plants, and feedlots could use them to ensure access to one of the dwindling number of plants in a region.

Under marketing agreements, the buyer and seller reach agreement on transaction terms, such as quantities, delivery periods, and pricing formulas, well before the commodity is transferred to the seller. Pricing formulas usually include a base price calculation as well as a schedule of premiums or discounts for cattle characteristics. In turn, the base price is usually derived from a market average price, such as one contained in *Market News* or an average of the prices paid across all of a plant's transactions. Before LMR, information in the agreements was often held confidentially and was not released to *Market News* reporters and other outsiders. As a result, shifts from spot markets to marketing agreements reduced the amount and quality of information available to market participants.

Fed cattle volume sold in spot markets began to fall sharply in the 1990s, with a concomitant increase in cattle moving under alternative marketing arrangements. Several sources provide evidence of the shift. For example, Schroeder, Grunewald, and Ward (2002) reviewed trends in "additional movement" cattle in weekly AMS reports. These "additional movements" are cattle not sold on a negotiated (cash) basis during the week and hence were not captured in AMS voluntary pricing reports.[3] The data show very rapid increases between 1995 and 2001 in additional movement cattle: In the major feedlot States of Colorado, Kansas, Nebraska, and Texas, addi-

[1] See RTI (2005) for a comprehensive description of alternative marketing arrangements being used in the cattle, hog, and lamb industries.

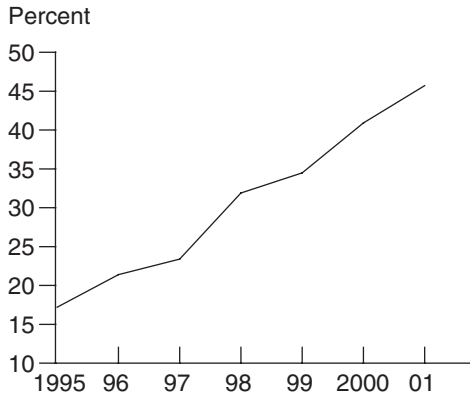
[2] Sellers of all sizes use marketing agreements, but the agreements are more likely to be used and cover more cattle in sales by larger feedlots.

[3] In *Market News* reports, "negotiated" transactions are spot market sales. Cattle moving under "additional movement" could include cattle sold under marketing agreements or forward contracts, sold under a formula pricing arrangement, already owned by a packer and moving from a packer-owned feedlot or a feedlot providing feeding services for the packer, or owned by a third party that has contracted with a packer to provide processing services.

tional movements rose to 46 percent of all fed cattle marketings by 2001, up from 17 percent in 1995 (fig. 1).

With declines in aggregate spot market volumes, local market coverage by daily *Market News* releases became much sparser. Schroeder, Grunewald, and Ward provide information regarding the share of days that the cash price was not reported (fig. 2). In the early 1990s, for example, about 10 percent of daily cash market prices for local fed cattle in Kansas and Texas were not reported in AMS releases because of insufficient trading volume—that is, not enough trades were reported for AMS to release an accurate market price. By 2000, daily cash trades had thinned so much that AMS was not releasing market prices in 60 percent of daily reports from those States.

Figure 1
"Additional movement" marketings of fed cattle as a share of total marketings in Colorado, Kansas, Nebraska, and Texas



Note: "Additional movements" are cattle not sold during the week on a negotiated basis and thus are not captured in AMS voluntary pricing reports.
Source: Ted C. Schroeder, Sarah Grunewald, and Clement E. Ward. "Mandatory Price Reporting in Fed Cattle Markets: Motivations and Implications." Paper presented at Council on Food, Agriculture, and Resource Economics Annual Symposium, Washington D.C., November 2002.

As the quantity, and perhaps quality, of public market information declined, cattle buyers and sellers turned to privately organized information providers, such as CattleFax and services organized by the Texas Cattle Feeders Association and Nebraska Cattle Feeders. Public information should be able to realize scale economies in collection of data as well as extensive and representative coverage, but the expansion of private sources before LMR suggests that coverage was a major concern to market participants (Schroeder, Gruenwald, and Ward, 2002).

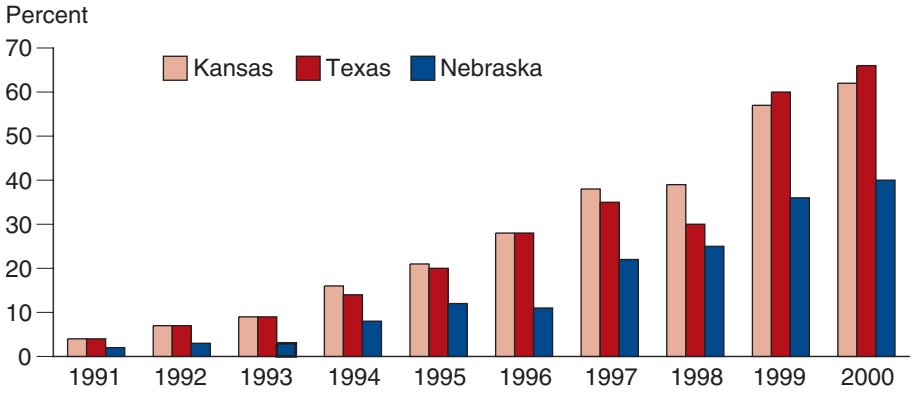
USDA's Grain Inspection, Packers and Stockyards Administration (GIPSA) surveys packers' fed cattle purchases as part of its regulatory responsibilities under the Packers and Stockyards Act. GIPSA defines "captive supplies" to be animals owned by the packer or committed to a packer under a forward contract or marketing agreement at least 14 days before slaughter. Although some transactions that would be part of AMS's additional movements data would not be reported to GIPSA as captive supply, both series tend to move in similar patterns.

GIPSA has reported captive supply flows for the four largest packers since 1999. The reports show that captive supplies accounted for 43 percent of cattle acquired by the packers in 2001, up from 38 percent in 2000 and substantially greater than the 32 percent reported for 1999. These large shifts are consistent with the longer-term trend apparent in AMS data.

Market participants expected those trends to continue after 2001. In a survey of cattle feeders reported by Schroeder, Lawrence, Ward, and Feuz (2002),

Figure 2

Share of business days that fed cattle cash price was not reported under voluntary price reporting, 1991-2000



Source: Ted C. Schroeder, Sarah Grunewald, and Clement E. Ward. "Mandatory Price Reporting in Fed Cattle Markets: Motivations and Implications." Paper presented at Council on Food, Agriculture, and Resource Economics Annual Symposium, Washington D.C., November 2002.

respondents reported that they moved 55 percent of their cattle through spot markets in 2001, down sharply from 90 percent in 1996.[4] When asked about their expectations 5 years out, feeders reported that they expected to move 36 percent of their cattle through cash markets by 2006.

Throughout the late 1990s and into 2001, fed cattle were shifting rapidly from spot markets toward other marketing channels. That shift, if it continued, could undermine the usefulness of voluntary market news data and could make producers' use of spot market prices more difficult. Less effective spot markets could then accelerate the movement away from spot markets and toward contract-based transactions (Roberts and Key, 2005). In short, there were understandable reasons for concern about the future of voluntary price reporting in the late 1990s.

The industry's ongoing consolidation complicates the issue of price reporting. Consolidation led many sellers to fear that packers had gained significant market power and could force cattle prices down (GIPSA, 1996). Many sellers also believed that packers paid higher prices for captive supply cattle obtained largely through marketing agreements with very large commercial feedlots and that expanded use of captive supplies drove down spot market prices (MacDonald, et al., 2004; Stumo, 2003). According to a USDA Advisory Committee report, aside from concerns about the effect of concentration on prices, sellers were also concerned about the effect on market access—their ability to find a buyer for their cattle when they wanted to sell (AMS,1996). Each development also could have contributed to declining spot market volumes and the erosion of confidence in spot markets. Thus, declining spot market volumes could have followed from industry consolidation as well as from poor performance in tying spot market prices to livestock quality.

Several proposals were offered to guide policy about price reporting for a restructured cattle industry during the late 1990s and early 2000s. Several States (Iowa, Minnesota, Missouri, Nebraska, and South Dakota) passed

[4] Note that the spot market estimate for 2001, 55 percent, implies that 45 percent were moving through other channels, quite close to the 2001 estimate of 46 percent, using AMS's additional movements data, and 43 percent, using GIPSA captive supplies data for the top-four packers. Several sources provide similar estimates of levels and trends.

their own mandatory price reporting legislation. Then, during deliberations over the 2002 Farm Bill, the U.S. Senate passed a proposal to ban "packer control" of livestock, a proposal that did not survive in the final bill. States also considered bills to limit corporate ownership of farms.[5] Producer groups sued major packers over their contracting practices. Because of this intense interest by producer groups in the structure of the industry and resultant pricing mechanisms, the U.S. Congress considered redesign of the price reporting system. Given the variety of concerns of industry participants when LMR was passed, participants likely also had varying expectations for what LMR could accomplish. Those expectations were affected by views of what needed to be done to facilitate fair pricing and better price reporting.

[5] In Nebraska, which has statutory restrictions on corporate farming, very large cattle feedlots (with capacities of at least 32,000 head) handle a far smaller share of fed cattle marketings than they do in other major feeding States, such as Texas, Colorado, Kansas, or Oklahoma.

Mandatory Price Reporting Begins

Congress passed the Livestock Mandatory Reporting Act of 1999 (LMR), which requires the reporting of all livestock sales transactions of large meatpackers. LMR aimed "…to establish a program of information regarding the marketing of cattle, swine, lambs, and products of such livestock that (1) provides information that can be readily understood by producers, packers, and other market participants, including information with respect to the pricing, contracting for purchase, and supply and demand conditions for livestock, livestock production, and livestock products; (2) improves the price and supply reporting services of the Department of Agriculture; and (3) encourages competition in the marketplace for livestock and livestock products." (P.L. 106-8, Title IX, Livestock Mandatory Reporting Act).

The Act established a program of reporting information on the marketing of cattle, swine, lambs, and products of such livestock. As implemented, packers are required to report on livestock transactions if they annually slaughter an average of 125,000 cattle or 100,000 swine, or slaughter or process an average of 75,000 lambs—reporting is not mandatory for smaller entities.[6] Importers who annually import an average of 2,500 metric tons of lamb meat products are also required to report. This program provides information on pricing, contracting for purchase, formulated sales, and supply and demand conditions for livestock, livestock production, and livestock products that can be readily understood by producers, packers, and other market participants. After passage of LMR, AMS added a large number of new reports and increased the amount of information in the reports, resulting in a great deal of new price reporting information. Publication of data under LMR was initiated in April 2001.[7]

Mandatory price reporting applies to a subset of livestock (see above for who is required to report); this report focuses on the slaughter cattle reports. There is some voluntary reporting by feedlots of prices for slaughter cattle, but these data are not commingled with the mandatory price reporting data. The mandatory system differs in several important and subtle ways from the voluntary system (table 2). The most obvious difference is that the mandatory system is more comprehensive and reports information from all types of transactions, while the voluntary system reported information from only spot market, or "negotiated" transactions. However, LMR also changed the methods of data collection. Under the mandatory system, information is transmitted electronically from packers to AMS, whereas local AMS agents

[6] Mandatory reporting requirements cover about 90 percent of commercial cattle slaughter, and do not change the voluntary reporting on feeder and replacement cattle. According to GIPSA statistics on plant sizes, cattle slaughter at plants handling at least 250,000 cattle amounted to 85.1 percent of commercial slaughter in 2001, while plants handling between 100,000 and 250,000 added another 6.6 percent. Plants in the latter group with less than 125,000 cattle are not required to report.

[7] See http://www.ams.usda.gov/lsmnpubs/mprrule.htm for more information about AMS implementation of the mandatory price reporting rule.

collected voluntary information from packers and cattle producers, feedlots, and retailers. This shift from voluntary reporting through a market news reporter to mandatory electronic reporting directly to AMS had several important consequences.[8]

First, the shift to an automated process was not without mishaps, and some early misreporting did not incorporate sufficient verification controls. As a result, a programming error caused certain boxed beef prices to be misreported for about 6 weeks.

Second, some *Market News* reports were dropped, including live cattle reports for Montana Direct, South Dakota Direct, California/Arizona Nevada Direct, Indiana/Michigan/Ohio Direct, Illinois Direct, Wyoming/South Dakota/Nebraska Direct, and Washington/Oregon Idaho Direct.[9] More aggregate reports replaced these regional price reports. Aggregation may mask regional differences that might provide additional information for producers. However, research on cattle markets in the 1990s suggested that, for purposes of price determination, markets had become more national.[10] If that were the case, then the loss of localized reports would have little impact on price determination.

[8]One change is that the location of the reporting changed for some reports with the mandatory reporting system. Under voluntary reporting, generally prices were based at the point of sale, e.g., the feedlot. With mandatory price reporting, packers submit the state of origin of where cattle are fed to slaughter weight for each lot of cattle reported. All of the regional negotiated reports (such as the 5-Area Weighted Average report) represent cattle that were fed in those areas. However, there are three regional reports - the lm_ct160 (TX-OK-NM), lm_ct161(KS) and lm_ct162 (NE) - which show the weekly regional formula prices for cattle by the state in which they were slaughtered.

[9]Direct prices are for transactions that occur outside an auction and directly between the farmer or feedlot and the slaughterhouse.

Table 2
How price reporting changed with mandatory collection

	Before mandatory reporting	After mandatory reporting
What transactions are covered?	Information was collected from only negotiated spot market sales of cattle and beef, included feeder, replacement and slaughter cattle. Providing information was voluntary.	Information on all slaughter cattle and beef transactions of large meatpackers; voluntary reporting is retained on feeder and replacement cattle.
How is information disseminated?	Electronic and hard-copy reports for a variety of local, regional, and national markets.	Electronic reports for a variety of purchase and sales transactions; some local and regional reports are discontinued.
How is the information collected?	By market reporters in local offices through observation and telephone and personal conversations.	Electronically filed reports transmitted to Washington office.
Who provides the information?	Meatpackers, retailers, producers, and feedlots.	Mandatory reports on slaughter cattle and beef from large meatpackers, additional voluntary information on feeder and replacement cattle from producers and feedlots.
How is confidentiality maintained?	AMS policy was to have reports from at least three participants.	Statistical guidelines ensure confidentiality (3/70/20 rule, earlier 3/60 rule). (See p.12).
How are the data audited and verified for use in reports?	Information could be verified among parties for either side of a transaction.	No verification of packer filings with other parties, but electronic review systems and quarterly compliance audits of reporting by packers are in effect.

Third, with automated methods of reporting information, more data are available to be used in reports. Under the voluntary system, AMS reporters used discretion to filter out information that was not considered representative of the trade, either because it covered highly unusual transactions or because reporters doubted the accuracy of the information. While reporters still examine the records, and outliers are marked to be excluded from the reports, information that may have not been reported under the voluntary system are part of the mandatory reporting. The change to electronic filing made reporting, collecting and compiling the data more comprehensive and efficient. As a result, mandatory reports may reflect a wider range of transactions and prices than the filtered voluntary reports.[11] Also, while LMR reports add detail and accuracy to the pricing information, trades that occur after 2 p.m. are not reported until 10 a.m. the next day. Because trading occurs before release of the LMR report the next day, industry has acted on private information and incorporated prior-day trade information into their bids.

Fourth, standard rules to prevent disclosure of confidential data that apply widely across statistical agencies came into play with the mandatory system. Until the rules were modified, the introduction of mandatory reporting actually reduced the amount of market information available. Protection of confidential and proprietary data is of utmost importance for both the voluntary and mandatory reports, but the LMR Act imposed strict confidentiality requirements that affected the disclosure of data in publicly disseminated reports. Under voluntary reporting, AMS policy was that there be at least three participants to report a price quote, although exceptions could be made if necessary and acceptable to the participants. Nondisclosure rules became stricter under mandatory reporting, when the LMR Act required protection of individual firm information. At first, the common government agency "3/60" rule guarded confidentiality and prevented disclosure of proprietary information. The rule required that the reported price represent at least three packers and that no more than 60 percent of the volume reflected by a quoted price was from a single packer. That rule proved to be quite restrictive and, until it was changed, no reports were made for 81 percent of the regional and national daily afternoon direct-slaughter negotiated-purchase prices because of confidentiality concerns. The rule was changed August 20, 2001.[12] After the confidentiality guidelines were modified, all of the regional and national daily afternoon direct-slaughter negotiated purchases that occurred in the test period between August 20, 2001, and April 2, 2002, were reported.

Confidentiality rules can protect cattle sellers, as well as buyers, because reporting systems that detail actual transactions prices can abet collusive agreements among buyers, particularly in a concentrated industry (Posner, 2001). Suppose that packers agreed among themselves to refrain from competing aggressively and aimed to set artificially low prices for cattle. A system that reported detailed transactions prices would then ensure that attempts to renege on that agreement would be discovered. Thus, the information system would support the collusive agreement that restricted competition and reduced prices. Wachenheim and DeVuyst (2001) provide a discussion of this topic with an application to mandatory price reporting.

AMS continues to refine the mandatory reporting process. New reporting categories were added in November 2003 (new aggregates of "Total all

[10]See USDA, GIPSA (1996) for general information and the technical reports in that project by Hayenga et al. (1996) and Ward et al. (1996) for specific information.

[11]Some filtering still occurs under LMR; it appears to be substantially lower than under voluntary reporting.

[12]The new "3/70/20" rule means that over a 60-day period (1) at least three entities have to submit data at least 50 percent of the time, (2) no one entity can account for more than 70 percent of the data for a report, and (3) the same firm cannot be the only reporting entity more than 20 percent of the time.

grades" and "All beef type") and again in April 2004 ("negotiated grid" categories). The modifications and refinements to the reporting system complicate our objective of assessing trends in purchasing methods because we had to account for changes in reporting methods and report categories in assessing the cause behind observed trends.

Because of the restrictions imposed by the early confidentiality rules, and perhaps because of other difficulties in initiating a new reporting system, *Market News* reported only a fraction of cattle transactions in the early months of the system. We should be cautious, therefore, in interpreting data from those months. We summarize the evidence in table 3, in which we compare quarterly volumes of steers and heifers in AMS reports with quarterly steer and heifer slaughter in Federally Inspected (FI) facilities.

Market News volumes are not expected to match FI slaughter exactly for several reasons. The timing of sale and slaughter may be different, as sales of cattle in one quarter could be delivered for slaughter in the next. Some cattle reported in *Market News* go to facilities under State inspection and, hence, are not reported in FI slaughter.[13] Mandatory reporting for *Market News* does not apply to small packing plants that account for about 8 percent of FI slaughter, although continued voluntary reporting may cover some of that. Finally, *Market News* does not cover custom slaughter, in which packers provide slaughter services but do not take ownership of the cattle, while FI statistics do cover custom slaughter. Nevertheless, the two series should be reasonably close.

AMS steer and heifer volumes fell far below FI numbers in the second quarter of 2001 (table 3) but began to rise late in the third quarter, hitting 65 percent of third-quarter FI slaughter before rising to 94 percent of FI totals in the fourth quarter. While one should not expect the two series to match, the wide gaps between *Market News* and FI slaughter in the first two quarters after LMR implementation suggest that the confidentiality restrictions substantially limited *Market News* coverage. Because of the early lag in capturing cattle transactions under LMR, we must exercise some caution in analyzing data from the second and third quarters of 2001. Nevertheless, if one compares the data in table 3 with the additional movements cattle reported for the voluntary system in figure 1, it is clear that, by the fourth quarter of 2001, mandatory reporting had greatly expanded the coverage of cattle sales in *Market News*.

[13] In 2001, FI cattle slaughter was 98.3 percent of total commercial slaughter, according to statistics from USDA's National Agricultural Statistics Service.

Table 3
Expanding *Market News* coverage during LMR implementation for steers and heifers, 2001

Period	Steer and heifer volume		
	FI slaughter[1]	LMR	LMR/FI
	1,000 head		*Percent*
2nd quarter	7,377	3,831	52
3rd quarter	7,348	4,803	65
4th quarter	7,015	6,603	94

LMR = Livestock Mandatory Reporting Act of 1999.
[1]FI slaughter is cattle slaughter at federally inspected slaughterhouses. State-inspected slaughterhouses are not included in this count.
Source: USDA, National Agricultural Statistics Service, *Livestock Slaughter: 2001 Summary*, March 2002.

Prices and Volumes Under Mandatory Price Reporting

The early evidence from AMS mandatory price report data supports two important findings. First, the prices reported under negotiated transactions align closely with prices reported in formula marketing agreements for cattle in the same quality class. Second, the volume of cattle moving under negotiated transactions has stabilized or even increased slightly since introduction of LMR. Neither finding was expected, so it is important to document the evidence for each. We do that in the following section and provide other important supporting information on prices and volumes since implementation of LMR. Ward (2005) reports similar findings for data through 2003; our findings support his, provide greater detail, and extend the evidence to 2005 data.

Using AMS *Market News* Data

Market News reports do not identify individual transactions. For reporting purposes, the data are sorted according to several key characteristics of transactions, and *Market News* then reports summary data across like transactions. It is important to understand the key sorting characteristics when evaluating the reported data.

Meatpackers rarely buy individual cattle but instead usually purchase them in groups, called lots, which contain cattle that are alike in some ways. Reports of prices are then based on the average characteristics of the lots sold in specified periods and geographic areas. The transaction characteristics that drive reporting are class of cattle, selling basis, quality grade, and purchase type.

Cattle are assigned to a lot in one of nine class categories: bulls, dairy cows, beef cows, mixed (dairy and beef) cows, steers, heifers, mixed steers and heifers, dairy-breed steers and heifers, and mixed steers, heifers, and cows. Because lots of steers and heifers bring much higher prices than cows and dairy-breed steers and heifers, it is important to properly mix the cattle and identify the lot class. Cattle can be priced when alive (liveweight) or after slaughter (dressed weight). A 1,200-pound steer will likely yield 750-800 pounds of meat, so a dressed-weight price will substantially exceed one expressed in liveweight. Reports therefore group sales according to the selling basis.

Nearly all steer and heifer cattle carcasses are graded voluntarily for quality by government inspectors after slaughter. Beef grades range from Prime through Choice and Select and then through lower quality grades of Standard, Commercial, Utility, Cutter, and Canner. Lower-quality carcasses can bring substantial price discounts compared with Choice, while Prime cattle usually bring premiums. Under LMR, packers report to AMS the percentage of cattle in the lot that they expect to grade at Choice or better, and transactions are assigned to one of four categories—0-35 percent, 35-65 percent, 65-80 percent, and more than 80 percent Choice.

Cattle are classified in this manner whether they are priced as liveweight or dressed-weight. If cattle are priced as liveweight, the buyer carries some risk that the cattle may dress out at a lower grade than the one on which the price was based. Conversely, sellers carry risk that their cattle will dress out better than the grade on which the liveweight price was based. Processors' "kill sheets" can provide information on the dressed-weight yield to be used to modify prices for the next transactions.

At the beginning of mandatory reporting, AMS recognized four purchase types: negotiated, formula marketing agreement, forward contract, and packer owned. AMS introduced a fifth purchase type, negotiated grid, in 2004. In negotiated-grid transactions, the buyer and seller arrive at a base price through negotiation, with delivery to occur shortly thereafter. The final price then reflects the base price that was negotiated and a grid of premiums and discounts applying to the realized yield and quality of the carcass after slaughter.

Market News reports cover many locations. We focus on two major reporting categories: nationwide reports and "five-region" reports, which include Colorado, Iowa/Minnesota, Kansas, Nebraska, and Texas/Oklahoma/New Mexico (we also look at data from the component States).

Meatpackers report daily data for live cattle to AMS twice daily, by 10 a.m. and 2 p.m. Central Time, and the Agency also releases a variety of morning, afternoon and summary *Market News* reports. We rely on daily and weekly summary reports released by AMS, and we report some monthly, quarterly, and annual averages based on those data.

Among other factors, cattle prices vary with cattle classes, cattle quality, and purchase type, and average prices calculated across many lots of cattle will vary with the types of cattle and their quality across those lots. For example, when we compare steer and heifer prices, we find that Nebraska and Iowa typically have much higher proportions of higher graded cattle. Hence, average prices in those regions often will be greater than average prices in Kansas and Texas/Oklahoma, and five-region average prices can rise as more cattle are sold in the more northern regions. Higher quality cattle also may be more likely to be sold on a dressed basis than are lower quality cattle; hence, average prices also will be sensitive to the proportion of lots sold on a dressed basis.

Packers are required to report any premiums or discounts associated with weight, quality grade or yield grade. This would include any premiums or discounts based upon the buyer's estimate of the carcass characteristics of the lot. For example, a buyer might pay an additional $1.00/cwt. over the base price for a lot of cattle of uniform weight or quality or might deduct a $1.00/cwt. from the base price for a dissimilar pen of cattle.

Any analysis of the price reporting data is made more difficult by the temporal aspect of price reporting. Researchers should take care, because the data do not carry a "true" prior day report for cattle. Currently, the CT100 report contains data submitted to AMS at 1:30 p.m. on the prior day and at 9:30 a.m. on the current day for the 10 a.m and 2 p.m. reports. Because few, if any, trades typically take place before 9:30 a.m., most of the

transactions submitted by packers at that time occurred the day prior, after 1:30 p.m. reporting deadline. Thus, the 10 a.m. CT100 report published on a given day is essentially a prior-day report, but there is a possibility that some current-day transactions could be included. For the first several months of mandatory price reporting, however, the CT100 included data submitted at 9:30 a.m. and at 1:30 p.m. the prior day. As a result, the report included a mix of late afternoon trades 2-days prior and midday trades from 1-day prior.

Another temporal aspect of price reporting is that transactions are reported when the cattle are "committed" and actual slaughter must occur some time later. Cattle are considered to be committed once an agreement to sell the cattle has been reached. According to the AMS website at http://www.ams.usda.gov/lsmnpubs/mpr/qa.htm, packers may price cattle purchases on the basis of a prior week average while others may price based on the average of the current week prices, which will not be known until the beginning of the following week.

Packers are required to submit information on purchases of cattle that are scheduled for delivery 15-plus days from the date they are purchased or priced. Packers submit this information on a daily basis as either a forward contract or a formula marketing arrangement purchase type. Additionally, information on these purchases is required to be reported on a weekly basis for forward contract purchases and for formula marketing arrangement purchases. Thus, cattle are priced by a mixture of pricing systems and those prices do not reflect when the cattle actually enter the slaughter facility. See the AMS website given above for questions and answers and for more information about the way that prices are reported.

Because quality, purchase type, and cattle class all affect prices and because the incidence of those characteristics can vary over time and across locations, we need to consider them together when analyzing how average cattle prices vary over time and across purchase types.

Negotiated Prices Align Closely With Formula Prices

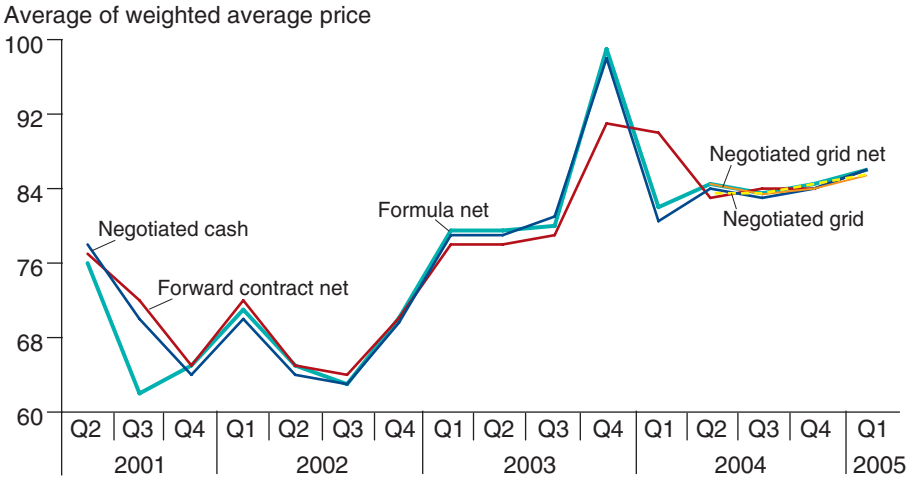
Figure 3 displays quarterly average prices for steers, sold on a live basis, in the most common quality class (35-65 percent Choice). Prices are charted for five different purchase types: (1) formula net, (2) forward contract net, (3) negotiated cash, (4) negotiated grid base, and (5) negotiated grid net.[14]

The data cover the second quarter 2001 through the first quarter 2005, and prices follow a generally increasing trend after the third quarter 2002. Cattle prices reached a record high in October 2003 as cattle inventories were low and the U.S. border was closed to live cattle imports from Canada, contributing to declining beef production. Prices for the various purchase types track each other closely through time, and average prices for formula net and negotiated cash transactions appear to closely correspond.

We see similar patterns in other price series—for steers and heifers, varying quality grades, and dressed as well as live basis. Formula net prices track negotiated cash prices closely over time. Formula net prices do appear to be

[14] Negotiated grid transactions report two prices—the base and the net that results after yield and quality premiums and deductions are applied to the base.

Figure 3
Simple average of weekly weighted-average prices by quarter by purchase type for live steers grading at 35-65 percent Choice



Source: U.S. Department of Agriculture, Agricultural Marketing Service. *Datamart*. Accessed at http//www.ams.usda.gov/lsmnpubs/. June 10, 2005.

slightly less variable than cash prices over time—that is, negotiated cash prices are more likely to fall below formula net prices when all prices are falling and to rise above formula net prices when prices are rising, but even those differences are quite small.[15]

The data in figure 3 are quarterly average prices, built up from AMS reports of weekly volume-weighted average prices. When we analyze the underlying weekly data, some differences between purchase methods emerge, but those differences do not show a consistent pattern. We summarize the weekly data in table 4, where we focus on the weekly differences between the formula net price and the negotiated cash price (again for steers, live basis, 35-65 percent Choice).[16] Formula net prices were higher, on average, than negotiated cash prices over the entire period from April 2001 through March 2005. [17] However, the difference was small but statistically significant, with a mean difference of 65 cents per hundredweight, less than 1 percent of the mean series steer price.

The pattern of differences also was not consistent over time (table 4). Across all weeks in 2001 and in 2004, formula prices averaged about $1.40 more than cash prices. The average gaps were much lower in other years and not statistically significant. Furthermore, weekly cash prices frequently exceeded formula net prices; across all sample weeks, formula prices exceeded cash prices 61 percent of the time, but cash prices exceeded formula prices 39 percent of the time. If we restrict ourselves to the weeks when formula prices were higher, the mean gap rises to $2.28, while cash prices averaged $1.87 higher in the weeks when cash prices exceeded formula prices.

Figure 4 plots the weekly differences through time of prices for formula net transactions minus negotiated cash transactions. Several patterns stand out. First, wide gaps (positive and negative) occurred from mid-2003 to early 2004. We attribute these gaps to increased uncertainty in the market as cattle prices initially rose sharply to a record high, followed by the discovery of

[15] Forward contract prices are clearly more stable over time and less sensitive to market fluctuations than formula net or negotiated cash prices, which may be due to greater "averaging" of forward prices relative to the other price types (fig. 3). Forward prices can be locked in months before delivery. Hence, the average for any delivery period reflects market expectations for a range of preceding months.

[16] Each is a weighted average of all prices reported in that week for transactions using that purchase type, where the weights are quantities of cattle in each transaction.

[17] With a standard deviation of the weekly price differences of 3.42, a mean of 0.645, and 185 weekly observations (prices were not reported in all weeks), the difference was statistically significant at a 98-percent level of confidence (a t statistic of 2.79).

Table 4

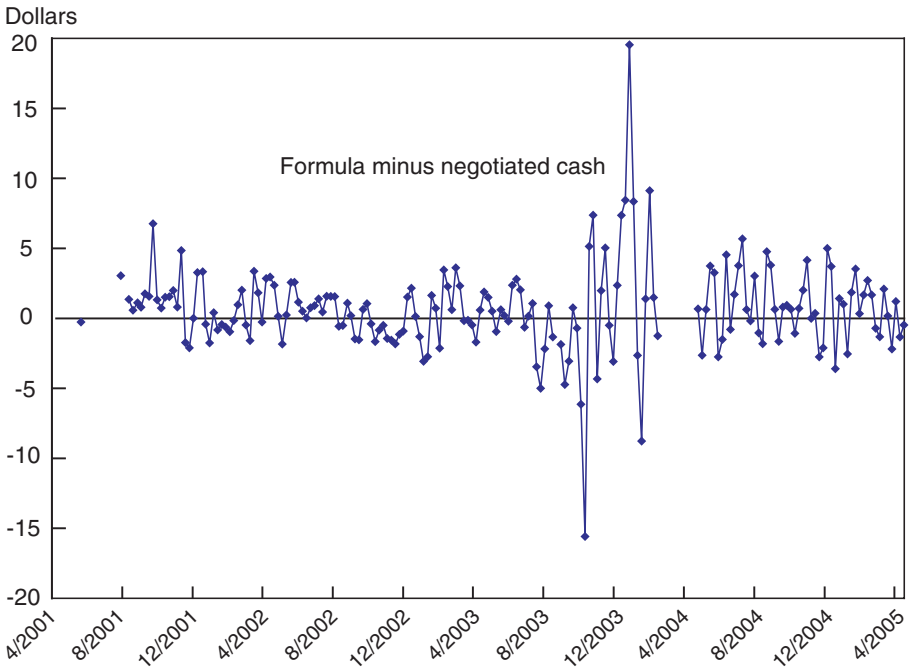
Comparing formula prices with negotiated cash prices

Weekly price difference (Pf-Pc)	All years	2001	2002	2003	2004	2005
Mean overall difference ($/cwt)	0.65	1.45	0.30	0.04	1.41	0.53
Standard deviation ($/cwt)	3.14	1.99	1.43	3.80	4.35	1.74
t statistic: Difference = 0	2.79	3.42	1.51	0.08	2.13	1.25
Mean difference, Pf > Pc ($/cwt)	2.28	2.02	1.34	2.51	3.52	1.61
Mean difference, Pf < Pc ($/cwt)	-1.87	-1.13	-1.01	-2.73	-2.16	-1.43
Percent of weeks with Pf > Pc	61	82	56	53	63	65

Note: The table compares weekly average prices for steers, live basis, 35-65 percent Choice. The two purchase types are formula net (Pf)and negotiated cash (Pc).

Figure 4

Weekly difference between formula prices and negotiated prices



Source: U.S. Department of Agriculture, Agricultural Marketing Service. *Datamart*. Accessed at http//www.ams.usda.gov/lsmnpubs/. June 10, 2005.

bovine spongiform encephalopathy (BSE, also known as mad-cow disease, discussed later) in the United States. That discovery led to trade restrictions on meat shipments and live cattle movements to the United States that roiled cattle markets. Second, although, on average, formula prices were higher, they do not appear to have any predictable advantage, and the differences frequently fluctuate from positive to negative. Finally, prices do appear to persist, in that positive values tend to bunch together in time, as do negative values, suggesting that one purchase method usually maintains a price advantage for several weeks at a time.[18]

Ward provides (2004) more analysis of differences between formula and negotiated prices, using LMR data from April 2001 through March 2004. First, he finds that the average difference between formula and negotiated sales was 7 cents per hundredweight for dressed-weight steers and heifers

[18] We tested a number of runs in which we rejected the hypothesis that positives and negatives appeared randomly (a z-statistic of 2.38 against a critical value of 2.24 at the 95-percent confidence level); rather they appear to be correlated over time.

sold in the five-region price series. This difference is much smaller than our mean difference of 65 cents and reflects the timing of the analysis (note that the gap is much higher in 2004, pulling our average up). Second, Ward points out that formula trades frequently set a base price on the prior week's negotiated price. Indeed, he finds that weekly differences between formula and negotiated prices shrink when he compares formula prices with the prior week's negotiated prices. Third, he finds that negotiated prices tend to exceed formula prices when prices are rising, while formula prices tend to exceed negotiated prices when prices are falling. Finally, Ward extended prior research that analyzed links between negotiated prices and the volume of cattle moving under marketing agreements and other forms of captive supplies. As in previous studies, he found that negotiated prices were lower, by small, but statistically significant, amounts during weeks when packers were buying more cattle under marketing agreements.

The close alignment in price levels suggests that formula marketing agreements held a small price advantage in the time since LMR implementation but that the advantage has not been consistent and that negotiated cash prices have frequently been higher. This finding supports and extends that of Ward (2005), who analyzed *Market News* price data through 2003. Before the passage of LMR, many producers believed that formula prices were consistently and noticeably higher than negotiated (cash) prices and that knowledge of formula prices would help them obtain better prices from packers (Grunewald, Schroeder, and Ward, 2004). The actual pattern of prices may have disappointed the expectations of many producers; in the 2002 survey reported in Grunewald, Schroeder, and Ward, many producers responded that LMR did not enhance their negotiating position. Other work by Fausti and Diersen (2004) concludes that the assertion that voluntary price reporting degraded market transparency was not valid for the case of South Dakota. The price evidence in LMR reports may nevertheless have affected producers' marketing decisions. In showing that formula prices were not consistently above negotiated cash prices, the data may have encouraged producers to continue to use spot markets, slowing the shift toward contracts.

Cattle to Beef Price Differences Match for Formula and Negotiated Transactions

Because consumers typically do not buy food directly from farmers, livestock producers see a derived demand for their animals based on the prices that consumers pay for meat. In addition to cattle prices, LMR also required packers to report the prices that they receive for the sale of wholesale meat products, and specifically for boxed beef—the major product shipped from packing plants.[19] As a result, market participants can track livestock and meat prices on a daily and weekly basis, and may use meat prices in negotiations over cattle prices.

We used *Market News* reports to analyze weekly movements in the relationship between cattle and beef prices. We selected average reported cattle prices (per hundredweight), for each pricing basis, transaction type, quality grade category, and cattle class reported in a week, and compared those prices to the weekly average boxed beef cutout price reported in *Market*

[19]The "boxed beef" concept allows the centralized fabrication of carcasses into major primals and/or subprimals followed by vacuum packaging. A carcass produces 7-9 boxes.

News each week, for choice beef. Specifically, we used a regression model to analyze movements in the ratio of cattle to boxed beef prices over time and across cattle transaction categories.

Our basic model included a set of dummy variables representing transaction characteristics: the quarter in which the sale occurred; the class of cattle (steer, heifer, heifer and steer, or mixed steer, heifer and cow); the purchase type (negotiated cash, negotiated grid base, negotiated grid net, formula, or forward contract); the grade category; and the pricing basis (dressed or liveweight). The model also included the average weight of cattle sold in that transaction category in a week, as well as the difference between Choice and Select cutout prices. Finally, we evaluated two different measures of aggregate volumes of cattle moving under negotiated transactions in a week. In Model 1, we used the percentage of cattle (0 to 100) sold under negotiated prices, while in Model 2 we used the total number of cattle (in tens of thousands) sold in this type of transaction. Detailed regression results are in appendix 1.

Since the dependent variable is the ratio of cattle to boxed beef prices, a positive coefficient is associated with a higher cattle price relative to the boxed beef price. In general, the results are consistent with what one would expect. Prices on a dressed basis are much higher (34 percentage points) than live basis prices. Lots comprised of steers bring the highest prices, and cattle classes with cows bring the lowest prices. Lots with few high-quality cattle bring lower prices, as do lots in which cattle are heavier.

There are small differences among transaction types, of magnitudes consistent with our previous evidence. With formula transactions as the base, prices under negotiated cash transactions are lower, by statistically significant but small amounts. For example, in a transaction for liveweight steers, 35-65 percent Choice, negotiated in the second quarter of 2005, with sample average values for other continuous variables, Model 1 predicts that cattle prices would be 63.76 percent of boxed beef cutout prices under a formula transaction, and 63.44 percent under a negotiated cash transaction, a difference of 0.5 percent. In contrast, negotiated grid base prices were higher, on average (64.44 percent of boxed beef prices), than formula prices, by statistically significant amounts. Finally, forward contract prices were the lowest, over the period studied.

Price differences for Choice and Select cutout beef show a wide variation. The mean gap was $8.23 per hundredweight, with a standard deviation of $5.25 and a range from $1 to $23. The Choice-Select price gap was directly important in the model, as the coefficient was highly significant and improved the model's fit. It also affected other model coefficients, especially the effect of negotiated volumes. Model 1 includes the share of cattle moving under negotiated trades. The negative and statistically significant coefficient suggests that a 10 percentage point increase in the negotiated share would reduce cattle prices by 0.22 percent relative to boxed beef prices. However, with the Choice-Select price gap omitted from the model, the effect of percentage of negotiated transactions jumps, such that a 10-percent increase would lead to a 2-percent decline in cattle prices relative to boxed beef prices.

If we replace the negotiated share with the number of cattle moving under negotiated trades in a week (model 2), the effect of the Choice-Select cutout difference is starker. With the price difference excluded, the coefficient on the negotiated head count is negative and highly significant, and suggests that increased negotiated volumes reduce cattle prices. Once we controlled for the Choice-Select price difference, however, the coefficient on the negotiated head count changes sign, suggesting that cattle prices rise by small amounts when negotiated volumes increase.

The results from the regression models support our previous findings, based on more descriptive statistics; cattle sold under negotiated transactions brought prices that were quite close to those sold under formula transactions during the period under study. Moreover, the effect of negotiated volumes on overall cattle prices appeared to be sensitive to the specification of the model and to the choices of a measure of negotiated volumes. These findings are consistent with those of Ward (2004) noted above, as well as the literature reviewed therein.

Spot Market Volumes Appear To Have Stabilized

Cattle transactions were shifting sharply toward contracts and away from spot markets before LMR was implemented. Since then, the share of cattle moving through spot markets appears to have stabilized or even increased. The mandatory reporting requirement may have led to additional spot market reports that had not been provided under voluntary reporting. We have no consistently defined data series on spot market and contract movements of cattle over the period 1995-2005 and so must rely on several different incomplete sources, but those sources tell an interesting story.[20]

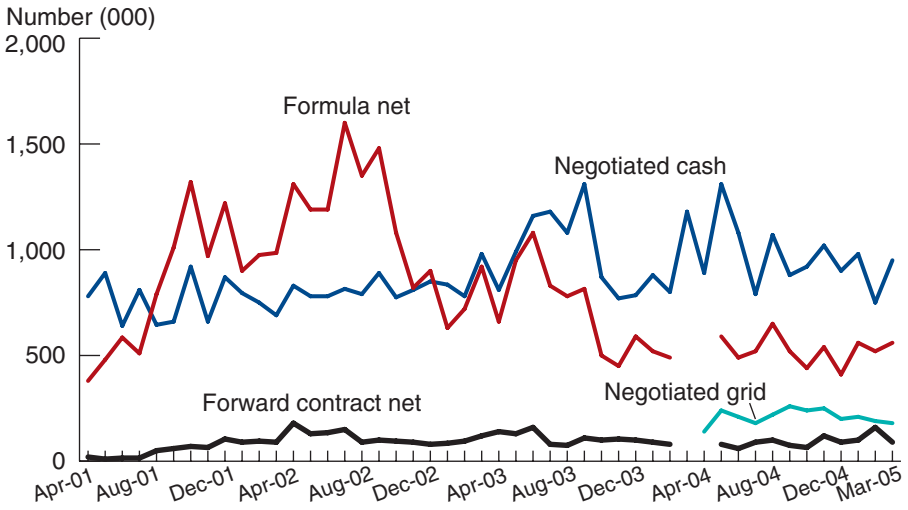
As previously mentioned, GIPSA data show that captive supplies by the four largest meatpackers increased between 1999 and 2002. AMS *Market News* reports, as well as producer surveys, showed corresponding sharp declines in spot market cattle transactions before LMR implementation. Figure 5 summarizes what happened after the LMR legislation was implemented. It shows monthly volumes of steers and heifers moving under each of four purchase types between April 2001 and March 2005, although we should probably focus on the data starting in September 2001, given the early LMR coverage problems arising from confidentiality rules (see earlier discussion).

We clearly see substantial and growing volumes of cattle moving under formula marketing agreements in 2001 and 2002, peaking at about 1.5 million head per month in the third quarter (July-September) 2002, a pattern that appears to continue the pre-LMR trend noted in GIPSA and AMS data. Formula price volumes fell sharply after that peak, down to around 500,000 head per month in the last 18 months of the figure. Meanwhile, negotiated cash transactions rose sharply through the third quarter 2003 and fluctuated between 800,000 and 1,200,000 head per month after that, substantially higher than sales volumes in formula transactions and a substantial reversal from prior trends. Sales volumes under forward contract show no trend after early 2002, and fluctuate between 75,000 and 175,000 per month.

[20] GIPSA data on captive supplies go back to only 1999 under their current definition, and the agency has not yet released 2003 data. Before price reporting became mandatory, formula transactions in AMS reports had to be inferred from additional movements data. After LMR implementation, AMS data definitions, while more precise, were different from those used earlier. Finally, AMS has changed some transaction definitions since LMR implementation.

Figure 5

Monthly steer and heifers volumes, by purchase type



Source: U.S. Department of Agriculture, Agricultural Marketing Service. *Datamart*. Accessed at http//www.ams.usda.gov/lsmnpubs. June 10, 2005.

Our analysis is complicated by the April 2004 introduction of the new purchase type, negotiated grid base. Those transactions account for about 200,000 steers and heifers per month compared with formula volumes of about 400,000-600,000 and negotiated cash transactions of 800,000-1,200,000. The introduction of the new type presents two complications. First, to what purchase type were these transactions previously assigned? Second, if we keep a dichotomy between spot market and contract cattle, where should we put negotiated grid transactions?

We view negotiated grid sales as spot market sales because the base price is negotiated at the time of sale and close to the time of delivery to the packer. The grid reduces the costs of making the transaction because it provides an easily recognized set of quality and yield adjustments. By contrast, participants in marketing agreements commit to quantities and a pricing method well before delivery of the cattle to the packer. As a result, we add negotiated grid and negotiated cash volumes in measuring the share of cattle moving under spot market transactions.

However, most of these transactions were previously recorded as formula net (contract) sales prior to the addition of the negotiated grid category. As a result, the formula net volume series was, by our definition, too high before April 2004. Figure 6 overstates the decline in formula net transactions between September 2002 and April 2004.[21]

Further information is provided in figure 7, which shows quarterly volumes of fed cattle moving under negotiated transactions in the five regions—Colorado, Iowa/Minnesota, Kansas, Nebraska, and Texas/Oklahoma/New Mexico.

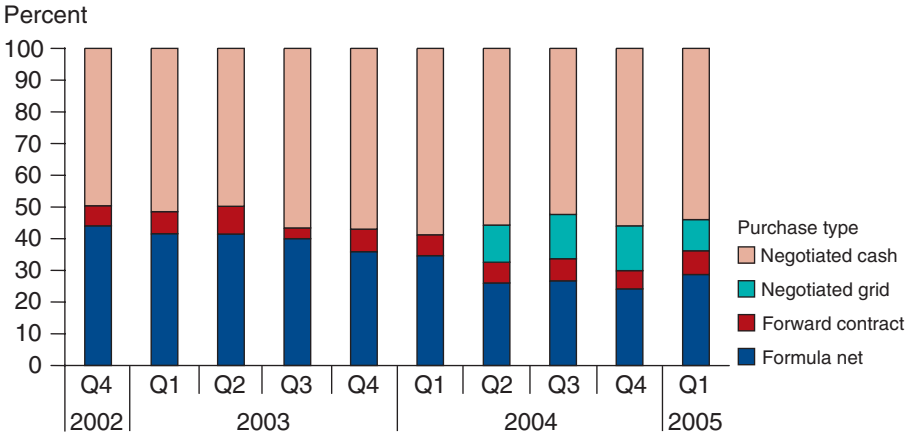
Again, we focus on the period starting in the fourth quarter 2001, as the earlier data may not be reliable. The chart shows a doubling of negotiated cash volumes between 2002 and 2005, to 4 million head per quarter. While

[21] Prior to the introduction of the negotiated grid category, negotiated grid transactions were treated as formula sales because grids embody a formula for determining premiums and discounts. Furthermore, even though the transactions allow for negotiation, sellers may accept the first offer made by the packer, which, in turn, may be the base price by the packer in its formula transactions. Many grids have a formula base that is not negotiated, but the feedlot is not committed to the packer and can sell elsewhere. A true negotiated base price is beginning to be used (Lawrence, personal communication).

Colorado and Iowa/Minnesota show only modest changes, the other three regions all show large increases in the use of negotiated sales.

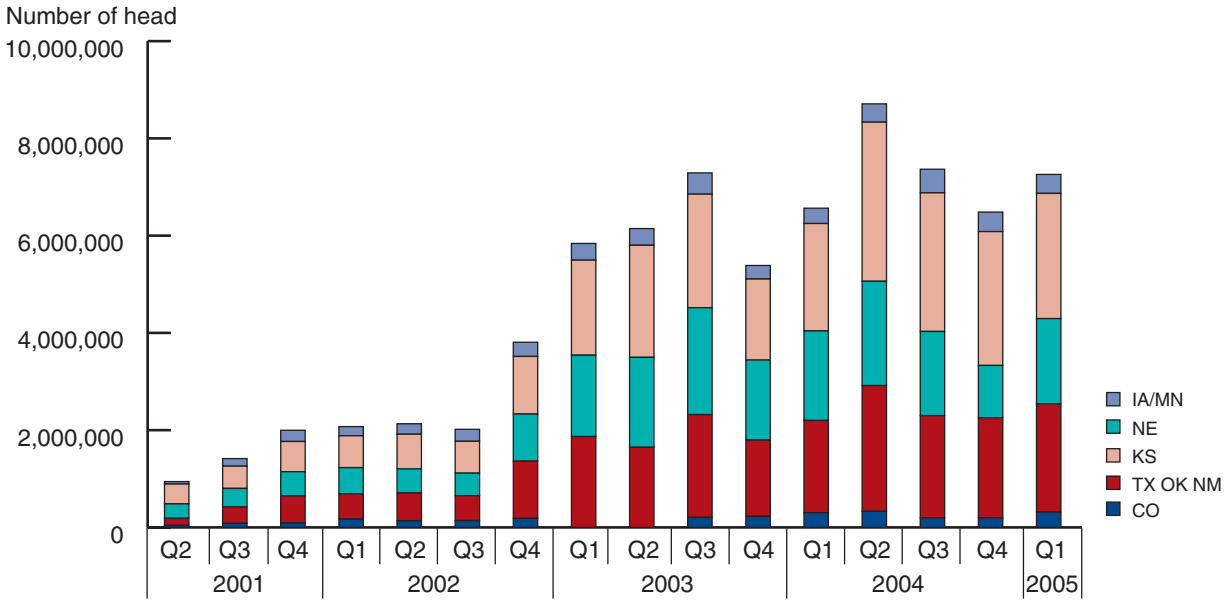
Even with the limitations of these data, a clear pattern appears. The strong shift of fed cattle sales from negotiated cash markets to marketing agreements ended after implementation of LMR, and the negotiated cash market share of fed cattle transactions has grown in recent years. The pattern is in striking contrast to that observed before implementation: The sharp movement of cattle to marketing agreements appears to have slowed and even reversed in the 4 years after implementation. More cattle continue to move

Figure 6
Share of head of steers and heifers sold by type of transaction



Note: It is not clear where Negotiated Grid was counted prior to Q2 2004.
Source: U.S. Department of Agriculture, Agricultural Marketing Service. *Datamart*. Accessed at http//www.ams.usda.gov/lsmnpubs/. June 10, 2005.

Figure 7
Number of head of cattle sold under negotiated cash prices by area



Source: U.S. Department of Agriculture, Agricultural Marketing Service. *Datamart*. Accessed at http//www.ams.usda.gov/lsmnpubs. June 10, 2005.

through spot markets than many feeders and independent observers expected (Schroeder, Lawrence, Ward, and Feuz, 2002).

Did the shift to mandatory reporting cause the growth in the negotiated cash or spot market sales? While voluntary reporting may not have captured all spot market transactions, it seems unlikely to have captured a smaller share of spot market than of formula transactions. Hence, the shift to spot market transactions that appears in LMR data appears to be real. The timing of the strong turnaround, coming 18 months after implementation, suggests that LMR may have played a role. The new pricing evidence provided by LMR, of near equivalence between negotiated cash and formula net prices, supports that interpretation.

However, one should exercise great care in attributing causality to LMR because other major events affected the cattle industry after LMR was instituted. LMR may be reflecting these market conditions that led to changes in the distribution of transactions rather than influencing that distribution. Increased beef demand led to sharp increases in cattle and beef prices in 2003, and virtually no difference between formula and negotiated prices (see table 4). This increased demand came at the same time that cattle inventories were at a cyclical low. With rising prices and eased concerns over market access, many feeders may have opted to forego formula trades in favor of the spot market.

Then, the discovery of BSE in North America, first in Canada and later in the United States, led to major interruptions in trade, such as the closing of some international markets to U.S beef and the closing of the U.S. market to live cattle imports from Canada. The events could have affected producers' marketing decisions and could have caused the shift toward greater reliance on spot markets. As a result, we cannot be certain that LMR price reports induced producers to shift to spot market transactions.

Does *Market News* Provide More Useful Price Information Under LMR?

Is the price information provided under LMR more useful than that provided under the voluntary system? The answer depends on what participants want from the reports and what they do with the data. The question is challenging because the issue of what participants do with the information is quite subtle. We provide limited and preliminary evidence from three approaches. First, one can survey market participants directly and ask them if they find the information to be more useful. Second, one can review the statistical properties of the average daily and weekly prices reported in *Market News*, evaluate whether those properties changed after implementation of LMR, and ask whether they have changed in ways that make them more useful. Third, one can investigate whether market participants react more strongly to *Market News* prices in the post-LMR period.

Survey Information

Schroeder, Lawrence, Ward, and Feuz (2002) surveyed feedlot managers in Iowa, Kansas, Nebraska, and Texas about their methods for marketing cattle and their views of LMR. The survey offered a series of statements on cattle marketing and on LMR, and respondents could select from a range of numerical responses to indicate their degree of agreement with each statement offered, from 1 (strongly disagree) to 9 (strongly agree). Table 5 summarizes the results, listing selected survey statements and the mean response for each, as well as the proportion of respondents who tended to disagree (responses 1–3) and the proportion who tended to agree (responses 7-9) with the statement.

The upper panel of table 5 reports on feeders' views about competition in the cattle industry, which help explain some of the forces behind the introduction of LMR. A very strong majority (65 percent) of feeder respondents believed that reduced cash market trading would harm the industry, with 14 percent disagreeing with the statement (#4). Furthermore, another large majority, 81 percent, agreed with the statement that cash market bids by packers are lower when packers have cattle contracted (#1). A large majority believed that meatpackers should not be allowed to own or feed cattle, while views on contracts were more mixed, not surprising because many of the feeders used marketing agreements.

Statements 5-11 are directed at respondent views of LMR, which were generally negative. Overall, less than half of the respondents believed that LMR was benefiting the beef industry.

Respondents expressed strong disappointment, with 76 percent agreeing that LMR was not as beneficial as they had expected it to be (#6). Small fractions (13-16 percent) agreed with the statements that LMR has provided more price information (#7 and #8), and almost two-thirds (63-65 percent) disagreed with the propositions that LMR had enhanced their ability to negotiate with packers (#9 and #10).

The timing of the survey may be an important clue to the responses. The survey was carried out shortly after LMR implementation, in March and April 2002. That is, it occurred 1 year after introduction of LMR, 7-8 months after the confidentiality rules were modified to allow comprehensive reporting, and with other problems (such as the error on reporting boxed beef prices) fresh in respondents' minds. Cattle prices remained in the range of $70 per hundredweight (liveweight), and the slowing of the shift from negotiated cash purchases, to contract pricing, back toward negotiated prices, had not yet begun. In short, mandatory reporting had been in place for only a short time at the time of the survey and had gone through a series of modifications in response to unexpected problems. Feedlots had been under pressure because of low demand for fed cattle; thus, their dissatisfaction with LMR prices may have been a reflection of market conditions, rather than the implementation of the mandatory price reporting system.

The disappointment of respondents with the legislation may be the most interesting evidence in the survey. The data provided by LMR indicate that the systematic difference between formula and negotiated cash prices is small, evidence that appears to be at odds with respondents' prior beliefs. Respondents could be surprised by that result, but they might also be more likely to continue using cash markets as a result of the information in the new reports.

Table 5

Feedlot respondent opinions on LMR and competition in cattle markets

Responses (1 = strongly disagree to 9 = strongly agree)

Survey statements	Mean score	Share indicating 1-3	Share indicating 7-9
	Number	*Percent*	
Opinions on competition in cattle markets			
(1) Cash market bids by packers are lower when packers have cattle contracted	7.7	7.2	81.2
(2) Packers should not be permitted to own or feed cattle	6.6	18.1	61.0
(3) Packers should not be permitted to contract or form marketing agreements with feeders and cattle owners	4.8	38.5	29.4
(4) Reduced trading in the cash market would be harmful to the beef industry	6.8	14.3	65.1
Opinions on LMR			
(5) LMR is benefiting the beef industry	4.3	41.4	21.6
(6) LMR is not as beneficial as expected	7.3	6.1	75.8
(7) Information on regional daily fed cattle prices has increased	3.6	51.6	13.0
(8) Information on base prices used in grid pricing has increased	3.9	46.1	15.9
(9) LMR has enhanced my ability to negotiate cash prices with packers	3.0	64.7	6.8
(10) LMR has enhanced my ability to negotiate base prices or formulas with packers	3.0	63.0	5.2
(11) Current morning, afternoon, and daily summary reports are timely/frequent enough for my decision needs	3.8	47.6	14.3

Source: Ted C. Schroeder, John Lawrence, Clement E. Ward, and Dillon M. Feuz. *Fed Cattle Marketing Trends and Concerns: Cattle Feeder Survey Results*. Manhattan, KS: Kansas State University Agricultural Experiment Station and Cooperative Extension Service, June 2002.

Have the Statistical Properties of *Market News* Prices Changed Under LMR?

Cattle prices appear to be more volatile and less predictable since implementation of LMR (fig. 8). We expected pre-LMR prices to be more volatile because of the smaller share of cattle transactions that were covered by voluntary reporting. With reporting based on fewer transactions, we expected average prices to be more influenced by extreme prices during any given day or week and to display greater day-to-day and week-to-week volatility. However, the evidence gathered thus far indicates the opposite: Weekly prices have become more volatile since LMR was implemented. While that greater volatility might result from changes in reporting methods (recall that the shift to LMR expanded the coverage of slaughter cattle transactions), prices in the industry may simply have become more volatile in recent years.

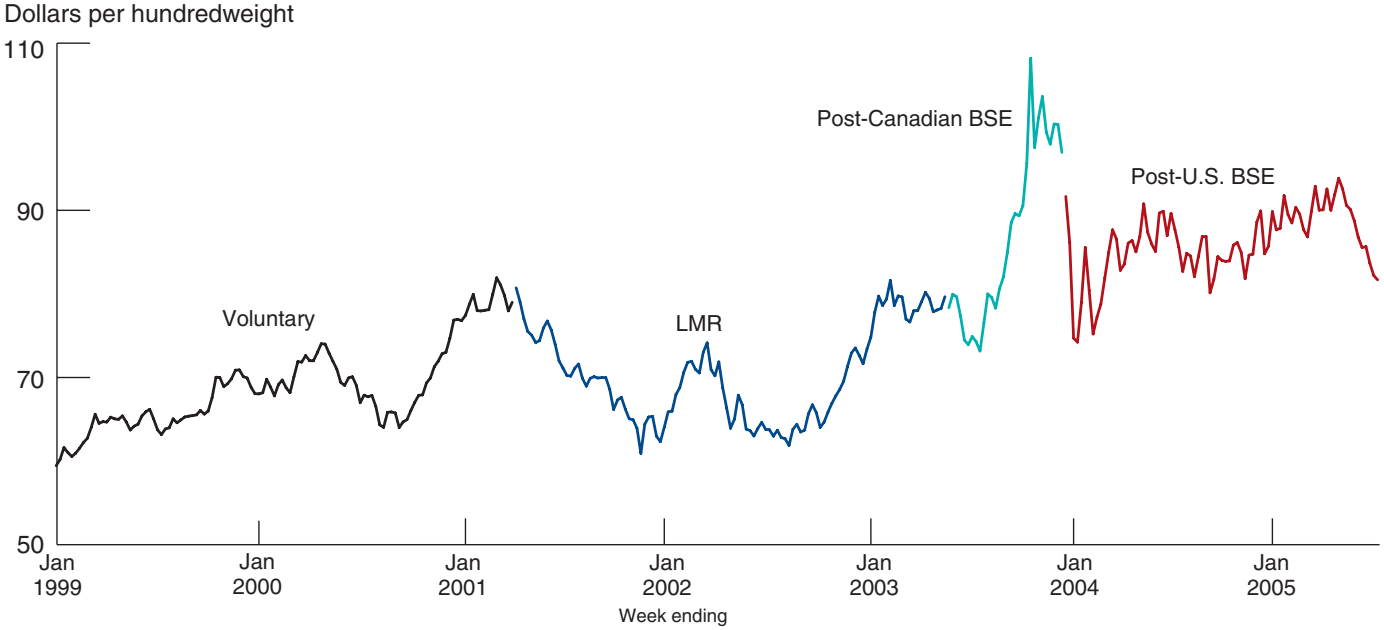
To assess the issue, we analyzed weekly average five-area prices reported by *Market News* for steers, 35-65 percent Choice, priced on a liveweight basis.[22] Our sample period started with the week ending January 2, 1999, through the week ending July 2, 2005. That gives us 340 observations, 118 of them before the start of mandatory price reporting in April 2001. In addition to the switch to mandatory price reporting, two other events significantly affected the cattle market—the discovery of bovine spongiform encephalopathy (BSE) in Canada, confirmed in May 2003, and the discovery of BSE in the United States, confirmed late December 2003.

We evaluated a time-series model of prices. Appendix 2 has more details on the model results. In such models, this week's prices depend on previous values for prices—that is, the model predicts a price series based on

[22] Recall that five-area mean prices cover Colorado, Iowa/Minnesota, Kansas, Nebraska, and Texas/Oklahoma/New Mexico. The volatility concerns we describe for voluntary reporting possibly may have been more prevalent in more narrowly defined local areas or in shorter (daily) time windows.

Figure 8

Steer prices before and after mandatory price reporting, with BSE affecting the market more than the reporting system, five-area, 35-65 percent Choice steer



Source: U.S. Department of Agriculture, Agricultural Marketing Service. *Market News* reports and *Datamart*.

previous values of the price series without using any other information except the dates on which prices were recorded.

When time-series or other statistical models predict price changes, they invariably have errors. The type of model that we estimated identifies two types of prediction errors. One type has persistent effects on prices—knowing this error helps predict next week's and the following week's prices. The other type has no effect on prices in following weeks. Our measure of volatility is the standard deviation of the second type of error.

As just noted, we expected that the switch to mandatory pricing might have decreased volatility. Voluntary reports included a sample of transactions, with a *Market News* average price then based on this sample. Even under the best of circumstances, a sample average will differ randomly from the population average. (If a sample has good statistical properties, the average difference between the sample and populatioin average is zero.) We expected the time-series model to be valid for the population average price. Estimating the model with the measured average price introduces an additional source of error, the sampling error. The sampling error would increase the measured volatility.

The volatility of cattle prices more than doubled after the switch from voluntary to mandatory price reporting, which is not what we expected. We can think of several explanations. One has to do with time-varying quality of cattle which greatly varies. Even among cattle lots that fall into the same measurable *Market News* quality range (for example, 35-65 percent Choice), some lots may contain far more high-quality cattle and may command a higher price than other lots. Over time, the actual quality of the cattle sold within a quality grade may vary, and with it the observed prices. This introduces variation in observed prices independent of underlying trends in the market. With voluntary reporting, AMS may have had less week-to-week change in unobservable qualities so that the voluntary reports were averaging a more consistent quality of animal.

Another cause of time-varying skew might be the quality of the feedlot operator's bargaining acumen. Some operators may get consistently high prices, others consistently low prices. Those weeks where the sharp bargainers sell unusually high volumes of cattle will tend to have high prices and vice versa. Presumably, there is some difference in the quality of bargaining acumen by packer-buyers as well. Filtering out the outliers caused by changes in the quality of bargaining would make a voluntary system more reflective of the market.

Mandatory pricing would improve market information if the outliers are caused by factors unrelated to bargaining or animal quality. In some weeks, packers offer large numbers of relatively high prices because supplies are low. By filtering out the outliers, voluntary reporting would suppress this information; mandatory reports would be better under this scenario.

Another potential source of volatility may be due to measurement differences between the voluntary and mandatory systems. Previous to mandatory reporting, the seller and buyer had to agree to have a transaction reported, There is evidence that the reporters used discretion to reject reports that

were either unusually high or unusually low. While outliers are still noted, because all transactions are now included in *Market News* reports coverage is now much broader. The broader coverage is more representative of the universe of transactions compared with the nonrandom sample from the previous voluntary reports. A few unusually high/low prices will increase/lower the average, possibly making it more volatile.

Does including the outliers improve price reporting quality? It depends on what causes outliers and how outliers are defined. Part of the cause could be differences in the quality of the lots of cattle. The 35-65 percent Choice category includes a wide range of potential grades. Lots with 35 percent Choice cattle would have a lower value than lots with 65 percent Choice cattle (all other things the same). In late 2003, the premium for Choice-grade cattle over Select-grade became particularly large and stayed there. Two lots with the same percentage of Choice cattle would have much different values if one lot was exclusively Yield Grades 1 and 2, while the other had an unusually large number of Yield Grades 4 and 5. If the reporter understood what was causing the price differences and filtered out the unusually high- or low-quality lots, voluntarily reported prices could give a more accurate measure of a "typical" lot of cattle.

Does the increased volatility of post-mandatory reporting imply that the new system better describes what is happening in the market than the voluntary reports? It is almost impossible to say. Mandatory reporting brought more data into the system on which to base average prices than the voluntary reports. To the extent that the increased volatility represents a rise in measurement errors, then mandatory reports may reflect the market less than do voluntary reports. If voluntary reports were somehow suppressing the true volatility of prices, mandatory reports are better. Price expectations are formed (at least in part) on knowledge of past and current prices. If the voluntary price reporting mechanism was incomplete, then participants may have made different decisions than they do with the more complete information under the mandatory reporting system. It may be that decisions are made on the reported ranges rather on than the averages. When an unusually low or high price is reported in the range, then perhaps packers and feeders see that as evidence of the direction the market is going, or believe that the extreme is attainable for them. This behavior could lead to "chasing" the reported low or high, leading to increased volatility.

We also tested to see if the switch to mandatory reports increased or decreased reported prices in a fundamental way. As noted earlier, some producers were convinced that the voluntary reports did not reflect all market prices, particularly they alleged that higher prices were paid for cattle sold under formula marketing arrangements. Our tests found no evidence of this. Again, this producer reaction seems to be a factor in some of the initial producer disappointment with mandatory price reporting.

LMR may have reduced information asymmetry that may have been present because packers generally would have information on many more transactions than the feedlots under the voluntary system. LMR may reduce this information asymmetry through broader coverage of the market, perhaps increasing the bargaining position of sellers. While the result was not increased prices, improved efficiency of price discovery may reflect changes

in underlying supply and demand conditions more rapidly; hence increasing price volatility.

Finally, we also measured the effects of the Canadian and U.S. BSE cases on price volatility. In both of these cases, we expected that the volatility change would reflect fundamental changes in the market and not only measurement issues. After the Canadian BSE outbreak, price volatility increased by almost 400 percent. Somewhat after the U.S. outbreak, volatility moderated but was still higher than immediately after the switch from voluntary price reporting to mandatory reporting.

These possible explanations are not mutually exclusive. Each could have some role in driving the time-varying skew in cattle prices. Current research is not able to identify the source of this increased volatility.

Do *Market News* Prices Affect Futures Markets?

A third way to test the value of the information provided under mandatory price reporting is to see whether market participants use the information and whether mandatory information has a stronger impact than voluntary information. We explored that issue by investigating the links between the average prices reported in *Market News* and the prices set in futures markets for live fed cattle. Prices for futures contracts are determined through the interaction of many buyers and sellers in those markets. We reasoned that, if mandatory reporting provided "improved" market information, then we ought to observe that *Market News* prices would have a stronger impact on futures prices.[23] That is, future prices would change more rapidly in response to *Market News* prices.

To assess this question, we assembled a database on daily futures and *Market News* prices. The dataset consists of two equal-sized samples, one of 834 daily observations on prices covering a pre-LMR period of January 9, 1998, through April 2, 2001, and the second consisting of 834 daily observations covering the LMR period from April 24, 2001, through July 1, 2005.[24] Our futures price for any given day is the daily closing price for live cattle on the Chicago Mercantile Exchange for the nearest monthly contract.[25] The *Market News* price for any given day is the nationwide daily weighted average for steers; it averages the reported average prices across quality grade categories, with category volumes as weights. We used liveweight and dressed-weight prices. Our data come from the LMR report series CT100, which provide prices for several grades and a weighted average across all grades. To calculate the latter price, weight times volume of each category is calculated and summed across all grades to obtain a total quantity-weight. Quantity-weight shares of each category are then used to calculate a weighted average price across grade categories.

Observations were missing in each of the data series. Markets close over the weekend, so data are not collected for Saturday or Sunday. If, on any particular weekday, a *Market News* or futures price was not available, we replaced the missing value with the last reported weekday price. On several occasions, *Market News* prices went unreported for 2 days, and we had a few

[23]This is not to say that improved *Market News* information is useful only for futures markets but simply that future prices are easily observed and analyzed so that, if mandatory reporting did provide better market information, it might be apparent in the futures market.

[24]Because our analysis uses 14 daily lags of data, we have a gap at the start of the LMR period as we build up to the lags needed.

[25]Contracts on the Exchange are bimonthly, with February, April, June, August, October, and December contracts and settlement at the end of the month. Thus, the nearest monthly contract between May 1 (just after the April contract closes) and June 30 would be the June contract, while the August contract would be nearest for any date between July 1 and August 31.

periods of 3 or 4 days of unreported prices when a weekend fell between days that were not reported. In those instances, we followed the same principle and used the last reported weekday price. In our analyses, we took note of this feature of the data by incorporating a separate variable that measures the age of the price quote (0-4 days, in practice). Because of the statistical properties of the data, all of our analyses focus on the daily percentage changes in prices (from the previous day).[26]

Appendix 3 presents the regression model that estimates current futures prices as a function of past futures prices and past *Market News* prices, with separate equations for the voluntary period and the mandatory period. We also tested whether current *Market News* prices were a function of past futures prices and past *Market News* prices for both voluntary and mandatory reporting. We allowed extensive lags in the analysis to test for autocorrelation but found that lags up to 8 days provided the best fit to the data. A Box-Ljung (Pierce) test for autocorrelation was used to determine whether the residuals were randomly distributed. The test could reject only the null hypothesis of random errors for one of the four equations at the 10-percent confidence interval, so we accepted the efficient markets hypothesis that futures prices follow a random walk, even for this narrow time series (see Seiler and Rom, 1997).

We then tested the role of *Market News* prices in predicting futures price changes. Specifically, we examined whether *Market News* prices helped explain the variation of futures prices for the two models, using either *Market News* liveweight prices and dressed-weight prices as the explanatory variable over the whole period (1998 to 2005). In each case, removing *Market News* prices significantly reduces the fit of the equation. Futures prices seem to respond to changes in *Market News* prices for either liveweight or dressed-weight.

Then, because futures prices appear to respond to changes in *Market News* prices, we next tested whether the form of that relationship changed after introduction of mandatory reporting. We formulated a test of the hypothesis that the lagged effects prices during voluntary reporting and during mandatory price reporting were the same. We were able to reject the hypothesis that the price response was the same for the first day's lag in prices for both models, but we could not reject the hypothesis for longer lag periods. The test suggests that the response of futures prices to *Market News* prices changed little after the first day.

Finally, we constructed an alternative test: We created separate models for before and after mandatory price reporting started, then dropped *Market News* price variables from each futures price model and tested whether the exclusion affected the fit of the models. We are able to say that futures prices appeared to respond to *Market News* prices for the voluntary reporting period. However, we found that we could not reject the no-effect hypothesis for the mandatory period; there, dropping *Market News* prices from the equation had no statistically significant effect on the fit of the model explaining futures prices.

Our findings are essentially negative: We find no effect of lagged *Market News* prices, as reported under the mandatory system, on futures prices.

[26]That is, because the data series were all nonstationary, we transformed the data to first differences in logarithms.

One should be careful in interpreting this finding, which does not imply that LMR data are inaccurate or of limited value. Changes in communications technology mean that market information is now transmitted through many channels. Computerized services provide access to several different sources of short-term market news, and market participants can also quickly—almost instantaneously—communicate.

If the same information that is communicated through LMR is also quickly communicated among market participants (including futures market traders), then futures prices will adjust quickly to reflect the new information. However, daily cattle transactions reported through LMR are reported publicly through *Market News* only two times each day—10 a.m. and 2 p.m. Futures market trading commences earlier in the day than the release of the morning *Market News* report. And, as mentioned earlier, the morning report contains some prior day transactions. Therefore, the same information provided through LMR may also circulate widely to futures market traders before it is released through *Market News*. In a statistical model that already includes lagged futures prices, lagged *Market News* prices will then add no additional information beyond that already captured by lagged futures prices. Without more refined with-in day transaction data, we do not observe lagged *Market News* prices having an effect on current futures prices.

Conclusions

Price reporting systems have been modified since implementation to better reflect market conditions, the most recent being mandatory reporting for livestock prices. Livestock Mandatory Reporting did not simply expand existing reporting procedures to more transactions; rather, it introduced major changes in the ways that data from all covered livestock transactions were collected, organized, and disseminated through reports. Implementing LMR, thereby, created important challenges for USDA in system design and for industry participants in system use and application. The challenges in system design led to an important lag between initial implementation of LMR and delivery of *Market News* reports that made full use of accurate LMR information.

After implementation of LMR, several regional and local reports under the voluntary system were no longer provided. However, the mandatory system provided far more information on prices and volumes in formula sales of cattle in national and major regional reports and for different pricing basis and quality categories. This information on formula transactions allowed for rapid, accurate comparisons to similar information for negotiated transactions, comparisons that previously had not been possible.

On average, formula prices slightly exceeded negotiated prices for cattle in common quality categories and priced on the same basis. However, the difference was small and inconsistent; negotiated prices actually exceeded formula prices in nearly 40 percent of the weeks observed. Moreover, in regression analyses of the spread between cattle prices and boxed beef wholesale prices, with controls for time period, pricing basis, quality grade category, and cattle class, the spread was not significantly different for cattle sold under formula than for cattle sold under a negotiated cash transaction.

A few months after LMR implementation, cattle feeders expressed disappointment with the Act via survey responses. Their expectations for LMR may have been too high, thus leading to disappointment fueled by problems encountered in implementation. Disappointment also may have reflected expectations that LMR would show a gap between formula and negotiated prices, a gap that would then be closed through rising formula prices. Shortly after LMR was implemented, however, the strong shift in cattle sales toward formula transactions abated, and sales distinctly shifted back to negotiated cash transactions. The timing suggests that LMR may have been a factor in the shift, although other market drivers during the period also may have influenced the choice. In particular, the sharp rise in cattle prices and increased uncertainty due to BSE scares may have played important roles in the shift in purchase types and certainly complicate any evaluation of LMR.

Initial analyses of the data in *Market News* reports indicate that weekly volatility in reported prices rose substantially after implementation of mandatory reporting and, as a result, average weekly prices became harder to predict. This change may have occurred because of changes in the reporting system: Price data that are now electronically filed were filtered through market reporters under the voluntary system, and prices from a

wider range of sales are now included in reports. The mandatory reporting requirement also may have led to additional cash market reports that had not been provided under voluntary reporting. Those changes may make mandatory reporting better than the voluntary system if the unusual sales provide useful information to participants. Moreover, the change in volatility also may reflect changes in cattle markets and may not be driven primarily by reporting changes.

Lagged *Market News* prices reported through the voluntary system affected futures prices, but the lagged *Market News* prices apparently are no longer important in explaining futures prices in the mandatory period. In contrast, futures prices now have a greater effect on the prices reported under *Market News.*

Further analyses of the weekly price movements would be needed in order to understand the drivers of week-to-week fluctuations as well as the factors driving changes in the spreads between negotiated and formula prices and between livestock prices and wholesale beef prices.

The comprehensive nature of the changes introduced by LMR also created new challenges for the use and application of data in the system. As we prepared this report, we were struck by the paucity of existing analyses of LMR data by extension economists, researchers, and industry specialists. The collection of data for analysis is not easy, and the sheer volume of prices for the multitude of categories makes comparisons difficult.

AMS has recently created a public website, named the *Datamart*, that provides archived *Market News* reports at (http://www.ams.usda.gov/lsmnpubs/). We expect that there will be more comprehensive analyses of the historical patterns with these data, and that such analyses will provide participants and industry observers with new guidelines for interpreting the current data in contemporaneous daily and weekly reports.[27] Markets become more efficient as information about transactions is disseminated and we expect that cattle markets are no exception. AMS plans to enhance that process by making more easily accessible data files available and by encouraging analyses of those files.

[27]For examples, see Diersen (2004) and Grimes and Plain (2005).

One comprehensive survey of cattle feeder views of LMR has been performed since implementation, and that survey yielded a strong and striking set of opinions. Unfortunately, the survey was carried out in spring 2002, just a year after LMR implementation, which was not trouble free. A followup survey would provide useful information on the current views of the system's intended beneficiaries.

AMS has designed reporting forms for the LMR system to provide usable and quickly deliverable information while minimizing the burdens on reporting entities. In a world in which marketing arrangements may change rapidly, AMS faces a challenge in monitoring and responding to changes in marketing methods. The agency has adjusted its cattle-reporting categories already by introducing negotiated grid transactions. AMS strives to ensure that reporting categories are clearly defined, for both data users and providers. Reports will be reviewed periodically to reflect changes in industry marketing arrangements. Such reviews and redesigns will be clearly communicated to stakeholders.

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Appendix Table1

Regression analyses of boxed beef to cattle price differences

	Model 1		Model 2	
Variables	Estimated Coefficient	Standard Error	Estimated Coefficient	Standard Error
Class of cattle				
Dairybred steer/heifer	-4.451	0.073	-4.523	0.073
Heifer	-0.334	0.076	-0.335	0.077
Mixed steer/heifer	-0.714	0.074	-0.707	0.074
Mixed steer/heifer/cow	-6.856	0.145	-6.841	0.146
Steer (base)	0	0	0	0
Transaction type				
Negotiated grid base	0.684	0.116	0.668	0.116
Forward contract	-0.855	0.070	-0.831	0.070
Negotiated cash	-0.318	0.062	-0.347	0.061
Formula Net (base)	0	0	0	0
Quality grades				
0-35% Choice	-1.742	0.079	-1.750	0.079
35-65% Choice	-0.823	0.071	-0.827	0.071
65-80% Choice	-0.431	0.070	-0.438	0.070
Over 80% Choice (base)	0	0	0	0
Other variables				
Choice-Select cutout	-0.062	0.005	-0.063	0.007
Average weight (cwt)	-0.316	0.042	-0.317	0.042
Dressed (Live is base)	34.411	0.193	34.417	0.193
Percent negotiated	-0.022	0.004		
Negotiated head count (0000)			0.016	0.005
Intercept	68.544	0.602		
R^2	0.956		0.956	
N	22,954		22,891	

Note: We used *Market News* reports to analyze weekly movements in relationship between cattle and beef prices. We estimated two models, with the dependent variable as the ratio of the cattle price to the boxed beef price. The boxed beef price is the weekly average choice cutout price. The cattle price is the weekly average price for each transaction category (cattle class, transaction type, quality grade, pricing basis) listed below. The models also included seventeen quarterly dummy variables. Model 1 was the percentage of cattle, (0-100) sold under negotiated cash prices. Model 2 depicts a slightly different formulation—the total number of cattle (in tens of thousands) sold in this type of transaction.

Appendix 2. Time-Series Analysis of the Weekly Five-Area, 35-65 Percent Choice Steer, Pre- and Post-LMR

We analyzed the weekly five-area, 35-65 percent Choice steer price before and after LMR using time-series analysis. In time-series analysis, one uses the past pattern of a set of data to predict its future movements. Our basic modeling approach is the autoregressive, integrated, moving average model (ARIMA). Rather than "classic" ARIMA, we cast our model in a more flexible state-space framework. In particular, the state-space model handles the "I" (integrated) part of the model particularly well. In the classic ARIMA approach, one tests the data to see if it is stable over time. If not, one uses "filters," which are like weighted averages of current and past values that eliminate the instability. State-space modeling does not require stable data and does not require filtering.

In addition to allowing the Choice steer price to explain itself, we also used seasonal variables and trends to help explain the prices. The model has 15 seasonal variables, of which 12 are associated with the months of the year. The other three seasonal variables account for the end of the year because livestock and meat prices always drop in the week between Christmas and New Year. The model includes a seasonal term for the week before Christmas, the week between Christmas and New Year, and the week after New Year.

We also included seven trend variables, each associated with a different year. The actual value starts on January 1 at 1/365 (or 1/366 in leap years). The values grow linearly day by day until they hit 1 on December 31, then stay at 1 for the rest of the sample period. The steer price is reported for the week ending on Saturday, so the seasonal and trend terms are the values on Saturday. Our sample period started with the week ending January 2, 1999, through the week ending July 2, 2005. That gives us 340 observations, 118 before the start of mandatory price reporting.

State-space models have two types of equations—one for the "state" variables and one for the observed variables. The state variables are not directly observed. One has to estimate what the states are doing based on what the observed values are doing. Our "basic" state and observation equations are:

1) $S(t) = \alpha_s * S(t\text{-}1) - \beta_s * S(t\text{-}2) - u(t) - \alpha_u * u(t\text{-}1) - \beta_u * u(t\text{-}2)$

2) $Y(t) = S(t) - X(t) * c - e(t)$

Equation 1 defines how the state variables change over time. The current week's state variable is S(t); last week's is S(t-1), and the value 2 weeks ago is S(t-2). The u(t) are random error terms. Equation 1 has second-order autoregression (this week's state depends on the previous two) and a second order moving-average-error term (the current error and the previous 2 weeks' values affect the current state). The Greek letters, α and β are estimated terms. The α and β determine whether or not the autoregressive or moving-average terms are stable. The stability of the AR (autoregressive) or MA (moving average) parts depends on only their coefficients. When we

estimated our statistical models, we bounded both pairs of α and β so that they were borderline stable. (Technically, we bounded the α and β so that the largest (absolute) value of their roots/modulus was 1.)

Equation 2 is the observation equation; Y(t) is this week's steer price, X(t) the vector of trend and seasonal effects we discussed above, "c" a vector of coefficients and e(t) another random error term. It is technically true that we could skip the entire state-space specification by using a more conventional ARIMA of the form:

2a) $$Y(t) = X(t)*c - \alpha_s *\{Y(t-1) - X(t-1)*c\} - \beta_s *[X(t-2) - X(t-2)*c] + v(t) + \alpha_v *v(t-1) + \beta_v *v(t-2)$$

Equation 2a has the same autoregressive parameters (α_s and β_s) but different error terms and moving-average coefficients.

Equation 1 is generic to all the models we estimated. We modified equation 2 to account for the effects of the shift from voluntary to mandatory reporting:

3) $$Y(t) + f(t)*[S(t) - X(t)*c] - g(t)*e(t)$$

The terms f(t) and g(t) are positive multipliers and compare the behavior of prices before and after the start of mandatory price reporting. After the switch to mandatory price reporting, BSE was discovered in North America, first in Canada, then in the United States. We specified four sets of values for the f and g parameters, one for the voluntary price reporting period, (VOL) one for the mandatory price reporting period (LMR), one for the period after the discovery of BSE in Canada (CAN) and one for after the discovery of BSE in the United States (USA).

One of the motivations for passage of the LMR was some producers' beliefs that packers were manipulating the reported prices, making them lower. The "f" parameter is designed to test for that type of effect. We made the four "f" values average to 1. If "f" increases significantly past the implementation of the LMR, then that could be taken as evidence that voluntary reporting suppressed reported prices. Increases/decreases in "f" after the discoveries of BSE could be taken as evidence that BSE led to higher/lower prices.

The "g" also averages to 1 over its four values. Changes in "g" lead to changes in the effect of the "e" term. If there are measurement errors in the reported prices, they should be reflected in the variance of the "e": the higher the measurement error, the higher the variance of "e," and the higher the value of "g." The "e" term also measures general price volatility—that is, changes in this week's prices that do not affect prices in the following weeks. The "u" errors have persistent effects. This week's "u" changes this week's state, which affects following states and this week's "u" also directly affects the states for the next 2 weeks. We would not expect BSE to affect measurement errors, but it could have affected price volatility.

Our graphs of the Choice steer prices do not show any sharp breaks in the prices around the times of the switch to mandatory pricing or the confirma-

tion of BSE in Canada or the United States. We allowed the "f" and "g" values to phase themselves in over a period of time. We selected 50 weeks, approximately a year, for the phase in of most of the shocks. Because only 31 weeks passed between confirmation of BSE in Canada and the United States, we had the "f" and "g" switch from LMR to CAN values over the 31 weeks between the confirmations of BSE.

We ran a model with a full set of shifts and three alternatives. The most restrictive alternative had no shifts in the "f" and "g" parameters. They were set to 1 for the entire sample. Another alternative fixed the "f" but let the "g" vary, while the third alternative fixed the "g" but let the "f" vary. We estimated the four models using maximum likelihood estimation, using the mathematical optimization software GAMS. Table A2-1 shows some estimation results and tests.

Allowing the "g" parameters to change had a small effect on the likelihood. We accept the hypothesis that "g" is constant over time. LMR and the BSE outbreaks did not have a fundamental change on the reported price level. This does not mean that BSE had no effects on price levels; immediately after the BSE outbreak, the forecast prices were higher than the actual prices. These overforecasts lead to persistently lower (and more accurate) forecasts. However, allowing the "g" parameters to change lead to a significant increase in the likelihood. Selected parameter estimates for the model where only the "g" parameters change can be found in table A2-1. It appears that LMR, and the BSE outbreaks had a significant effect on the volatility of prices. It turns out that the shift from voluntary reporting to mandatory reporting more than doubles "g." The "g" after the Canadian outbreak was the largest of the four parameters. After the confirmation of BSE in the United States, the volatility of prices was approximately three times higher than it was in the pre-BSE voluntary price reporting period.

The first column of table A2-1 shows the r-square, a measure of how well the model fits the data. Usually, as one adds features to a model, it fits better, but in this case, the best fit is for the most restricted model. How did this happen? Increasing volatility makes it harder to forecast prices. Part of the likelihood function is based on (1) how much the forecast misses the actual and (2) the theoretical variance of the forecast. When the theoretical variance increases, as it will when g increases, the penalty for the forecast missing the actual value declines. The mathematical procedure tends to

Appendix Table A2-1

Model results and tests

Models	Percent r-square	Twice the log of the likelihood	Test compared to least-constrained model	Degrees of freedom for test	Probability of a larger test statistic, based on Chi-square
Model with no shifts at all	85.154	2,151.185	195.652	6	0.0%
Model where only the "f" parameters change	84.380	2,320.158	26.680	3	0.0%
Model where only the "g" parameters change	83.491	2,345.476	1.361	3	71.5%
Model with all the parameters changing	83.559	2,346.838			

focus on forecasting those values which are, in theory, easier to predict. This degrades the overall fit for the sample.

The estimated autoregressive parts of the state equation are stable (see Table A2-2); however, the moving average coefficients hit the stability boundary. This helps us explain why state-space techniques can handle this type of problem while ARIMA cannot. The state variables in a state-space model

Appendix Table A2-2
Selected parameter estimates for the model with time-varying "g"

"g" estimates		
VOL	0.290	
MPR	0.590	
CAN	2.274	
USA	0.846	
ARIMA parameters		
	Autoregressive model	Moving average model
ALPHA	0.908	1.065
BETA	-0.026	0.065
Standard error of random parts, in $/CWT		
u(t)	0.591	
e(t)	1.059	

are not directly observed; state-space works by making a running estimate based on trends in the observed variables. In conventional ARMA, the u(t) terms are not actually observed either. The analyst, or the computer program, picks the starting values for u(t). If the MA part of the process meets stability conditions, and if we have the correct values for the ARIMA coefficients, then even though the initial guess is wrong, as we move forward through time, estimates of the u(t) improve and approach the correct values. If the MA parts are not stable, the initial mistakes we made in estimating the u(t) will become worse.

In the state-space format, one also calculates a measure of how accurate the estimate of the unseen components is. We know our initial estimates are inaccurate, and if the MA part is unstable, we know we will not ever have correct estimates. We do not compound our initial errors.

Appendix 3. Future Prices and Mandatory Price Reporting

We assembled a database representing daily futures and reported prices beginning on January 2, 1998, and ending on January 24, 2005. Futures prices were obtained from the website futuresource.com and are reported daily. Reported prices represent the AMS CT100 series and tend to reflect negotiated prices for various categories of slaughter cattle. CT100 prices that were reported before April 2, 2001, were obtained from AMS reports. Prices obtained after the mandatory price reporting were obtained from AMS's online *Datamart.* The reports provide prices for several grades and a weighted average across all grades. Price share weights are set equal to the share by grade of the total pounds of cattle sold. When weighted average prices were not available, we calculated these prices using a weighted average of grade-specific prices.[28]

[28]After an extended period of mandatory price reporting, AMS returned to reporting a weighted-average price across grades.

A four-equation model was used to investigate whether price relationships were different before and after price reporting became mandatory. To estimate the model, the data were broken into two equal-sized components: data representing 834 observations from period 1 (January 9, 1998, until April 2, 2001) and data representing 834 observations from period 2 (April 30, 2001, until July 26, 2004). Both futures and reported prices are regressed on lagged futures prices and lagged reported prices. The lag length was set equal to 8 (days). A days-old variable reflects how many days old the price was. For example, if we used Wednesday's (Tuesday's) price to represent a missing Thursday price, the days-old variable would be 1 (2). This days-old variable was included to account for occasional missing observations and a similar days-due variable accounted for days to maturity (of future contracts). The first two equations use data from the first period, while the second two equations use data from the second period.

We estimate the model with differenced data using seemingly unrelated regression—which, if errors are correlated across equations, improves the efficiency of the estimators. While a series of restrictions were imposed on the model to carry out the hypothesis discussed in the text, only the unrestricted version of the model is reported below.

We had four equations. A futures price equation was specified as a function of lagged futures prices and lagged *Market News* prices. A *Market News* price equation was specified with the same exogenous variables. Each of these equations were represented twice for the voluntary period and the mandatory period. We also tested for whether the errors are completely random using Box-Pierce (or Box Ljung) Q-tests, which were individually applied to each equation error. If we cannot reject the null hypothesis of random residuals, no additional variables (i.e., longer lags) or any other correction is required. It is distributed as χ^2, with the degrees of freedom equal to the number of autocorrelations used in the test. For all four equations, the null hypothesis of random residuals cannot be rejected at the 0.05-confidence level. This indicates that no additional variables are needed. However, for the *Market News* price equation in the second period, random errors can be rejected at the 0.1-confidence level. In general, this result indi-

cates both that lag length is sufficient and serial correlation among residuals is absent.

We also apply Glejser's method for checking for heteroskedasticity by regressing the squared residuals on the same exogenous variables. A second test regressed squared residuals on the both linear and squared values of the exogenous variables. The extremely low R-squares from these regressions clearly indicate that heteroskedasticity is not a problem.

As noted, the model was estimated in differences. (A reason for this is that earlier tests indicated that both reported and future prices had unit roots) There are numerous ways to interpret coefficients. The most common is to ignore the differencing (both right-hand side and left-hand side variables undergo the same transformation). However, it is a simple matter to recast a model estimated in differences back into a level model as shown below. For example,

consider the simple equation:

$$\Delta P_t = \beta_1 \Delta P_{t-1} - \beta_1 \Delta P_{t-2}$$

Writing $\Delta P_t = P_{t-1}$ and and $\Delta P_{t-1} - P_{t-2}$…etc. The above relationship can be recast as a levels model the results of which are reported in table A3-1:

$$P = (1- \beta_1)\, P_{t-1} - (\beta_2 - \beta_1) P_{t-2} - \beta_2 P_{t-3}$$

There are numerous ways to interpret coefficients in the difference models. One way is to recast the difference model back into a levels-model (table A3-2). After recasting the model in a level model, then cumulative parameters were calculated and are reported in the table above. These parameters can provide insight considering effect lagged prices have on evolution of a price series. What stands out from time 1 to time 2 is that futures prices have a stronger effect on reported *Market News* prices. This may reflect that *Market News* prices are more representative of a market that uses all freely available information.

Appendix Table A3-1

Unrestricted autoregressive model for cattle futures prices and *Market News* cattle prices[1,2]

System R Sq=.48

Endogenous variable is Futures Prices

TIME 1

	Variable name	Coefficient	T-stat
Lag			
1	Ft	-0.10	-1.24
2	Ft	-0.02	-0.51
3	Ft	-0.09	-2.35
4	Ft	0.02	0.51
5	Ft	0.00	0.00
6	Ft	-0.01	-0.27
7	Ft	-0.02	-0.61
8	Ft	-0.05	-1.28
in*do[3]	ft*dold	0.04	0.23
in*dd[3]	ft*ddue	0.00	0.83
1	Spot	0.10	3.25
2	Spot	0.05	1.60
3	Spot	-0.03	-0.94
4	Spot	0.01	0.22
5	Spot	-0.03	-0.79
6	Spot	-0.04	-1.34
7	Spot	-0.07	-2.11
8	Spot	0.02	0.84
days old	FDOA	0.02	0.13
days due	FDDA	0.00	2.14
MR[4]	JJ1A	0.00	-0.66
Do inter	spot*dold	-0.21513	-2.27

TIME 2

Variable name	Coeff	T-Stat	
1	Ft	0.135	1.740
2	Ft	0.020	0.526
3	Ft	0.068	1.729
4	Ft	0.036	0.902
5	Ft	-0.044	-1.092
6	Ft	-0.006	-0.153
7	Ft	-0.052	-1.306
8	Ft	0.042	1.072
in*do[3]	ft*dold	0.080	0.318
in*dd[3]	ft*ddue	-0.005	-2.480
1	Spot	0.034	1.086
2	Spot	0.016	0.495
3	Spot	-0.009	-0.269
4	Spot	0.023	0.743
5	Spot	-0.063	-2.006
6	Spot	-0.028	-0.882
7	Spot	-0.049	-1.621
8	Spot	-0.017	-0.592
Days-old	FDOA	-0.063	-0.220
Days-due	FDDA	-0.003	-1.561
MR[4]	JJ1A	0.000	1.004
In*do[3]	spot*dold	0.088	1.396

Endogenous Variable is *Market News* Prices

TIME 1

	Variable name	Coefficient	T-Stat
Lag			
1	Ft	0.380	3.788
2	Ft	0.331	6.823
3	Ft	0.276	5.564
4	Ft	0.197	3.884
5	Ft	0.103	2.006
6	Ft	-0.033	-0.644
7	Ft	0.065	1.283
8	Ft	0.035	0.702
in*do[3]	ft*dold	-0.419	-1.870
in*dd[3]	ft*ddue	-0.003	-1.325
1	Spot	-0.487	-13.164
2	Spot	-0.376	-9.260
3	Spot	-0.243	-5.673
4	Spot	-0.049	-1.149
5	Spot	0.111	2.637
6	Spot	0.039	0.957
7	Spot	-0.001	-0.029
8	Spot	-0.075	-2.143
days old	FDOA	0.207	1.085
days due	FDDA	0.001	0.774
MR[4]	JJ1A	0.000	-0.616
Do inter	spot*dold	0.231	1.955

TIME 2

	Variable name	Coeff	T-Stat
1	Ft	0.65	6.93
2	Ft	0.31	6.60
3	Ft	0.21	4.34
4	Ft	0.14	3.02
5	Ft	0.06	1.26
6	Ft	0.03	0.62
7	Ft	-0.09	-1.91
8	Ft	0.10	2.09
in*do[3]	ft*dold	-0.03	-0.10
in*dd[3]	ft*ddue	-0.01	-3.13
1	Spot	-0.31	-8.14
2	Spot	-0.17	-4.5
3	Spot	-0.07	-1.76
4	Spot	0.03	0.76
5	Spot	0.08	2.05
6	Spot	0.04	1.14
7	Spot	-0.07	-2.03
8	Spot	-0.04	-1.08
Days-old	FDOA	0.35	1.00
Days-due	FDDA	0.00	0.20
MR[4]	JJ1A	0.00	2.39
Ind*do[3]	spot*dold	0.05	0.61

[1] Model estimated in differences. Futures prices are developed from the Chicago Mercantile Exchange closing futures prices for the nearest monthly contract. Mandatory prices are weighted averages considering the volume of cattle sold by transaction type and weight class, using the CT100 series prices from AMS *Market News* reports.

[2] time 1 = (Jan 9th 1998 - April 2, 2001), time=2 (April 30, 2001-July 26, 2004).

[3] in*do interaction terms between days old and days due variable, in*dd interaction term between days due (on future contracts) and price.

[4] MR-Mills ratio –from probit models, based on whether prices were reported. MR is typically used for zero-reported in an observation. We used it here, even though the zero-reported observation was recorded by using an older observation, thus the coefficient on MR does not have the standard MR interpretation. However, in the model for reported prices, time 2 it is significant, justifying its use.

Note: FT = futures prices, Spot= *Market News* prices

Table A3-2

Cumulative impact, difference model recast into levels model

	Time 1	Time 1	Time 2	Time 2
Endogenous price	Futures prices	*Market News* prices	Future prices	*Market News* prices
Exogenous lagged price	*Market News* prices	Futures	*Market News* prices	Futures prices
Lag 1	0.097	0.380	0.034	0.646
Lag 2	0.052	0.331	0.016	0.306
Lag 3	-0.033	0.276	-0.009	0.205
Lag 4	0.008	0.197	0.023	0.144
Lag 5	-0.027	0.103	-0.063	0.061
Lag 6	-0.044	-0.033	-0.028	0.030
Lag 7	-0.066	0.065	-0.049	-0.091
Lag 8	0.024	0.035	-0.017	0.098

Note: *Market News* prices from AMS *Market News*. Futures prices are developed from the Chicago Mercantile Exchange closing futures prices for the nearest monthly contract.