Captive Supply Trends and Impacts since the Advent of Mandatory Price Reporting

Clement E. Ward

and

Jonathan T. Hornung*

Paper presented at the NCR-134 Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management
St. Louis, Missouri, April 19-20, 2004

* Ward is a professor and extension economist (ceward@okstate.edu) and Hornung is a graduate research assistant (hornung@okstate.edu), Department of Agricultural Economics, Oklahoma State University.

Captive Supply Trends and Impacts since the Advent of Mandatory Price Reporting

Practitioner's Abstract

Captive supplies have been a contentious issue in the livestock industry for fifteen years and the subject of both theoretical and empirical research. In 2001, mandatory price reporting was implemented. One objective by its proponents was to increase the amount of information available on captive supplies. This paper examines data now available as a result of mandatory price reporting to determine what additional information is available compared to previously. Second, several models were specified and estimated to determine the impacts captive supplies had on fed cattle prices in the two years following implementation of mandatory price reporting. Models showed mixed results. There was a consistent negative effect on cash market prices from formula priced trades; generally a positive impact from negotiated trades and packer owned trades on cash market prices; and mixed but often a positive impact from forward contract trades on cash market prices.

Keywords

Captive supplies, Fed cattle, Pricing, Pricing methods, Price reporting

Introduction

Captive supplies in fed cattle procurement have been a major concern and divisive issue in the beef industry for fifteen years. Issues related to captive supplies were among the reasons many producers supported Congressional legislation to impose mandatory price reporting on packers. Alleged sweetheart deals offered only to selected large feedlots by large packers were thought to unfairly harm smaller cattle feeders. Limited data and information on how packers procure fed cattle were believed to hinder cattle feeders in price discovery. As a result, there was a push to move from voluntary to mandatory price reporting.

Implementation of the Livestock Mandatory Reporting Act, hereafter referred to as mandatory price reporting (MPR), began April 3, 2001. One effect of the Act was to create new data series on pricing of fed cattle, some of which pertain to captive supplies. This paper presents information on volume trends for pricing fed cattle and what can be learned about captive supplies and their impacts from the new mandatory price reports with two years of data since the Act was implemented. Specifically, this article addresses two questions. First, what can be learned from the new data generated under MPR? This question pertains to the extent and pattern of captive supplies relative to what we knew prior to MPR. Second, what cash market price impacts (if any) can be estimated from captive supplies data now available with MPR?

Captive Supplies Before Mandatory Price Reporting Data

Captive supplies refer to slaughter livestock that are committed to a specific buyer (meatpacker) two weeks or more in advance of slaughter. The three most common types of captive supply methods include marketing/purchasing agreements, forward contracts, and packer feeding.

Prior to MPR legislation, official data on captive supplies came from the Grain Inspection, Packers and Stockyards Administration (GIPSA). GIPSA required packers to report their

captive supplies by captive supply method and month beginning in 1988. Annual average captive supplies ranged from 18 to 24% of fed cattle slaughter for the four largest beefpacking firms between 1988 and 1998 (GIPSA 2003). Marketing agreements and forward contracts accounted for 14-19%; and packer feeding, 3-6% during that period. GIPSA reported higher percentages for the three most recent reporting years based on audits of packer records and clarification of definitions for various captive supply arrangements (GIPSA 2002). Total captive supplies for the four largest packers were 32-43% for 1999-2001. Marketing agreements and forward contracts increased to 24-32%, while packer feeding increased to 8-11% (GIPSA 2003). GIPSA cautions that the audited figures for 1999-2001 are not comparable to previous year figures.

As Agricultural Marketing Service (AMS) reporters collected market price information for their voluntary market reports, they began collecting and reporting data on the non-cash-market shipment of fed cattle in 1994. This series was called "additional movement" and became a proxy for some people for the extent of captive supplies. However, while it included shipments of cattle that constitute captive supplies, it also included shipments of cattle priced by methods that may not constitute captive supplies, such as cattle priced on a grid but not part of a marketing agreement or contract. The annual average percentage of additional movement of fed cattle (as reported by AMS) began slightly below the annual average of captive supply cattle (as reported by GIPSA) for 1994. However, the percentage of additional movement cattle increased sharply. In 2000, the additional movement series averaged 42%, which was a few percentage points above the GIPSA captive supply percentage. Recall, however, that the AMS data also included shipments that do not fit the GIPSA definition for captive supplies.

Pricing Methods from Mandatory Price Reporting Data

MPR made available data on various methods of pricing fed cattle. Some of this data provides information on captive supplies. Information in this section is presented about negotiated pricing, formula pricing, forward contracting, and packer owned cattle for the two years following implementation of MPR, which began April 3 2001.

Negotiated pricing on average accounted for 44.7% of fed cattle marketings over the two-year period (Table 1). On a weekly basis, the percentage of negotiated pricing was as low as 24.5% and as high as 95.2%, which should be noted was for the first week of MPR. Just over two-thirds of negotiated priced fed cattle were sold on a live weight basis (67.4%) with the remaining 32.6% sold on a dressed or carcass weight basis.

Formula pricing accounted for 46.0% on average of fed cattle marketings over the two-year period. This percentage varied widely also, ranging from a weekly low of 4.8%, also the first week of MPR, to a high of 64.8%. Of formula priced trades, 94.4% were on a dressed weight basis and 5.6% on a live weight basis. Nearly all formula pricing represents the method of determining the base price in a grid. MPR data match closely with what cattle feeder respondents from Iowa, Nebraska, Kansas, and Texas indicated in a 2002 survey (Schroeder et al. 2002). In 2001, 45% of weighted average marketings by respondent feedlots were priced with a grid. Of grid priced cattle, 35% of weighted average marketings were formula priced with the reference market being the cash market, either a quoted market price or a plant average price.

Forward contracting was the least used pricing alternative over the two-year period since MPR began. On average, it accounted for 3.2% of fed cattle marketings and ranged on a weekly basis from a low of 0.2% to a high of 9.4%. Of forward contract trades, 45.8% were on a live weight basis and 54.2% were on a dressed weight basis. Survey data also indicated little use of forward contracts by cattle feeders in 2001 (Schroeder et al. 2002).

Packer ownership of livestock is a contentious issue in itself (Bailey; Ward). Prior to MPR, there was no on-going data series on the extent of packer ownership of fed cattle, only the annually reported figures by GIPSA which were compiled and released well after the year in which they occurred. Thus, the series since MPR generates essentially new, more current information. The extent of packer feeding was relatively stable over the two-year period since MPR began and consistent with the reported annual statistics by GIPSA. Reported packer owned deliveries of fed cattle averaged 6.4% of fed cattle marketings for the two-year period. The weekly percentage ranged from a low of 2.6% to a high of 10.2%.

Is there more information available on captive supplies since mandatory price reporting than before? A quick answer is yes, but as will be indicated here, the data do not present a clear picture of captive supplies. MPR provides some additional information but likely less than many advocates of the legislation had expected. Figure 1 shows weekly captive supply estimates from MPR. Note, captive supplies as estimated here include formula priced trades, forward contracts, and packer owned fed cattle. However, it should be noted that these categories do not compare exactly with the definitions used by GIPSA for captive supplies. Formula priced cattle, while likely being primarily marketing agreement cattle, may include trades that occurred within two weeks of slaughter, thus not technically being part of captive supplies. Therefore, summing these three categories (i.e., formula pricing, forward contracts, and packer owned marketings) from MPR data likely overstates captive supplies.

In summary, MPR provided *some* weekly data on captive supplies that were not available previously. Plus, since the data are reported weekly, it is much more timely than waiting a year or two for the monthly or annual reports by GIPSA. *However, it bears repeating that the data on captive supplies using mandatory price reports does not necessarily match the definition GIPSA has used for captive supplies*. Thus, there is more timely information and marginally better information on captive supplies since MPR, but the data have distinct limitations and probably the captive supply information is less than MPR advocates expected.

Previous Conceptual Models and Empirical Estimates

Previous research on captive supplies consists primarily of four conceptual/theoretical articles interspersed with four empirical studies. Articles are discussed here in chronological order of publication.

Elam first estimated the effects deliveries of captive supplies had on monthly average, fed cattle prices in the U.S. and in selected individual states (Texas, Kansas, Colorado, and Nebraska). Captive supply deliveries were inversely related to fed cattle prices over the period October 1988 to May 1991. For each 10,000 cattle delivered under captive supply arrangements, U.S. fed cattle prices declined by $0.03-$0.09/cwt., while for individual states results ranged from not significant to minus $0.37/cwt.

Schroeder et al. (1993) collected transaction data from feedlots in southwestern Kansas during May-November 1990 to examine the relationship between forward contracting (including marketing agreements) and transaction prices for fed cattle. They used two measures of forward contracts. One was contract deliveries as a percentage of the weekly total. The other was each packer's share of contract deliveries for each week. Results indicated a negative relationship between forward contracting and fed cattle prices, ranging from -$0.15 to -$0.31/cwt. over the six-month data period. Impacts also varied for two-month sub-periods and for individual packers. Price impacts were not significant for some packers and time periods.

Some argued that early work estimating price effects from captive supplies lacked a strong theoretical framework identifying the motive(s) for beefpacking firms procuring fed cattle via captive supply methods. Azzam (1996) developed a conceptual framework for arguing the monopsony-inefficiency motive for integration by beefpackers to capture fed cattle supplies. He estimated the model empirically with aggregated, quarterly data for 1978-93. While the estimate of vertical integration from the model exceeded the level believed to exist, the model provides plausible but not conclusive evidence of the monopsony-inefficiency motive.

Azzam (1998) further developed a conceptual model for estimating the price effects from captive supplies, without incorporating a backward integration motive. He found that price effects depend on a complex combination of several variables, among them the respective fraction of cash-market and captive-supply procured livestock supplies. His model suggests that non-competitive conduct is not a necessary condition for negative effects on cash prices from captive supplies. In fact, Azzam argued previous work suggesting that the negative relationship between fed cattle prices and pre-committed supplies was due to non-competitive behavior was not defensible.

The most extensive, detailed data to study price impacts from captive supplies were made available in a Congressionally mandated study on meatpacking concentration. Ward, Koontz, and Schroeder estimated price impacts with alternative approaches. They examined the interdependent nature of delivering cattle from three types of captive supply inventories and purchasing fed cattle in the cash market. And they modeled the impact on transaction prices caused by the size of captive supply inventories from which future deliveries could be made. Transaction data were collected from the 43 largest steer and heifer slaughtering plants, owned by 25 firms, for a one-year period, April 1992-April 1993. They found that increasing deliveries of cattle from two of the three types of captive supply inventories were associated with lower transaction prices for fed cattle. A 1% increase in captive supply deliveries, measured in percentages, was associated with a $0.05/cwt. decline in fed cattle transaction prices for forward contracted cattle and a $0.36/cwt. decline for marketing agreement cattle. Simultaneity was found between cash market transaction prices and percentage deliveries of forward contracted and marketing agreement cattle. Coefficients on individual captive supply inventory variables had mixed signs while the coefficient on the total captive supplies variable was not significant. A 1,000 head increase in the size of captive supply inventory was associated with: a $0.01/cwt. increase in transaction prices for the forward contract inventory; an $0.18/cwt. decline for the packer fed inventory; and a $0.02/cwt. decline for marketing agreement inventory.

Love and Burton also developed a strategic rationale for backward integration by packers into livestock production or feeding. Their model included various forms of captive supplies. Two sources of gains were identified. First, a dominant firm benefits from efficiency gains associated with expanded production. Second, the integrating firm pays a lower price in their model for captive supply purchases. Love and Burton argued their results were consistent with previous research, i.e. the Ward, Koontz, and Schroeder findings. Love and Burton concluded that use of captive supplies by beefpackers can be a potential source of market power. However, they note that market power exertion may not be the prime motive for vertical integration.

Schroeter and Azzam (1999) used similar GIPSA data to the that used in the Ward, Koontz, and Schroeder study to examine the price and captive supplies relationship. The Schroeter and Azzam study had access to less transaction data, i.e., from only four plants in the Texas Panhandle region, but it covered a more recent period, February 1995-May 1996 compared to previous work. They found that packers expecting relatively large deliveries of non-cash-market cattle, paid lower prices in the cash market. However, the magnitude was small. A 10% increase in captive supply deliveries was associated with a $0.02-0.04/cwt. lower price. They stated their findings were generally consistent with previous studies and provided a rationale for this relatively consistent finding, cautioning that the negative relationship is not necessarily causal in nature nor a sign of non-competitive behavior by packers.

Zhang and Sexton employed a spatial model to illustrate how meatpackers can use captive supplies strategically to influence cash market prices. Their model hinges on the importance of space to processors, i.e., relative shipping costs to product value. As the importance of space increases, the more likely meatpacking firms will create a geographic buffer between their plant and competing plants which reduces competition in the cash market.

Data and Models Estimated

The second question addressed in this research relates to the impacts on cash market prices from captive supplies using MPR data. Schroeder et al. (1993) developed a conceptual model leading to an empirical model for estimating the cash market price impacts from forward contracting (including marketing agreements). They estimated the impacts using transaction price data. Their conceptual model can be extended to include all methods of procuring fed cattle. They used primary data for fed cattle transactions, whereas this study uses weekly, publicly reported data. Weekly data imposes limitations on price-influencing data for individual transactions but also aggregates certain data, holding some factors constant within and between weeks. Weekly data began the week ending April 8, 2001 and ended the week ending April 27, 2003.

The basic, derived demand model estimated is shown in equation 1. Several variations of the model were estimated and variables in equation 1 for models reported here are described in Table 2.

(1) $Price_t = f(BoxBf_{t,1}, SlWt_t, QNegot_t, QForm_t, QFwdCon_t, QPkrOwn_t)$

where *t* is the current week. This derived demand specification assumes the weekly average cash market price depends on the previous week's boxed beef cutout value, current week's average slaughter weight, and reported quantities marketed for negotiated, formula priced, forward

contracted, and packer owned trades. Variations of this model included a specification without the quantity of negotiated trades, thus including only the three variables most nearly matching the definition of captive supplies. In another version, quantities were replaced by percentages for each type of captive supply of total slaughter for the week.

While equation 1 and all previous research assumes a linear relationship between price and each type of captive supplies, a quadratic relationship was hypothesized and estimated here. Lastly, a set of regression equations similar to the above were estimated as a partial adjustment model, thus inserting a lagged dependent variable ($Price_{t-1}$) into equation 1. Models were estimated by FGLS with Proc Reg in SAS to correct for first-order autocorrelation (SAS Institute); however, due to convergence problems only OLS estimates were available for the derived demand models. In total, six versions of a derived demand model and six versions of a partial adjustment model were estimated.

Results and Discussion

Regression results for selected models are shown in Table 3. Generally, R^{2}'s were quite high, ranging from 0.866-0.897 for the derived demand models and 0.953-0.960 for the partial adjustment models. Results were very robust for several variables across various specifications.

The lagged dependent variable was positive and significant in all estimated models. The previous week's boxed beef variable was positive and significant in all derived demand models and significant but negative in all the partial adjustment models. While the negative coefficient was unexpected, it may be related to the lagged dependent variable accounting for a large percentage of the variation in price. Steer weight was negative and significant in all models as estimated.

There was less robustness for some of the procurement method variables, yet considerable robustness for others. A summary of signs and significance are shown in Table 4.

- Both linear forms of the quantity of negotiated traded fed cattle were positive and significant and in one of the two quadratic forms the first term was positive and the squared term negative.
- For the 12 models in which the variables quantity or percentage formula traded appeared, 11 coefficients were negative and significant. For the two quadratic models in which quantity marketed appeared, the first term was negative and the second negative. However, that was not the case for the two quadratic models using percentage formula traded.
- Relatively few of the forward contract variables were significant. When they were, there was a positive relationship between quantity or percentage forward contracted and cash market prices. The second term was negative for three of the six the quadratic models.
- About half of the packer owned variables had a positive coefficient, with a negative sign on the quadratic term in the percentage version.

Thus, there was generally a positive, significant effect on cash market prices from increased use of negotiated trades, ranging from $0.09 to $0.16/cwt. Note that these coefficients are associated with a 1,000 head or 1% increase in trades, depending on the model. Similarly, there was a negative relationship between formula trades and cash market prices, ranging from -$0.14 to -

$0.54/cwt. Relatively few models showed a significant relationship between forward contracting and cash market prices. However, in the few that did the relationships were positive, ranging from $0.36 to $0.72/cwt. Positive effects on cash market prices were found for increasing packer owned trades also. This was somewhat surprising but not as much as the coefficient sizes, ranging from $0.32 to $1.90/cwt.

Summary and Conclusions

This research had two objectives. First was to determine if mandatory price reporting increased the amount of information available on captive supplies. The quick answer is yes, but probably not to the extent many proponents of MPR had anticipated.

Second was to estimate the impacts captive supplies have had on cash market prices in the two years since implementing MPR. Models estimated showed both positive and negative effects from various types of pricing methods, both for negotiated trades and various types of captive supplies. Net effects are difficult to determine. Cash market impacts from negotiated trades were generally positive; and from formula trades, generally negative. Negative coefficients for formula trades were similar to previous research for captive supplies. Results from forward contract and packer owned trades were mixed but unexpectedly positive. Positive impacts from increased packer owned trades were also larger than expected.

References

Azzam, A. "Testing the Monopsony-Inefficiency Incentive for Backward Integration." *American Journal of Agricultural Economics*. 78(1996):3 585-90.

Azzam A. "Captive Supplies, Market Conduct, and the Open-Market Price." *American Journal of Agricultural Economics*. 80(1998):1 76-83.

Bailey, D. "A Discussion of Some of the Potential Impacts on the Proposed Ban on Packer Feeding." Virginia Tech University, Research Institute on Livestock Pricing, www.aaec.vt.edu/rilp/ .

Elam, E. "Cash Forward Contracting vs. Hedging of Fed Cattle, and the Impact of Cash Contracting on Cash Prices." *Journal of Agricultural and Resource Economics* 17(1992): 205-17.

(GIPSA) Grain Inspection, Packers and Stockyards Administration. *Captive Supply of Cattle and GIPSA's Reporting of Captive Supply*. U.S. Department of Agriculture, January 2002.

(GIPSA) Grain Inspection, Packers and Stockyards Administration. *Packers and Stockyards Statistical Report: 2001 Reporting Year*. U.S. Department of Agriculture, SR-03-1, October 2003.

Love, H.A. and D.M. Burton. "A Strategic Rationale for Captive Supplies." *Journal of Agricultural and Resource Economics*. 24(1999):1 1-18.

SAS Institute. *SAS™ System under Microsoft Windows*. Release 8.1. SAS Institute Inc., Cary, North Carolina. 2000.

Schroeder, T.C., R. Jones, J. Mintert, and A.P. Barkley. "The Impact of Forward Contracting on Fed Cattle Prices." *Review of Agricultural Economics.* 15(1993):325-37.

Schroeder, T.C., C.E. Ward, J. Lawrence, and D.M. Feuz. *Fed Cattle Marketing Trends and Concerns: Cattle Feeder Survey Results*. Kansas State University Agricultural Experiment Station and Cooperative Extension Service, MF-2561, June 2002.

Schroeter, J.R. and A. Azzam. "Econometric Analysis of Fed Cattle Procurement in the Texas Panhandle. U.S. Department of Agriculture, Grain Inspection, Packers and Stockyards Administration, Unpublished report. November 1999.

Ward, C.E. "An Appraisal of Expected Impacts from the Proposed Ban on Packers Owning Livestock." Virginia Tech University, Research Institute on Livestock Pricing, www.aaec.vt.edu/rilp/ .

Ward, C.E., S.R. Koontz, and T.C. Schroeder. "Impacts from Captive Supplies on Fed Cattle Transaction Prices." *Journal of Agricultural and Resource Economics* 23(1998):2 494-514.

Zhang, M. and R.J. Sexton. "Captive Supplies and the Cash Market Price: A Spatial Markets Approach." *Journal of Agricultural and Resources Economics*. 25(2000):1 88-108.

Table 1. Summary Statistics, April 8, 2001-April 27, 2003

	Mean	Std dev	Min	Max
Weekly 5-State Weighted Average Liveweight Price ($/cwt.)	70.01	5.51	61.01	81.41
Weekly Average Boxed Beef Cutout Value ($/cwt.)	118.32	7.92	106.25	135.72
Weekly Average Fed Steer Weight (Lbs.)	1264	30	1191	1310
Weekly Average Negotiated Trades (Head)	178,529	39,811	87,069	303,729
Weekly Average Formula Priced Trades (Head)	197,713	67,672	12,249	313,981
Weekly Average Forward Contract Trades (Head)	13,908	6,925	516	6,671
Weekly Average Packer Owned Trades (Head)	27,388	6,272	12,955	42,630
Weekly Average Negotiated Trades (Percent)	44.70	11.67	24.51	95.16
Weekly Average Formula Priced Trades (Percent)	46.92	10.05	4.83	64.80
Weekly Average Forward Contract Trades (Percent)	3.23	1.54	0.17	9.37
Weekly Average Packer Owned Trades (Percent)	6.40	1.46	2.62	10.23

Table 2. Variable Descriptions for Quadratic Derived Demand and Partial Adjustment Models

Variable	Description
$Price_t$	Five-state weighted average fed cattle price in week t ($/cwt)
$Price_{t-1}$	Lagged five-state weighted average price ($/cwt)
$BoxBf_{t-1}$	Average boxed beef cutout value, lagged one week, for Choice YG1-3 550-700 lb. carcasses ($/cwt)
$SlWt_1$	Five-state weighted average fed cattle weight in week t (lbs.)
$QNegot_t$	Quantity of reported negotiated trades in week t (head)
$QNegot2_t$	Square of the quantity of negotiated trades (head)
$QForm_t$	Quantity of reported formula priced trades in week t (head)
$QForm2_t$	Square of the quantity of formula priced trades (head)
$QFwdCon_t$	Quantity of reported forward contract trades in week t (head)
$QFwdCon2_t$	Square of the quantity of forward contract trades (head)
$QPkrOwn_t$	Quantity of reported packer owned trades in week t (head)
$QPkrOwn_t$	Square of the quantity of packer owned trades (head)

Table 3. Regression Estimates for Quadratic Derived Demand and Partial Adjustment Models

Variable	Partial Adjustment	Derived Demand
Intercept	46.798*** (3.88)	61.990*** (3.18)
$Price_{t-1}$	0.834** (11.40)	NA
$BoxBf_{t-1}$	-0.086* (1.80)	0.339*** (7.14)
$SlWt_t$	-0.020*** (2.76)	-0.030** (2.63)
$QNegot_t$	0.000038 (1.34)	0.000101** (2.32)
$QNegot2_t$	-7.68E-11 (0.98)	-2.37E-10* (1.95)
$QForm_t$	-0.000064*** (3.88)	-0.000070*** (2.63)
$QForm2_t$	9.84E-11** (2.54)	4.36E-11 (0.70)
$QFwdCon_t$	0.000054 (0.66)	0.000324** (2.56)
$QFwdCon2_t$	-1.71E-9 (0.80)	-8.91E-9*** (2.70)
$QPkrOwn_t$	0.000240 (1.53)	0.000352 (1.44)
$QPkrOwn_t$	-3.08E-9 (1.09)	-4.08E-9 (0.92)
n	79	81
R^2	0.956	0.897

Numbers in parentheses are absolute values of calculated t statistics; *=0.10, **=0.05, and ***=0.01 significance level.

Table 4. Summary of Pricing Method Variables

Variables	Models in which it appears	Signs and significance
Negotiated Trades		
$QNegot_t$	4	3+
$QNegot2_t$	2	1-
Formula Priced Trades		
$QForm_t$	8	8-
$QForm2_t$	4	2+
$\%Form_t$	4	3-
$\%Form2_t$	2	0
Forward Contracted Trades		
$QFwdCon_t$	8	2+
$QFwdCon2_t$	4	2-
$\%FwdCon_t$	4	1+
$\%FwdCon2_t$	2	1-
Packer-Owned Trades		
$QPkrOwn_t$	8	5+
$QPkrOwn_t$	4	0
$\%PkrOwn_t$	4	4+
$\%PkrOwn_t$	2	1-

Figure 1. Weekly Estimate of the Percentage of Captive Supplies vs. Negotiated Sales since MPR, April 2001 to April 2003