Econometric Analysis of Fed Cattle Procurement in the Texas Panhandle*

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I. EXECUTIVE SUMMARY

I.1. Introduction

Concentration, structural change, and market performance in the beef packing industry continue to raise questions and concerns from cattle producers across the nation. In addition, many of the slaughtering firms are relying, to an increasing degree, on "non-cash purchases" as a means of procuring cattle. (Non-cash purchases are often referred to as "captive supplies," and include forward contracts, marketing agreement/formula purchases, and packer fed cattle.) A key question is whether packers' use of non-cash procurement methods has the effect of depressing cash ("spot market") prices paid for cattle. Because the results of prior research have been equivocal, the Grain Inspection, Packers and Stockyards Administration (GIPSA) has commissioned this study to measure the effects of non-cash purchases on prices paid for fed cattle during the period and in the region of investigation. GIPSA collected detailed data on the cattle procurement activities of four large beef packing plants in the Texas panhandle region (the Excel plants at Friona and Plainview, the IBP plant at Amarillo, and the Monfort plant at Cactus) over the period from early February 1995 through mid-May 1996. These data were provided to Professors John R. Schroeter (Iowa State University) and Azzeddine M. Azzam (University of Nebraska - Lincoln) the cooperating investigators and authors of this report. The research was carried out in fulfillment of Cooperative Agreement No. 98-PPD-01, "Econometric Analysis of Fed Cattle Procurement in the Texas Panhandle," USDA, GIPSA.

I.2 Scope of the Inquiry

Concerns about the relationship between packers' use of non-cash procurement methods and the spot market price of fed cattle have raised at least two distinct questions. One question, arising from what we might call a "long-run" perspective on the matter, is: "How is the spot market price affected by a change in the overall proportion of annual fed cattle slaughter that is attributable to non-cash procurement methods?" A clear understanding of the nature of this long-run relationship would be essential for predicting the changes in market conditions that would occur if currently practiced non-cash procurement methods were to be prohibited or sharply restricted by law. Another question, viewing the matter from a short-run perspective, is: "How is spot market price affected by packers' and feeders' decisions about the volumes of non-cash cattle to deliver to packing plants in a particular week?" A clear understanding of the nature of this short-run relationship is needed to determine whether the capability exists for one party to use short-run supply-sourcing strategies as a means of "manipulating" spot market prices to the detriment of another party. The data collected in the GIPSA investigation are only suited to an analysis of the short-run, not the long-run, question. Consequently, the main focus of this report will be the short-run (week-to-week) relationship between the delivery volumes of cattle procured by

non-cash methods and the spot market price of fed cattle. As a prelude to that main inquiry, however, we also use the GIPSA data to address two related preliminary issues: Does the quality of cattle vary across procurement methods? Do the quality-adjusted prices paid for cattle vary across procurement methods?

I.3. Non-cash Procurement and the Cash Market Price: Research Procedure

In our investigation of the short-run relationship between the use of non-cash supply sources and the spot price of fed cattle, we sought to answer four questions:

1. Who is responsible for deciding how many cattle procured by non-cash means will be delivered to a packing plant within any given week? How far in advance of delivery is that determination made?

2. What is the empirical relationship, in the short-run, between the use of non-cash supply sources and spot market prices?

3. What economic mechanisms could be behind the empirical relationship?

4. Does the nature of the base price in the formula used to price marketing agreement cattle influence a packer's spot market pricing conduct?

Addressing the first question sets the "ground rules" and insures that the underlying assumptions of the econometric analysis square, as much as possible, with real practice. It is crucial to the analysis that one does not assume, *a priori,* that the decision to deliver non-cash cattle rests exclusively with one transacting party or the other.

Addressing the second question establishes whether the empirical regularity, found in previous studies, of a negative relationship between the use of non-cash procurement methods and spot prices, is also present in the 95/96 Texas panhandle data. Empirical regularities are useful pieces of information when stable and robust over different regions, time periods, and statistical methods. But they do not, by themselves, constitute evidence of a causal relationship *from* the use of non-cash methods of procurement *to* spot market price determination. They do, however, serve as a guide to questions needing further investigation.

The third question inquires about possible explanations for the often-found negative relationship between non-cash procurement and spot cattle prices. It is our opinion that this is one area to which previous research on the impact of non-cash procurement methods has given insufficient attention. Normally, the inquiry ends with the demonstration of a statistical relationship. But with no notion of an economic mechanism responsible for the statistical relationship, there is no way of knowing what

should be made of it. In this report, we propose a specific economic mechanism that could account for the negative relationship.

The last question addresses the possibility of strategic behavior by packers in the manipulation of the base price of marketing agreement pricing formulas. The hypothesis here is that the relationship between marketing agreement cattle deliveries and spot market prices may differ depending upon the type of base price used in the pricing formula. In particular, when the formula base is derived from the plant's average hot cost, rather than a USDA reported price, packers may be able to conduct their spot market activities so as to manipulate the formula base to their advantage. The data are checked for telltale signs of this sort of manipulative conduct.

I.4. Findings

We began the empirical analysis with a preliminary investigation of differences in cattle quality and quality-adjusted price across procurement methods. Insofar as cattle quality is concerned, some generalizations are revealed by a casual comparison of means and standard deviations of quality indicators, by procurement method. For example, marketing agreement purchases appear to contain a higher proportion of all-steer lots (as opposed to all-heifer or mixed sex lots) and have a higher lot average yield than do spot market purchases. In a case such as this, for which commodity "quality" is multidimensional, it is possible to develop a one-dimensional, dollar-value index of quality using a product characteristic approach. In our application of this approach, we used data on spot market prices paid for lots of fed cattle to determine the spot market's implicit valuations of a variety of lot attributes. Using these estimated lot attribute valuations, it is possible, for each fed cattle lot in the data set, to estimate a "price" at which the lot would have sold had it been transacted on the spot market on a given day. These hypothetical "prices" can be used as indexes of lot "quality" that are comparable across procurement methods. The results of this exercise did not produce evidence of systematic differences in cattle quality across procurement methods. It should be noted, however, that the analysis was hampered by the fact that the data set did not contain information on all potentially important lot quality characteristics. For example, little information was available on the degree of uniformity of cattle within each lot.

To investigate the possibility of differences in quality-adjusted prices, we used a regression analysis to explain the delivered prices paid for spot market, forward contract, and marketing agreement lots of fed cattle in terms of lot quality indicators, other factors which may influence price (like the identity of the purchasing plant and the week of purchase), and a set of variables which, for each plant separately, identified the procurement method. The results of this analysis indicated that all four plants appear to pay quality-adjusted delivered price premia for marketing agreement cattle, relative to spot market cattle, that ranged from a low of $0.52/cwt. (on a carcass-weight basis) to a high of $2.26/cwt.

also appear to pay quality-adjusted price premia for forward contract cattle, relative to spot market cattle. Estimates of these premia range from about $2.00/cwt. to about $2.50/cwt. We can only speculate about the sources of these apparent premia. In the case of marketing agreement cattle, they could be reflections of the transactions cost savings packers experience by employing marketing agreements or they could merely be statistical artifacts due to omission of data on some potentially relevant lot quality attributes. In the case of forward contract cattle, there is some tentative evidence to suggest that these price "premia" are attributable to futures market performance that, over the period of investigation, happened to favor basis forward contract sellers over buyers.

Again, this study's main line of inquiry concerns the short-run relationship between the use of non-cash procurement methods and the spot market price for fed cattle. We review our findings with regard to each of the four questions defining our research procedure.

Question 1.

As part of the investigation, GIPSA personnel interviewed feedyard owners and managers about various aspects of fed cattle markets including the terms of their marketing agreements with packers. From our review of the reports of these interviews, the following conclusions, pertinent to question 1, were reached.

A. For the most part, the number of cattle to be delivered by a feeder, to a plant, under a given marketing agreement, within a given week, is determined by the feeder. In some cases, it appears that packers may occasionally amend the delivery numbers submitted by feeders.

B. The number of marketing agreement cattle to be delivered by a feeder within any one week is normally determined two weeks in advance of delivery.

C. Once the volume of marketing agreement deliveries for a given week is set, the packer has discretion over the specific day or days of the week upon which delivery will be made.

With regard to forward contract cattle, standard basis forward contract (which we assume to be typical of basis forward contracts used by other packers) stipulates that "The cattle shall be delivered *on a day designated by Buyer* during the delivery month, or by mutual agreement at an earlier or later date." (emphasis added) Anecdotal evidence suggests, however, that delivery timing is usually a mutual decision between the buyer and the feedlot, with an effort made to deliver cattle when their optimal potential is reached. We assume that the timing of forward contract cattle delivery is determined primarily by the packer. Once the decision to deliver is made, there can be a time lag attributable to delays in arranging for transportation. For the

majority of forward contract lots, the data record the date on which the lot was scheduled for delivery as well as the date on which the lot was killed. Examination of these data suggests that the decision to deliver forward contract cattle is normally made either one or two weeks in advance of delivery.

During the period of investigation, packer fed cattle were not used at all by plant, constituted only a very small share of slaughter for the but did represent a significant percentage of all cattle killed by the Obviously, the packer has complete discretion over when to utilize packer-owned supplies of cattle.

Question 2.

In addressing question 2, we make a point of distinguishing between two different "levels of analysis" at which the short-run empirical relationship between the use of non-cash procurement methods and spot prices can be explored. At the "plant level," we investigate whether packing plants that anticipate relatively large volumes of non-cash cattle deliveries in the near-term future tend to pay spot market cattle prices that are low *relative to regional average prices*. At the "regional level," we examine the relationship between the weekly slaughter, by the four Texas plants combined, of cattle procured by non-cash means and the week's average spot market price of fed cattle in the Texas panhandle region.

When a packing plant purchases cattle on the spot market, it is purchasing those cattle, not for immediate slaughter, but to fulfill slaughter needs for some future period. It stands to reason that a plant's spot market pricing conduct would be influenced, at least to some extent, by the proportion of the future period's desired slaughter that is already met with pre-scheduled deliveries of cattle from non-cash sources (assuming, as seems justified, that non-cash cattle deliveries for the near-term future are known, at least roughly, by the packer). So it makes sense to search the data for a connection between a packer's near-term future slaughter of non-cash cattle and the prices the packer is paying for spot market cattle "today."

One problem, of course, is that it is not obvious how the relevant "near-term future" is appropriately defined. In our empirical work, we examine the relationship between the spot prices a packer pays "today" and its relative degree of reliance on non-cash supply sources in the future using a variety of plausible "planning horizons" as bases for the definition of future non-cash supply usage. We find that packers who expect relatively "large" volumes of non-cash cattle deliveries in the near-term future *do* tend, other things equal, to pay "low" spot market prices relative to regional averages. As for the magnitude of the effect, regression results suggest the following generalization: If a typical plant's non-cash cattle supply proportion of near-term future slaughter were to increase by ten percentage points relative to its rivals' degrees of reliance on non-cash supply sources, then we would expect the spot market prices paid

by that plant, for cattle of given quality, to fall somewhere between 0.02 $/cwt. and 0.04 $/cwt. (on a live-weight basis) relative to regional average prices.

In our investigation of the relationship between non-cash procurement methods and price at the regional level, we regressed various measures of weekly average fed cattle prices in the Texas panhandle region on measures of the four-plant combined weekly use of cattle procured by non-cash means and other control variables. Using weekly time series data and various combinations of variable definitions and statistical techniques, a robust empirical relationship was found in every case: The slaughter of cattle procured by non-cash means and contemporaneous spot market prices are negatively related at the regional level. The results, moreover, when taken at face value, suggest that the impact of non-cash procurement methods on price is reasonably substantial. Suppose for example, that the weekly volume of non-cash cattle deliveries to the four Texas plants were to increase from its 66-sample-week average level (about 26,400 head) by one sample standard deviation (about 7730 head). The estimation results, taken at face value, imply that the other-factors-held-fixed impact of this change would be a decrease in the spot price by $0.69/cwt. (on a live-weight basis).

The regression results, at the plant level and at the regional level, uncover a stable and robust empirical regularity between the use of non-cash procurement methods and spot market prices that is generally consistent with the findings of previous studies. However, the question of what to make of the findings still remains. Is the relationship indicative of noncompetitive or "abusive" pricing conduct on the part of packers? Do increases in aggregate non-cash cattle deliveries *cause* the spot market price to fall? Or, for that matter, does the causality run in the other direction: Do low spot market prices create an incentive to deliver large volumes of cattle from non-cash supply sources? Until the nature of the economic mechanism responsible for the empirical regularity is established, its policy relevance will remain questionable. This leads to question 3.

Question 3.

To understand the economic mechanism responsible for the short-run empirical relationship between the use of cattle procured by non-cash methods and spot market prices at the plant level, one must recognize that any given regional market, at any given point in time, is characterized not by a single price, but by a distribution of prices for fed cattle. Prices paid for individual lots of cattle vary, in part, because of lot-to-lot variation in cattle quality. But they also vary due to random variation in the strength of competitive forces throughout the market area. On a given day, a feedyard in one part of the region may be visited by only one buyer and, consequently, receive relatively "low" bids. In other parts of the region, competition among bidders from two or three firms may be the norm and transaction prices may be higher.

When a packer enters the spot market knowing that a relatively large proportion of its typical slaughter volume is committed, for the near-term future, in the form of already-scheduled deliveries of cattle procured by non-cash means, it will usually want to purchase correspondingly fewer spot market cattle. This can normally be accomplished with relatively conservative bidding. As a result, it will succeed in procuring the desired number of spot market cattle at relatively low prices where only one or, perhaps, no other bidders contend for cattle, but will generally be outbid (or will decline to bid in the first place) where it finds two rival bidders already vying to make purchases. When, on the other hand, a packer enters the market needing to secure a relatively large share of near-term future slaughter volume with cash purchases, bidding behavior must be more aggressive, and the resulting transactions prices correspondingly higher. So it is not surprising, as the empirical results of section VII.1 indicate, that packers with a relatively high non-cash supply proportion of near-term future slaughter will pay spot prices that are slightly below the regional average price, other things equal.

For a *given* distribution of transaction prices, it is of little or no consequence to feeders that packers who currently have a relatively high degree of reliance on non-cash supply sources tend, other things equal, to be the ones paying relatively low prices within the distribution. What matters to feeders is whether the use of non-cash procurement methods can *cause* the regional average price to fall, shifting the entire distribution downward. To be sure, the regional-level analysis did uncover evidence of a negative correlation between the weekly volume of four-plant-combined slaughter of non-cash cattle and the week's average spot market price for the region. The crucial question is: What economic mechanism is responsible for this empirical relationship? One candidate explanation has to do with the impact that current prices and the expectation of future prices have on the incentives of feeders and packers to schedule delivery of cattle procured by non-cash methods.

Marketing agreements normally give feeders the right to determine the number of cattle delivered in a given week, but require that they notify packers of this number two weeks in advance of actual delivery. Thus, in the current week, feeders determine the number of marketing agreement cattle they will deliver to packers two weeks hence. Under conventional pricing formulas, marketing agreement cattle delivered in two weeks will bring a price based on the spot market price paid for (non-formula) cattle next week. So the expectation of a "high" spot price next week, other things equal, will incline feeders toward delivery of a "large" volume of marketing agreement cattle in the week after next. At the same time, however, if feeders currently expect price in two weeks to be high relative to next week's price, they have an incentive to postpone delivery of some of those cattle until three weeks hence, when formula prices will be based on spot prices for the week after next. Consequently, we would expect that the number of marketing agreement cattle delivered two weeks from now will be positively correlated with this week's expectation of next week's spot market price, and negatively correlated with the forecast, formed this week, of spot market price in the week after next.

Now consider the incentives packers face when deciding on the scheduling of forward contract cattle deliveries. Because the typical lag between purchase and slaughter of spot market cattle is about one week, from the packer's point of view, forward contract cattle deliveries next week substitute for spot market purchases this week. Assume, for the moment, that the typical interval between scheduling and delivery of forward contract cattle is about one week. Then a "high" spot market price this week will prompt packers to economize on spot market purchases, to some extent, by scheduling a large volume of the fixed-price contract cattle deliveries next week. On the other hand, if packers, this week, forecast a "high" spot price for next week, they will hoard their limited inventory of forward contract cattle, reserving them for delivery in the week after next, when they can substitute for spot market cattle that would otherwise have to be purchased at next week's anticipated "high" price. Thus, we would expect the number of forward contract cattle delivered next week to be positively correlated with the current spot price and negatively correlated with the forecast, formed this week, of next week's spot price. Were we to assume, on the other hand, that the typical lag between scheduling and delivery of forward contract cattle is two weeks instead of one week, a similar result would obtain: Just as with marketing agreement cattle, delivery numbers for two weeks from now should be positively correlated with this week's expectation of next week's spot price and negatively correlated with this week's expectation of spot price the week after next. Econometric results provide some support for this theory. Evidence of the predicted correlations were found in the data; especially in the case of marketing agreement cattle, the most important non-cash supply source for the four Texas plants during the period of investigation.

To summarize, this intuitive model of the scheduling of delivery of cattle procured by non-cash methods suggests that when the capability exists for packers and feeders to intertemporally shift non-cash cattle deliveries in response to economic incentives dictated by changing market conditions, deliveries of marketing agreement and forward contract cattle will tend to be "high," other things equal, when the *ex ante* forecast of the spot market price is "low." But because the experienced market participants who make the scheduling decisions are undoubtedly quite good forecasters of price (at least over a relatively short forecast horizon such as one or two weeks), their *ex ante* forecasts are likely to be quite highly correlated with the *ex post* realizations of price. So the tendency for weekly non-cash cattle deliveries to be negatively correlated with the unobserved *ex ante* two- (or one-) week-ahead forecasts of price could manifest itself in a negative correlation between weekly non-cash cattle deliveries and the observed *ex post* realizations of price. This, of course, is exactly the kind of empirical regularity found in section VII.2 in our investigation of the short-run relationship between the use of non-cash cattle and spot price at the regional level.

This line of reasoning counsels caution in the interpretation of empirical findings like those of section VII.2. The tendency for spot market cattle prices to be "low," other things equal, in weeks in which the slaughter of cattle procured by non-cash methods is "high," does not necessarily mean that there is an underlying mechanism whereby large

deliveries of non-cash cattle in a particular week cause that week's spot market price to fall. Even if the week-to-week fluctuations in a region's spot market price of fed cattle were generated completely independently of the region's use of non-cash procurement methods, the incentives that influence the delivery scheduling decisions of feeders and packers would still give rise to a negative correlation between the observed spot price and the volume of non-cash cattle slaughter in weekly time series data.

Question 4.

Although feeders determine the week in which marketing agreement cattle will be delivered, packers typically have two weeks advance notice of the volume of scheduled deliveries. When a packer anticipates an unusually large volume of marketing agreement deliveries in a given week, there would be an obvious incentive to try to reduce the pricing formula's base price so as to reduce the price that will have to be paid for the formula-priced cattle. When the base price is derived from a USDA reported price, however, there would appear to be little, if any, capability on the part of the packer to manipulate the formula base. When the base price is derived from a one- or two-plant average hot cost, on the other hand, the possibility exists that packers might manipulate the base through strategic conduct in their spot market (non-formula) purchases the previous week. This suggests the hypothesis that the relationship between marketing agreement cattle deliveries and spot market prices may differ depending upon the type of base price used in the pricing formula. In particular, when the pricing formula is based on the plant's average hot cost, there might be a tendency for the plant to pay relatively low spot prices, for cattle of given quality, in a week preceding a week in which a relatively large volume of marketing agreement cattle are delivered. When the pricing formula is based on a USDA reported price, any such tendency may be weaker or non-existent.

The econometric results do not lend support to the hypothesis that packers try to manipulate formula base prices through their pricing strategies in spot market purchases. When we compare marketing agreement deliveries that are base-priced on the basis of plant average hot cost, with marketing agreement deliveries that are base-priced on the basis of a USDA reported price, we find no systematic difference in the relationship between the volume of deliveries one week and the relative spot prices paid the previous week.

I.5. Recommendations

In light of our results, we recommend that the agency should not rely on the statistical finding of a negative correlation between the use of non-cash procurement methods and spot market prices as evidence of intent by packers to depress cattle prices through the use of non-cash procurement, or as evidence of the unintentional

consequence of lower prices as a result of the use of non-cash methods. The agency should be cognizant, however, that certain pricing mechanisms may be more conducive to noncompetitive conduct than others. For example, it stands to reason that when the formula base price is derived from an "in-house" average hot cost rather than a USDA reported price, there is a potential for manipulation of the formula base through spot market pricing conduct. We make this cautionary note in spite of the fact that we found no clear evidence of such abuse in the Texas panhandle data. Also, should the trend toward increased use of non-cash procurement methods continue, thus further thinning the spot market, spot prices will become increasingly less reflective of the forces of supply and demand. Under those circumstances, the cash market may no longer be the appropriate point in the beef marketing channel at which the formula base price should be derived.

II. STATEMENT OF THE QUESTION

Concentration, structural change, and market performance in the beef packing industry continue to raise questions and concerns from cattle producers across the nation. Concentration ratios for the top four firms slaughtering fed cattle rose from 50 percent in 1985 to a high of 82 percent in 1994, but decreased to 80 percent in 1996.

In addition, the procurement and pricing methods used by many of the slaughtering firms are very complex and sophisticated. As the industry continues its rapid move toward value-based methods of pricing, the complexity of the procurement and pricing practices will increase. The role of non-cash purchases in the price determination process is subject to considerable debate in the industry and in the agricultural economics profession. (Non-cash purchases are often referred to as "captive supplies," and include forward contracts, marketing agreement/formula purchases, and packer fed cattle). The Grain Inspection, Packers and Stockyards Administration (GIPSA) has published, for public comment, proposed rules to restrict certain cattle procurement practices. **The question addressed is whether packer's use of non-cash procurement methods has the effect of depressing cash prices paid for livestock in the spot market.**

One of GIPSA's major responsibilities under the Packers and Stockyards Act is to ensure open, competitive marketing conditions for livestock and meat. Concerns surrounding enforcement in this area were the major topic of discussion and review by the Advisory Committee on Agricultural Concentration established by Secretary Glickman in 1996. The advisory committee specifically recommended increased monitoring and enforcement of the antitrust and regulatory policy.