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FED CATTLE GEOGRAPHIC MARKET DELINEATION: SLAUGHTER PLANT AND FIRM SUPPLY RESPONSE ANALYSIS

Marvin L. Hayenga, Bingrong Jiang and Ronald D. Hook[1]

The beef packing plant and firm spot market purchase volume responsiveness to relative prices paid by potential competitors was estimated to serve as one element in determining the relevant geographic market for fed cattle. Plant transaction data for one year was used, and an average of two significant competitors was found for each plant and firm. Volume sensitivities to price changes were quite large. Data limitations did not allow examining longer lagged purchase volume responses to relative price differences.

Introduction

The purpose of this study is to analyze the usefulness of plant and firm quantity - price cross elasticities in determining the relevant geographic procurement markets for fed cattle in the U. S. Relevant market determination is essential for proper analysis of the structure of the industr and its performance. Market boundaries identify separate economic markets within which partial equilibrium analyses are valid. It is within the context of an economic market that, if the exercise of market power is possible, a firm may impose significant and nontransitory changes in price through noncompetitive conduct. The relevant geographic market for industrial organization and antitrust analysis is often based on the trade areas of firms currently dealing in closely related products. In addition, other firms may be included in the relevant market if their probable supply response to small, but significant and nontransitory price changes would likely cause them to become a market participant. This language serves as the basis for market definition in the merger guidelines by the Department of Justice and the Federal Trade Commission, though court decision may not follow that definition.

One method of determining relevant geographic markets is by mapping the trade areas of al firms currently producing or selling relevant goods in the same area. The location of entities in active competition with a firm are plotted on a geographical map. The extent of the area covered is then said to be the trade area or relevant market. This method is frequently used because of the availability of data and the ease with which the resulting mapping can be understood by observers

Others such as Papandreou have proposed demand cross elasticities for product market definition. Essentially, the cross elasticity of demand at the firm level (<u>not</u> the more typical market level of aggregation) measures the responsiveness of the quantity purchased of a firm's product by customers in response to the change in price by a potentially competing firm. However, this has been difficult to do at the firm level because of data inadequacy.

The strength of the interactions between plants and firms--namely, the changing flows of

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cattle in response to changes in relative prices paid--are the primary focus of this analysis. After adjusting for differences in cattle characteristics, the effects of prices paid by processing plants (firms) on the flows of cattle to each plant (firm) is estimated using econometric methods. This study should provide information useful in delineating the relevant procurement geographic market for general studies of beef industry structure and performance, and specific merger and acquisition or related antitrust cases.

Literature Review

The determination of the relevant market is vitally important in all antitrust analysis. Unfortunately, it is very difficult to define geographic markets with any measure of precision. Industrial organization textbooks and antitrust casebooks have devoted countless chapters to the relevant market question, but often make little distinction between the product market and the geographic market.

The relevant market is usually defined as the smallest group of producers which could hypothetically form an effective cartel (Boyer; Scheffman and Spiller). Firms may be included in the relevant market if their probable supply response to small, but significant and nontransitory price changes would likely cause them to become a market participant Determination of functional substitutability (ability to technically replace another product) is generally not enough to define a product market. Two goods must also be reasonable substitutes. Courts have determined functional substitutes are also reasonable substitutes when the goods which are functional substitutes also compete on the basis of price. If they did not, consumers would always choose the lower priced alternative. (Department of Justice and the Federal Trade Commission)

Some antitrust literature discusses the problem of geographic market delineation apart from the discussion of the product market. Unfortunately, most of these discussions are brief and incomplete. Greer mentions several factors which affect the courts' definition of the geographic market and thinks transportation costs is critical important in determining geographic markets. Elzinga and Hogarty discuss the weaknesses in the approaches to geographic market definition used in the courts prior to 1973, and propose a simple (but very arbitrary) 75% of a firm trading area as encompassing the primary supply and demand forces affecting a firm at a reasonable cost of substitution. Larner and Meehan and others also mention tests for including other firms in a market.

Papandreou and Scheffman and Spiller propose that cross elasticities of demand be used to test whether a firm or cartel has potential market power. Boyer, on the other hand, rejects the use of cross elasticities of demand to define industry boundaries, citing identification, model misspecification, and data availability problems. It is often difficult to obtain accurate price and volume data from all potentially relevant firms, both of which are necessary to compute cross elasticities.

Concerns about the practicality and accuracy of the cross elasticity approach to relevant market determination led to the development of price-based methods for defining industry boundaries. Stigler and Sherwin argue that the appropriate test for a market is the similarity of price movements within a geographic region. They propose the use of correlation analysis of direct or differenced time series to determine relevant geographic and product markets. While this approach is often more practical than a cross elasticity approach, it may lead the researcher to hasty conclusions about the extent of the market. Prices in two areas may move in a parallel fashion due to the effects of common changes in the costs of production inputs and not because the firms are competing in the same geographic market. Residual demand analysis can also be used in market determination. Kamerschen and Kohler found residual demand analysis to be less powerful than proponents claim, and the information required to apply this method makes it difficult to implement.

Studies on livestock procurement markets used several geographic market definitions in their analysis. Willard Williams split the country into fourteen procurement regions which were based on his and market reporters' observations of packer operating practices. These small regional markets which Williams delineated were used with little modification in recent cattle procurement market power studies by Quail, et al. and Marion, et al.

Several recent studies have examined the geographic market for fed cattle using the theoretical framework put forth by Stigler and Sherwin. Hayenga and O'Brien examined contemporaneous and lagged price relationships in cattle feeding states using correlation, vector autoregression, and bivariate and multivariate cointegration analyses. They suggested that the relevant geographic market may include all cattle feeding states. Schroeder and Goodwin analyzed geographic price lead-lag relationships in the fed cattle market using Granger causality tests and they identified some leading price discovery locations. Later, Goodwin and Schroeder tested whether regional cattle prices adhere to the law of one price.

Margaret Schultz used four approaches in attempting to define the relevant geographic market for fed cattle in the United States. One of these approaches was the cross-elasticity approach. Schultz attempted to define the relevant market for fed cattle using the classic cross-elasticity approach. She estimated a series of univariate transfer functions with market share at plant i as the dependent variable and price at plant j as the independent variable. Schultz was unable to reject the hypothesis that most of the plants in the survey were in the same relevant geographic market.

Data

A significant contribution of this study is that actual transaction data are used from a broad spectrum of packing plants. The data were provided by the Packers and Stockyards Program, GIPSA, U. S. Department of Agriculture. The original data set consists of transaction data for a total of 200,616 pens of cattle procured from March 23, 1992 through April 3, 1993 by 43 U. S. fed cattle slaughter plants. Each transaction contains information on 39 variables which include plant location, seller location, purchase method, cost/cwt, etc.

Since estimation of fed cattle movement changes in response to changing plant or firm prices are the focus of the analysis, only spot market fed steer, heifer, fed Holstein or mixed lots are analyzed, and only the lots which had county locations of origin specified are included in the analysis (Canadian cattle were excluded). Quality, yield, sex, weight and similar data are necessary for developing comparable prices for cattle purchased over time or plants, and lots which did not have that data are excluded from the analysis. In addition, there were numerous missing data, unreconcilable differences in data, differences in data available from different plants, or obvious data errors. The original data set was condensed down to 103,442 lots of cattle slaughtered in 28 plants for the time series estimation. Descriptive statistics for the data set used for the econometric analysis are in Table 1.

Table 1. Summary Statistics of Data Used to Estimate Daily Price Explanatory Models

Variable	Average	Standard Deviation	Minimum	Maximum
Price ($/cwt)	121.61	6.05	91.47	148.58
Steer (binary)	0.56	-	0	1
Heifer (binary)	0.36	-	0	1
Holstein (binary)	0.01	-	0	1
Mixed (binary)	0.07	-	0	1
Yield Grade 3 (%)	95.55	5.84	0	100
Pen Size (head)	118.55	94.04	35	1055
Average Hog Weight (lbs)	733.37	61.02	441.97	1021.57
Purchase to Kill Days (days)	5.84	3.08	0	30
Wholesale Value ($/cwt)	115.86	4.57	107.10	128.69
Average Plant Price ($/cwt)	121.61	5.62	112.64	138.50
Choice 5/700 Carcass Price ($/cwt)	117.92	3.90	111.48	128.10
Choice 7/850 Carcass Price ($/cwt)	117.32	4.28	110.89	128.69
Select 5/700 Carcass Price ($/cwt)	113.90	4.65	106.82	126.07
Select 7/850 Carcass Price ($/cwt)	113.26	5.18	106.49	126.87
Observations (pens)		103,442		

Price Standardization Procedure

A necessary step to conduct the time series analysis is to obtain a daily price series for each plant. These daily price series must be quality-adjusted to be comparable over time and across plants. Therefore, the transaction prices need to be converted to a quality-adjusted daily price quote for each plant. This process involves estimating a hedonic price model using cash market transaction data for each plant over all useable observations. These plant-specific models are then used to estimate the price that plant would have been expected to pay each day for a pen of cattle possessing a particular set of quality traits and pen characteristics.

The specification of the hedonic model is based upon previous research on fed cattle pricing (Ward 1992; Schroeder et al.; Jones et al.; Schultz) and data availability. The lot average carcass price adjusting equation[2] is:

$$p_{ilt} = f(type_{ilt}, yield_{ilt}, head_{ilt}, weight_{ilt}, difday_{ilt}, valueidx_{ilt}, avgprice_{t})$$

where the subscript $_{ilt}$ stands for the i_{th} plant and the l_{th} transaction on day t. Type (binary variables for heifers, fed Holsteins, or mixed sexes), number of head in the lot (quadratic form), yield (percentage of cattle grading yield grade 3 or better), carcass weight (quadratic form), difday (days from purchase to slaughter), valueidx (weighted average wholesale USDA carcass price based on Choice-Select quality grade percentages in lot), and avgprice (average price paid by all plants on same purchase date) are the primary variables expected to explain the purchase price for each lot ($/cwt., carcass). The model described above is estimated separately for each plant and for all plants combined. These estimates are based on data from 28 plants, consisting of 103,442 pens of cattle, comprising 12.3 million head. The model for all plants combined explains 89 percent of the variability in transaction price. All parameter estimates are significant at the 0.00001 level and have the expected signs (Table 2).

[2] Developed in conjunction with Ted Schroeder at Kansas State University.

Table 2. Price Adjustment Model Parameter Estimates--All Plants

Variable	Parameter Estimate*
Intercept	-6.18
Sex/type variables	
Heifer	-.87
Holstein	-6.09
Mixed Sexes	-1.72
Quality variables	
Yield Grade 3/better	.04
Wholesale Value	.09
Avg. Hot Weight	.01
Avg. Hot Weight Squared	$-9.95x10^{-6}$
Other traits	
Pen Size	.004
Pen Size Squared	$-6.13x10^{-6}$
Purchase-Kill Day Difference	.07
Average Plant Price	.91
R-Squared	.89
RMSE	2.03

*All parameters were significantly different from zero at the .00001 level of confidence.

Consistent with expectations, different types of fed cattle receive lower prices than steers (the default type), though heifers were less than $1 per cwt. carcass lower than steers. The percentage of cattle grading yield grade 3 or better positively influences price. Price increases with increasing number of head in a lot, and increasing carcass weight, but at a declining rate (a quadratic functional form is specified). The results indicate that a slight price increase was associated with an earlier purchase date relative to slaughter date. Longer delivery time may be reflective of packer desires for feedlots to hold cattle longer than normal, and packers paid for this service. As expected, the quality grade and related wholesale value of the lot is positively and significantly related to cattle purchase prices, as is the weighted average plant price for all 28 plants which adjusts for changing price levels over the study period.

The individual plant models used in the price adjustment process generally had significant parameters with the anticipated signs, but are not reported to maintain confidentiality. The R^2s of the plant-specific models range from 0.714 to 0.967, with most between 0.85 and 0.95. The RMSE's range from $1.097/cwt. to $3.401/cwt., or 1% to 2.8% of the mean price.

The plant-specific model estimated parameters are used to calculate a daily carcass beef price at each plant. For each day that cattle were purchased in the cash market by the plant, the actual price paid for each lot is adjusted for quality and other lot characteristic differences from standard lot characteristics, and the simple average of these adjusted prices is used as the plant price for that day. When firm analyses are done, the volume weighted average of adjusted plant prices for the firm serves as the dependent variable.

Slight modifications to this model allow examination of geographic price patterns for fed cattle and firm purchase price differences during 1992-93. The all-plant model is reestimated after individual plant dummy intercept shifters are added to this model to reflect the constant price differences associated with a plant not accounted for by other variables in the equation. The range of adjusted plant carcass weight prices for the 28 plants is $2.53 per cwt. The highest adjusted purchase prices are found in the Western Nebraska, Colorado and Kansas area; as the distance from this area increased, prices tended to decline. Note that differences in cattle value due to factors like breed differences, brand frequency, etc., not provided in the USDA data set may be contributing factors to the geographic price patterns observed.

A second modification to the model involves substituting firm dummy variables for the plant dummy variables just described. This allows one to estimate whether firms differ in adjusted prices paid for cattle, though not reasons for the differences. The average adjusted carcass price differences differ as much as $2.14 per cwt. for the high and low firms. The general tendency is the largest firms paying higher than average adjusted prices for fed cattle, while the smaller firms pay less than average. While this does not directly address the issue of overall market price movements in response to increasing concentration, the larger firms are not capturing lower procurement prices relative to their smaller competitors in this group of firms in 1992-93. This is not what one would expect to find if high packer concentration is leading to lower cattle prices.

Volume response to price: basic approach

If, in the short run, a plant's volume is significantly affected by a competing plant's price, conceptually they both should be in the relevant market for competitive or antitrust case analysis. Following Papandreou and others, the quantity purchased by a plant as a function of its potential competitors' prices is proposed to address the basic question of appropriate market boundaries. The volume response to price model can be expressed as:

$$q_{i,t} = f(p_{i,t-s}, p_{j,t-s}, .., p_{k,t-s}, x_t)$$

where q_i and p_i are the quantity procured and the price of the i^{th} plant, p_j, ...,p_k are procurement prices of potentially competing plants j through k. The subscripts t-s indicate the same or prior day (s = 0,1). The null hypothesis of a non-negative coefficient relating a plants procurement volume to a potential competing plant's price (or relative price) suggests there is no significant competitive relationship with that plant. This can be tested by a one tail t test. Since feedlot supplies vary, affecting overall slaughter levels, an additional variable x (total procurement by all the plants on each day) is incorporated into the model to account for noncompetitive behavioral factors affecting the aggregate quantity and price relationship. Since there are several multiplant firms, and behavior observed for individual plants may be conditioned by arbitrage possibilities in other plants and geographic areas in which the firm operates, this model is also estimated for firms (as aggregates of plants) to determine the aggregate responsiveness to other firms' prices, and to compare the results with individual plant behavioral estimates.

Estimation procedure

Price series for all plants have a trend over the time period studied. In general, they decrease from March 1992 to the end of July and then move upward. This trend exists for the original price series as well as the quality adjusted price series. Using both simple and augmented Dickey-Fuller unit root tests, the null hypothesis of a unit root can not be rejected for all the price series studied (either adjusted or unadjusted series). The quantity procurement data series are stationary. To deal with nonstationary prices, a detrending procedure for the price series is utilized in estimating the volume response model. The weighted average adjusted price of all 28 plants is calculated for each day, then the price series of each plant is divided by this average price. The price series after this detrending are stationary according to augmented Dickey-Fuller tests. The volume response model is estimated by OLS in the log-linear form for the detrended price series.

There are various approaches which could be used to select the appropriate independent variables in each plant's volume response model. One alternative is to include prices of all other plants. Due to overlapping data gaps, that results in an inadequate number of observations. Another alternative is to sequentially add other plants' prices in the order of the extent of overlap with that plant, but this could cause bias due to the ordering of plants added to the equation. As the preferred, though not perfect, procedure, we include in the model the prices for each plant with at least 10% overlap in cattle procurement with the plant serving as the dependent variable, though other plants owned by that plant's owner are excluded[3]. To test whether excluding other plants from the same firm or all plants with little or no overlap would potentially bias our results, joint F tests are conducted separately on the competitive impact of all plants with less than 10% overlap, and all other plants owned by the same packer. We fail to reject the null hypothesis that all less than 10% overlap plants are jointly not significantly different from zero (at the 5% level) in only 2 out of the 28 plant volume response models. Also, only 2 plants' volumes are significantly impacted by prices of other plants owned by the same packer (at 5% level). That low frequency of significant results could be due to chance. Thus, eliminating from the equations prices paid by other plants owned by the same packer and other plants with little or no procurement overlaps should not bias the resulting estimates.

Autocorrelation is not found to be a problem by the D-W tests. However, heteroscedasticity exists in the volume response model for some plants and firms, based on the Breusch-Pagan (B-P) test. Out of the 28 plant volume response models, 8 exhibit heteroscedasticity according to B-P test at the 5% significance level. In the firm response models, the null hypothesis of homoscedasticity is rejected in only 1 out of 9 firms equations at 5% significance level. When heteroscedasticity is present, White's procedure is used to re-estimate the variance of coefficient estimates, and the t values are re-calculated based on the corrected standard errors (Greene). Multicollinearity is also tested by the variance inflation factor (VIF) and is not found to be a problem; only two independent variables in two equations have a VIF greater than 10 (Chatterjee and Price).

Estimation Results and Interpretation

Plant Volume Response

The results of the volume response to price models show that plants sometimes are very responsive to price changes in the same day. Since the model is estimated in log-linear form, the coefficient estimates are elasticities themselves. They can be interpreted as the percentage change in a plant's volume associated with a one percent change in the independent variable. Generally, the proportions of the variation in the daily plant volume explained by these models range from 5% to 77%, with most equations (22 out of 28) in the 42% to 77% range.

A one-tailed t-test is used to test the significance of all own price and potential competitor's price coefficients (elasticities). The null hypotheses for the volume response model are nonpositive own price elasticities, and nonnegative cross price elasticities. For the 28 plants analyzed, the total number of estimated price elasticities which are significant with the expected sign at the 10% significance level are 17 and 39 for own price and cross prices respectively (at the

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[3]What could be considered a significant overlap with another plant is debatable. We arbitrarily define an area comprising 10% or more of a packer's total procurement of U. S. origin spot market fed cattle during the 1992-93 study period as a significant overlap with another plant. We expect that the cost consequences of losing that volume, or something close to it, would be likely to put a plant at a significant competitive disadvantage.

5% level, the number is 16 and 20, respectively).

There are not a large number of statistically significant coefficients on same day volume response to prices. A little more than half of the own price effects are significant at the 5 % level with the expected sign (16 out of 28 plants); 11 plants' volumes are not significantly related to their own price changes (at 10% significance level). The total number of significant (at 5 %) negative cross price elasticities in 28 equations is only 20, with an additional 19 at the 10% significance level. Most plants' volume are significantly impacted (10% level) by prices at one or two other plants; the maximum noted is three. There are 4 plants without a significant negative cross price coefficient at least at 10% significance level (and 12 at the 5% significance level)). The small number of valid observations (the average is 76) and related degrees of freedom in estimation due to the overlapping data gaps in individual plant price series may be a small influence on the small number of significant relationships observed.

A high price elasticity suggests that a plant's cattle procurement volume is very sensitive to price changes. For example, a plant may have an own price elasticity of 58.99 and cross price elasticities of -22.4, -28.52 and -31.85 with three other plants. That means, all other things equal, that plant's purchase of cattle will increase 59 percent for a one percent increase in its own price; likewise, its daily purchases decline 22.4, 28.52 and 31.85 percent with a one percent increase in the price of its significant competitors, respectively.

The estimated significant negative cross price elasticities were very large, with a mean value of -31.8, and a range of -8.13 to -82.62. While these high elasticities seem initially to be quite extreme (relative to demand elasticities, for example), the variability in plant daily transaction volumes is quite high relative to the variability in prices or relative prices. Daily plant price standard deviations are typically 4 percent of the mean price for the year, while quantity variability is dramatically higher (with standard deviations as low as 30 percent to many over 100 percent of the mean daily transaction volume). Recall that many plants only purchase cattle a few days each week. Consequently, slight variations in the number of days of purchase during a week could contribute to the large size of the measured standard errors and elasticities. Further, we expect that plants offering a price 50 cents per cwt. lower than neighboring plants (a small percentage change) would experience sharp volume declines in a competitive setting, and that certainly is consistent with estimated large cross elasticities. In addition, since some plants may not be attempting to buy cattle on the same day, the competitive reaction time for them may be longer than the one day specified in this model.

Most significant cross price elasticity coefficients are within the roughly defined regions where plants are in closer proximity and display more procurement area overlaps. There are few significant coefficients outside these regional blocks, and they are usually only significant at the 10% level. In studying these "outsiders" more closely, four of the significant relationships involve geographically close plant pairs, though they are not defined (arbitrarily) in the same region. Therefore, there is some evidence from these estimates that some limited intraregional or interregional interplay among nearby fed cattle slaughter plants does occur. However, the small number of significant plant volume and price relationships may also be related to the nature of the procurement behavior of multiplant firms. Only five plants included in this analysis are not owned by the top four firms. The largest packers may arbitrage cattle procurement across multiple plants in such a way that individual daily plant volume and price relationships would not behave as one might expect. However, the estimated small number of competitive interrelationships are also found for firms with only one plant. Since daily reaction functions may be too short, adding lagged prices would seem desirable to allow slight extensions to the competitive reaction time frame in our analysis; however, the great loss of observations makes estimation impractical with this plant data set.

Firm Volume Response

Weighted average adjusted daily prices are calculated for the nine firms with sufficient procurement records, and the volume response model is estimated for each firm. Since multiplant firms have more daily price observations than individual plants, we are able to slightly expand the time period for competitive response in our econometric estimation, adding one day lags in both own and other firms' prices. The fits of these models are substantially better than the individual plant models. The R^2s range from .37 to .94, with eight of nine above .50. The top four firms have nine significant negative cross elasticities on the same day or day earlier, with six of the nine with other top four firms. The five smaller firms in the sample have thirteen significant negative cross elasticities, with eleven of the thirteen with other small firms. Nine of the significant negative cross price elasticities are for the prior day. Only one small firm has no significant cross elasticities. All other firms have one to four significant cross elasticities in the same day or one day earlier. Overall, the number of significant cross elasticities with other firms averaged slightly more than two per firm, and the average number of significant negative cross price relationships are similar for big and small firms in the sample. While the number of significant firm price and volume relationships is not great, the firms' aggregate procurement volumes are sometimes significantly related to other firms' prices on the same day or one day earlier. When they are significant, the cross price elasticities are large. Significant negative cross price elasticities ranged from -6.68 to -42.3, with an average of -27.91. While the number of significant cross price elasticities in the same or prior day is not large, the magnitude of the volume shifts in response to small relative price changes seems likely to prompt other plant or firm responses subsequently.

Summary

The objective of this study is to analyze the usefulness of plant and firm quantity - price cross elasticities in determining the relevant geographic procurement markets for fed cattle in the U. S. The Packers and Stockyards Program, GIPSA, U. S. Department of Agriculture, provided daily transactions data for all lots greater than 35 head purchased by the 28 of the largest fed cattle slaughter plants in the United States. Geographic mapping to identify overlaps of fed cattle procurement areas for slaughter plants is a precursor to econometric modeling of the plant (and firm) volume responsiveness to prices paid by potentially competing plants (firms). Prices are adjusted for cattle quality and other lot characteristics. Adjusted plant prices are lowest in the far East and West, highest in the Western Nebraska, Colorado and Kansas area. The largest firms tend to pay higher than average prices, which is contrary to what one would expect to find if high concentration is leading to lower prices paid for cattle.

In general, the significant price elasticities found in this study are quite high for both own price and cross prices. High price elasticities suggest small price changes relative to others significantly affect plant or firm volume. Typically, only 1-2 significant and negative daily cross price relationships are found in the plant volume response models. When the same model is estimated at the firm level, firms are more frequently found to be responsive to other firms' prices (an average of two firms) on the same day or one day earlier. Top four and smaller firms exhibit a similar amount of competitive interaction, though most frequently within their own size class. The fits of the firm models were generally better than the plant models. Firm rather than plant behavioral models logically are more attractive to model competitive interrelationships in situations where multiplant firms have centralized purchasing and cattle allocation operations.

The main problems encountered in this statistical analysis are related to the data. The data set covers only one year, and many plants do not purchase cattle on the spot market on many days within this period. While conceptually the idea of using cross price elasticities to identify significant competitors has appeal, that approach in the fed cattle procurement market analysis has significant limitations. Trending, nonstationary prices, heteroskedasticity and data gaps create obstacles to effective estimation of these relationships. Allowing a slightly longer time frame for competitive response in our models beyond one day lags was impractical due to the data gaps in the single year of data provided. While a longer period for competitive response would be more appropriate, the volume responsiveness of large firms to small changes in price by some competitors in the same day or a day earlier indicates some very short term competitive behavior is present. The longer term behavior reflected in geographic mapping or econometric analysis of lagged price behavior extending past one day may more accurately reflect the full competitive interrelationships among plants and firms.

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