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Market Dynamics Associated with a Beefpacking Plant Closing and a Porkpacking Plant Opening

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Practitioner's Abstract

Previous research has estimated price effects of meatpacking plant closings and openings. However, none have been done for plants opening or closing during the last 20 years ago when concentration in meatpacking increased rapidly. Plant openings and closings affect industry slaughtering capacity. Many analysts contribute the lack of processing capacity to handle the large supply of hogs in 1998 a major factor why spot market hog prices plummeted to unprecedented lows. Just eight months after the capacity constraint in slaughter hogs, Maple Leaf Foods opened a hog processing plant in Brandon, Manitoba. A second but opposite event occurred in the beef industry in an area of concentrated cattle feeding and meatpacking. On Christmas day, 2000, the ConAgra fed cattle processing plant was damaged by fire in Garden City, Kansas. The objective of this research is to determine the market effects of a plant opening in the porkpacking industry and a plant closing in the beefpacking industry. Regression models were estimated to compare reported weekly average prices in the market where the plant opened or closed with comparable prices for benchmark markets before and after the plant opening or closing. Regression models followed previous research but explained relatively little of the variation in price ratios between the affected market area and comparison markets. Small price effects were found in some cases but with little consistency.

Keywords

Meatpacking, Fed cattle, Slaughter hogs, Marketing, Prices,

Introduction

Exiting meatpacking plants have been one contributor, almost definitionally, to increasing concentration in the industry. Meatpacking has long been acknowledged as a cost-competitive industry, apart from near-constant allegations of oligopsonistic and oligopolistic behavior. Previous research has estimated price effects of selected plant closings and plant openings but the last of these studies was for plants opening or closing in 1981, more than 20 years ago and well before the rapid increase in four-firm concentration. In fact, four-firm concentration in steer and heifer slaughter in 1981 was 39.6; and for slaughter hogs, 33.3 (Grain Inspection, Packers and Stockyards Administration). The most recent comparable figures for 2001 are 80.3 in steer and heifer slaughter and 56.7 in hog slaughter.

Plant openings and closings affect industry slaughtering capacity.[1] In 1998, industry capacity was barely sufficient to slaughter the large supplies of hogs during the fourth calendar year quarter. Some plants operated two shifts seven days a week in an effort to slaughter all the market-ready hogs. Many analysts contribute the lack of capacity or lack of excess capacity to

[1] Capacity is a commonly-used but rarely defined term. However, its exact definition greatly affects the resulting implications (Ward 1990). Its use here follows conventional though ambiguous usage.

handle the large supply of hogs a major factor why spot market hog prices plummeted to unprecedented lows. In fact, one major hog slaughtering plant closed just months prior to the beginning of the fourth quarter, reducing industry excess hog slaughtering capacity.

Over the next two years, two events occurred that may or may not have affected market prices for slaughter hogs and fed cattle. Just eight months after the capacity constraint in slaughter hogs, Maple Leaf Foods opened a 45,000 hd/wk hog slaughtering and processing plant on August 21, 1999, in Brandon, Manitoba. This plant opened during a time of expansion in the Canadian hog industry. At the same time there was little excess capacity in the U.S. hog slaughter industry and imported hogs from Canada contributed to the supply-capacity imbalance just a few months earlier. The opening of a large hog processing plant should have provided some relief to the minimal excess capacity problem. This plant opening provides on opportunity to study market effects from a large plant opening in an expanding production area.

The second event occurred in the beef industry. On December 25, 2000, the ConAgra fed cattle slaughtering and fabricating plant was damaged by fire in Garden City, Kansas. At the time ConAgra believed the damage was repairable and the plant would resume operations. However, after further consideration, ConAgra decided to permanently close the plant. This unexpected, abrupt change may have also affected market prices and buyer behavior. Similar past studies have considered slaughter plant closings but most have been located on the fringe of major production areas. The ConAgra plant closing was located in the heart of cattle feeding, an area of concentrated beef production (southwestern Kansas). While excess slaughter capacity in the beef industry was believed to exist prior to the plant closing, the closing reduced whatever excess capacity that existed prior to the plant closing.

The objective of this research is to determine the market effects of a plant closing in the beefpacking industry and a plant opening in the porkpacking industry. Were market prices affected? If a market impact occurred, was it "permanent" or did it degrade over time as markets adjusted? If the latter, how long did it take markets to adjust to the structural change in the marketplace?

Conceptual Framework and Previous Research

Number of slaughter plants has no effect on the market supply of livestock available for slaughter. However, given that market demand is the summation of the individual demand by all plants, number of plants affects the market demand in a comparative static sense. A reduction in one plant could be expected to shift market demand leftward, resulting in a decline in market price, *ceteris paribus*. Conversely, the addition of one plant could be expected to shift market demand rightward, resulting in an increase in market price.

In a more dynamic sense, the location of competing plants potentially affects the price impact of a plant opening or closing. Capozza and Van Order present a simple framework of spatial pricing in commodity markets that leads to a kinked demand behavior among competing firms. If plants A and B have equal spatial market shares and plant A raises its price, plant B must respond the same in order to purchase livestock and maintain its spatial market share. However, if plant A lowers its price, plant B will not follow, will purchase more of the available supply,

and thus expand its geographic market share. In the event of a plant closing and a decline in market price, all remaining firms can share equally in the available spatial market share that becomes available by acting in unison. However, one plant might expand its spatial market share by bidding up on the available supply of livestock or because it has a locational advantage relative to the plant that closed and remaining rival plants. Whether or not its price increase is matched depends on several competitive factors. One is plant location and the transportation costs related to the available livestock. Another is the supply-to-capacity ratio of the competing plants. Some plants may not be able to slaughter additional livestock while others may need supplies to lower plant costs.

Anderson et al. identified several factors affecting meatpacking plants that exited the industry over the period 1991 to 1993. Among them were plant capacity, age, whether the plant was a single or multi-species plant, and whether the plant was a slaughter-only or slaughter-processing plant. These same factors may affect the reaction of existing slaughter plants to a plant opening or closing.

Previous research on market effects of plant openings and closings focused almost exclusively on the relationship between market prices in the market where the plant opened or closed compared with other benchmark markets. Love and Shuffett studied a market structure change at the terminal market in Louisville in 1960. Local porkpackers merged and/or closed, leaving one packer to purchase 80% of the hogs sold at the terminal market. Love and Shuffett compared weekly prices at the Louisville terminal market with markets at Indianapolis and Chicago. This was done for 69 weeks prior and 87 weeks after the structural change. Their results showed that the change lowered the price $0.22/cwt. in Louisville compared with the Indianapolis market, and $0.26/cwt. compared with the Chicago market. They concluded that the increased market power for the remaining firm caused a decrease in market competitiveness and a lower price.

Ward conducted a similar study for the closing of an Oklahoma City porkpacking plant in 1981. He compared weekly Oklahoma City terminal market hog prices to hog prices in Omaha, Kansas City, and interior Iowa/southern Minnesota for the year prior to and following the plant closing. Ward found that after the plant closed, prices declined for the first 2½ quarters. At 3½ quarters following the plant closing, Oklahoma City prices were the same as Omaha prices, but lower than Kansas City and interior Iowa/southern Minnesota prices. The plant that closed had a considerable market share, 80% of all hogs slaughtered in Oklahoma.

Hayenga, Deiter, and Montoya attempted to determine what happened to market prices for hogs when slaughtering plants closed and then reopened.[2] They examined six plant closings from 1978 to 1981. Two of those plants reopened several months later under new ownership. Plants were located in the center of hog production as well as on the outer edges. It was hypothesized that the closing of slaughter plants would increase the market concentration and lower prices.

[2] Similar research has considered structural changes that effectively added additional buyers via better informing them of available supplies, e.g., the development of electronic markets in the late-1970s and early-1980s and satellite auctions in the mid-1980s (Ward 1984; Rhodus et al.; Bailey and Peterson). Similar studies could be conducted regarding the advent of Internet auctions.

They found that in four of the six markets, there was at least a two-week period of significantly lower prices. The lower price was observed shortly after the plant closing and the effects tapered off as more time elapsed. As for the plants that reopened, in one case, market prices gradually increased to higher levels. Hayenga, Deiter and Montoya point out that the numerous closings would have more of an effect than a single plant closing. They observed that increased market concentration would cause lower prices, but this effect would only be temporary and the market would be able to adjust to such structural changes.

Data and Models Estimated

Following previous research, regression models were estimated to compare reported weekly average prices in the market where the plant opened or closed with comparable prices for benchmark markets before and after the plant opening or closing. Models were intended to answer two questions. Did the plant closing (opening) affect local market prices? If yes, how long did the effect exist? Availability of data is an issue. Comparative prices may be affected by relative slaughter volume in each market, especially for selected weights and grades of livestock. However, ideal data are rarely available. For the Canadian plant opening, prices were appropriately adjusted for exchange rate variability.

Equation 1 is the general model estimated. A description of the variables can be found in Table 1.

(1) $PRatio_{i/j,t} = f\,[\, SlRatio_{i/j,t}, Event_t, Week_{t+2}, Week_{t+4}, \ldots Week_{t+12}\,)$

where *i* denotes the market where the plant opened or closed, *j* denotes a comparison market, and *t* denotes week. *PRatio* is the price ratio, *SlRatio* is slaughter volume ratio, *Event* is the week of the plant opening or closing, and *Week* is a series of variables for groups of weeks following the plant opening or closing. Price differences were the dependent variable in previous research. Price difference models were estimated also. Event and Week variables were common to similar models estimated in previous research. The model was estimated using the REG procedure in SAS (SAS Institute). One variable for each dummy variable (event and week) was dropped to properly estimate the model. The variables dropped will be denoted subsequently as the base variables for comparison purposes.

For the Brandon, Manitoba plant opening, weekly average hog prices in Manitoba were compared with Alberta, Iowa/southern Minnesota direct, Sioux Falls, South Dakota, and south St. Paul, Minnesota. Weekly hog slaughter in Canada was compared with hog slaughter in Federal inspection region 7. The data period was August 1, 1998 to December 30, 2000. A summary of the price ratio data used is shown in Table 2.

It is hypothesized that the Maple Leaf Foods plant opening should increase market demand in the Manitoba market and decrease concentration, thus resulting in higher hog prices relative to the comparison markets. It is hypothesized the price effect will be significant at first and gradually decrease over time. Market effects related to this industry may not be as significant as expected for the following reasons. At the time of the hog processing plant opening, the industry had little excess capacity. The opening of this plant increased the capacity and may not have allowed

prices to shift significantly. Also, the market may have anticipated the opening of the Maple Leaf Foods plant, since it had been announced several months earlier and its completion would have been anticipated by rival firms.

For the Garden City, Kansas plant closing, weekly average fed steer prices in western Kansas were compared with Texas panhandle, Colorado, Omaha, and five-state weighted average prices. Fed cattle slaughter in Kansas was compared with fed cattle slaughter in Texas, Colorado, Nebraska, Iowa and with Federal inspection regions 6-8. Region 6 includes Texas; region 7, Kansas; and region 8, Colorado. The data period was December 4, 1999 to January 5, 2001. A summary of the price ratio data used is shown in Table 2.

A converse hypothesis is anticipated for the ConAgra plant closing. Its closing will decrease market demand and increase concentration in the regional market, thus leading to lower fed cattle prices relative to the comparison markets. Again, it is anticipated that after the market shock, this price effect will slowly dissipate to a point were prices are comparable to other markets. The abrupt shift in the market structure may cause the adjustment to take some time to occur. However, it still should be similar to previous studies and be less than one year. Cattle slaughtered in Kansas should decrease slightly in number after the plant closing and slaughter in surrounding states should increase slightly. If excess capacity existed in Kansas for fed cattle, there may be enough capacity among rival plants in Kansas to compensate for the lost capacity or at least cover a portion of it.

Results and Discussion

Preliminary results are presented in Table 3. The estimated regression models performed poorly in terms of explaining the variability in price ratios. For the Brandon, Manitoba plant opening, none of the estimated price ratio models were statistically significant according to the standard F test and the adjusted R^2 for each was negative. This suggests a model specification or data problem or no significant impact from the plant opening. Further checking of the data suggests that is not the problem. Viewing plots of the price ratios over the data period (Figure 1 is one representative example) suggests that the ratios varied seemingly randomly from week-to-week within a relatively narrow range. There does not appear to be a noticeable shift in the price ratio at week 55 of the data series when the Brandon, Manitoba plant opened.

Results were only slightly better for fed cattle. Three of the estimated regression models were statistically significant according to the standard F test (Table 2). In each of the three significant models, the adjusted R^2 was better but not high. The coefficient on the plant closing variable was significant in all three models. It was negative for Kansas versus Nebraska and Kansas versus Iowa/southern Minnesota and positive for Kansas versus Texas. Similar results were found for the price difference models. There was little evidence of a significant pattern of adjustment to the plant closing as shown by the statistically not significant coefficients on the Week variables. There were a couple significant coefficients but one could argue they were random rather than systematic occurrences.

Viewing plots of the price ratios over the data period (Figure 2 is an example for fed cattle) again shows week-to-week variation within a relatively narrow range. A slight positive trend is

evident for Kansas versus Texas, while a slight negative trend is evident (figures not included here) for Kansas versus Nebraska and for Kansas versus Iowa/southern Minnesota. However, near the period of the plant closing, week 56, no abrupt shift in the price ratios is evident for any of the market comparisons.

These results suggest the market adjusted quickly to a major change in number of plants available to harvest livestock. In the case of the Brandon, Manitoba hog processing plant, market participants knew well in advance of the impending plant opening. Regression models indicate no shock was evident in the price relationship in the Province where the new plant was located and comparison markets. In the case of the Garden City, Kansas fed cattle processing plant, the plant closing was abrupt and unexpected. There appeared to be some adjustment as a result of the plant closing but it was nearly instantaneous and small.

Lack of specific data may mask other aspects of the market adjustment. For example, a feedlot manager remarked that when the Garden City plant burned, a competing packer was able to purchase cattle closer to its plant, implying it reduced its normal procurement area. In addition, that packer picked up a marketing agreement one large cattle feeding company had with the Garden City plant. Thus, the competing plant increased its proportion of captive supplies and decreased its need for cattle purchased in the cash market. Both factors, in the mind of the cattle feedlot manager, reduced the demand for fed cattle from his feedlot. Available data cannot reveal or confirm these buyer behavior changes.

Summary and Conclusions

Processing plant openings and closings potentially affect livestock demand by buyers. The conventional thinking is that a plant opening increases demand and livestock prices and that a plant closing has the reverse effect.

Available data were used to estimate models comparing prices in the area in which the plant opening (Brandon, Manitoba hog processing plant) or closing (Garden City, Kansas fed cattle processing plant) occurred. Regression models followed previous research but explained relatively little of the variation in price ratios between the affected market area and comparison markets.

Regression results failed to confirm one feedlot manager's perception of buyer behavioral changes following closure of the Garden City plant. This suggests more research is needed. In particular, more detailed data are needed to measure potential changes. Improved modeling of the dynamics of the marketplace may also be required.

Available data may mask the cattle feeder's perceptions; then research such as that presented here can be used to argue that perceptions are not reality. Economists are sometimes (too?) quick to dismiss anecdotal evidence in lieu of "sound science", i.e., properly estimated models, when available data may not allow the necessary detail in the "sound science" to reveal underlying, significant market reactions.

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Table 1. Regression Variable Definitions and Expected Signs.

Dependent Variable	Variable Definition	
$PRatio_{ij}$	Price ratio of weekly average prices in market i compared with market j	
Independent Variable	**Variable Definition**	**Expected Sign**
$SlRatio_{ij}$	Slaughter ratio of weekly slaughter in market i compared with market j	-
$Event_t$	Zero-one dummy variable for the week of a plant opening or closing, t=1-2, 1=Pre-opening or closing, 2=Post- opening or closing, Base=Pre-opening or closing	+/-
$Week_{it}$	Zero-one dummy variables for six, two-week intervals following the plant opening or closing, j=1-2, 1=Week interval, 2=Other weeks, Base=respective week interval	+/-

Table 2. Selected Summary Statistics.

Price Ratio	Slaughter Hog Plant Opening Pre-Opening		Post-Opening	
Manitoba vs.	**Mean**	**Std deviation**	**Mean**	**Std deviation**
Alberta	2.714	0.216	2.660	0.097
Iowa/So. Minn.	4.425	0.437	4.356	0.218
So. St. Paul	4.339	0.432	4.319	0.195
Sioux Falls	4.291	0.404	4.265	0.174

Price Ratio	Fed Cattle Slaughter Plant Closing Pre-Closing		Post-Closing	
Kansas vs.	**Mean**	**Std deviation**	**Mean**	**Std deviation**
Texas	0.999	0.003	1.002	0.003
Colorado	1.001	0.006	1.000	0.004
Nebraska	1.002	0.008	0.996	0.008
Iowa/So. Minn.	1.002	0.008	0.996	0.008
Five-State Avg.	0.999	0.008	1.001	0.003

Table 3. Regression Coefficients from Plant Opening and Plant Closing Models

Dependent variable = Weekly average price ratio for market i versus j

Independent Variable	Slaughter Hog Plant Opening Significant Coefficients at 10% Level ($/cwt.)			
	Manitoba vs. Alberta**	**Iowa/So. Minnesota****	**So. St. Paul****	**Sioux Falls****
SlRatio	NS*	NS	NS	0.652
Event	-0.05	NS	NS	NS
Week t+2	NS	NS	NS	NS
Week t+4	NS	NS	NS	NS
Week t+6	NS	NS	NS	NS
Week t+8	NS	NS	NS	NS
Week t+10	NS	NS	NS	NS
Week t+12	NS	NS	NS	NS
Observations	120	119	120	120
Adj R squared	-0.038	-0.001	-0.03	-0.004

Independent Variable	Fed Cattle Plant Closing Significant Coefficients at 10% Level ($/cwt.)				
	Kansas vs. Texas	**Colorado****	**Nebraska**	**Iowa/So. Minnesota**	**Five-State Average****
SlRatio	0.008	NS	NS	NS	NS
Event	0.004	-0.004	-0.006	-0.008	NS
Week t+2	0.004	NS	NS	NS	NS
Week t+4	NS	NS	NS	NS	NS
Week t+6	NS	NS	0.009	0.01	NS
Week t+8	NS	NS	NS	NS	NS
Week t+10	NS	NS	NS	NS	NS
Week t+12	NS	NS	NS	NS	NS
Observations	103	94	107	107	108
Adj R squared	0.208	-0.024	0.116	0.113	-0.032

* For Alberta, the absolute hog slaughter in Canada is used in lieu of a Manitoba-Alberta slaughter ratio.

** Model was not significant.

Figure 1. Ratio of weekly average slaughter hog prices in Manitoba versus Iowa/southern Minnesorta, August 1998 to December 2000.

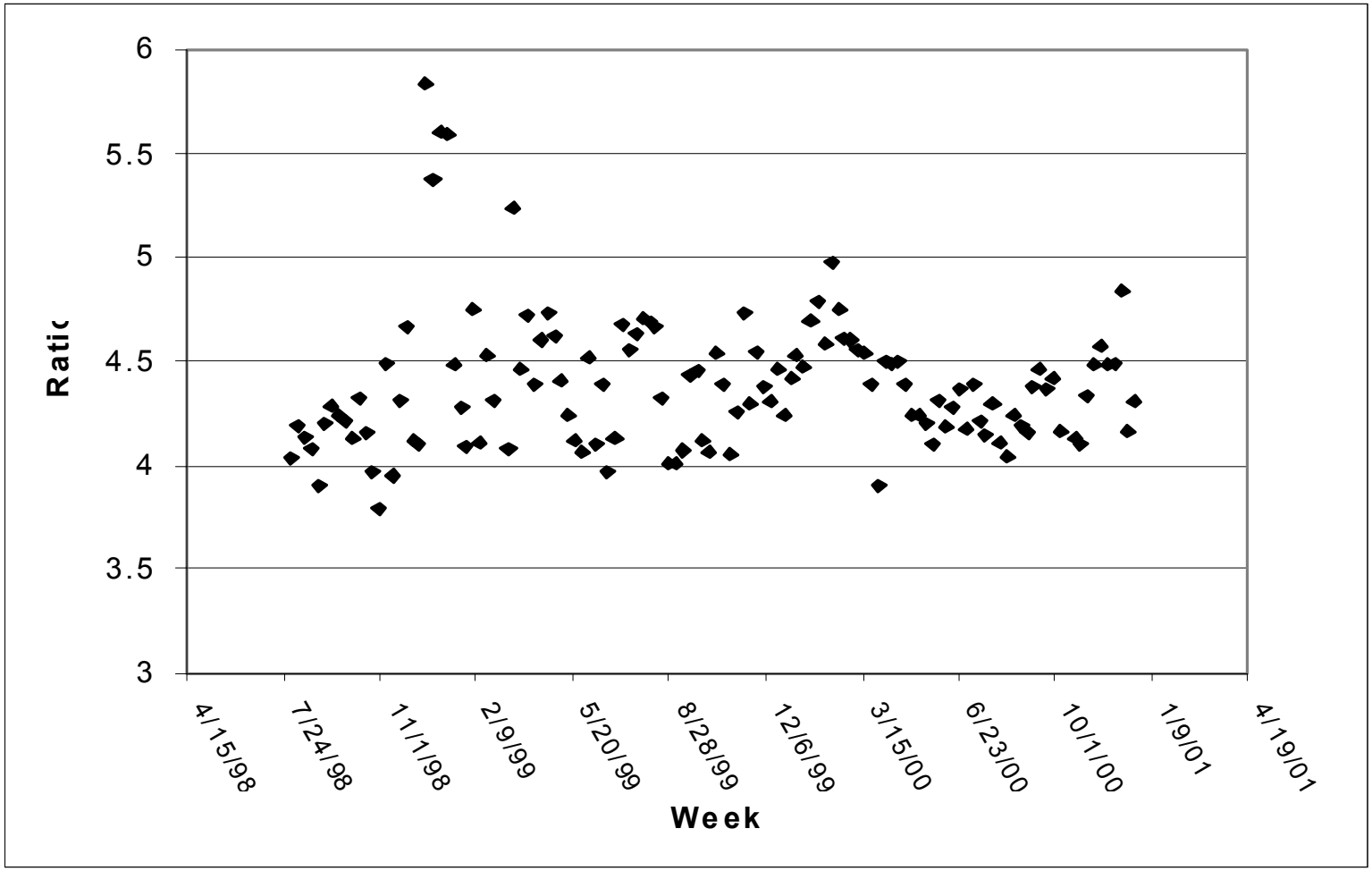

Figure 2. Ratio of weekly average fed cattle prices in western Kansas versus Texas panhandle, December 1999 to January 2001.