Price Impacts Associated with the Closing of Hog Slaughtering Plants

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PRICE IMPACTS ASSOCIATED WITH THE CLOSING OF HOG SLAUGHTERING PLANTS

Marvin Hayenga, Ronald Deiter and Cristobal Montoya

The impact of closing hog slaughtering plants is examined by comparing relative prices in affected local market areas with prices in distant markets before and after a plant closed. The results suggest that market arbitrage usually has been quite effective, with either temporary or insignificant price effects in six case studies.

The structure of the U.S. pork slaughtering industry has been changing rapidly over the past decade. Recently, there has been a noticeable trend toward fewer firms. From 1969 to 1980, the number of single-plant firms reporting to the Packers and Stockyards Administration fell by one-third from 681 to 435, while the number of multiplant firms rose only slightly from 28 to 34 (Hayenga et al.). During 1982 and the first part of 1983, plant closings occurred at packing facilities that had accounted for nearly 15 percent of all hog slaughter (Pork). More plants have subsequently closed. Reasons purportedly explaining the rash of plant closings include industry overcapacity, unequal labor costs, and inefficient, antiquated plants.

Despite the announced intentions of some firms, like the nation's largest beef packer, IBP, Inc., to expand in the pork slaughtering industry, the major focus of attention by industry observers and participants continues to be on the consequences of continued plant shutdowns. Of primary interest is the impact on prices paid to producers in areas with plant closures. As plants exit the market, there is the concern among producers and policymakers that the market power of remaining firms might be enhanced to such an extent that there could be a substantial, negative impact on prices paid to hog farmers.

Empirically, little research has been conducted to determine whether or not these concerns and resulting policy suggestions are warranted. The primary purpose of this article is to document what has happened to market prices for hogs in several local markets after slaughtering plant closings and, in a few instances, after plants reopen. In particular, this study attempts to determine if and when significant changes in prices occurred. In addition, behavioral differences are examined between plants located in major hog-producing areas (such as Iowa) versus plants located on the fringe of the Corn Belt where hog production density is lower.

Analytical Framework and Review of Literature

The hypothesis that increased buyer concentration may result in the use of market power to depress prices paid to producers is derived from industrial organization theory (Bain; Dalton and Penn; Scherer). The theory posits that elements of market structure, including the degree of seller concentration and the degree of buyer concentration, directly influence firm behavior which, in turn, ultimately determines market performance. One of the most frequently tested relationships in economics has been that between seller concentration and profit/price levels (Weiss). In contrast, relatively few economic studies have focused on the relationship between buyer concentration and profits/prices. Increasing buyer concentra-
tion in manufacturing industries has been found to be negatively correlated with seller's price-cost margins (Lustgarten; LaFrance) and with rates of return (Brooks).

One of the first similar studies involving an agricultural market, and hogs in particular, reported that hog prices at the Louisville terminal market decreased relative to prices paid for hogs at other markets after a major hog slaughtering firm withdrew its buyers in 1960 (Love and Shuffet). Dobbins analyzed the weekly price differential for hogs between St. Louis and other markets for three time periods during 1969-1972. There was a base period, a second period corresponding to the period immediately following the closing of a St. Louis plant by a national hog packer, and a third period corresponding to the period immediately following the opening of a new plant in the area. Dobbins found that relative hog prices in St. Louis increased both when a plant closed and when a new plant opened. The observed price behavior after the plant closed was inconsistent with expectations. One possible explanation offered by Dobbins was that other buyers may have been attracted to the market in anticipation of the national packer's plant closing. Miller and Harris, using 1978 data, reported that a 10 percent increase in four-firm buyer concentration levels in state markets would decrease slaughter hog prices 18 to 20 cents per hundredweight. Ward studied the effect on terminal hog prices in Oklahoma City after a major hog slaughterer, accounting for about 80 percent of all hogs slaughtered in the state, closed its Oklahoma City plant. He found a significant initial decrease in Oklahoma City hog prices relative to other markets but prices essentially recovered to earlier levels within a year.

There is a definite need to supplement the few empirical studies that have attempted to quantify the impact of changes in buyer concentration on hog prices. Previous results are not consistent, although there seems to be a general consensus that buyer concentration is negatively correlated, at least initially, with prices paid to producers. Also, some of the previous studies have dealt with plant closings in lower-volume markets (often terminal markets) outside major hog-producing areas such as Iowa and Illinois. There are likely to be fewer buyers in these markets, so one might expect a more noticeable impact if a buyer exits in these fringe areas. There may be critical levels of concentration on the buying side of a market, comparable to those reported on the selling side (Dalton and Penn; Miller), which are more likely to be reached in fringe areas. Hence, the possibility that plant closings in major hog-producing areas may produce different results needs to be examined. Finally, few previous studies have focused on local, direct-market price impacts of a plant closing. This should be done because the direct market is where most hogs (more than 75 percent) are acquired by plants, and it is the price in the area closest to a plant that closes that would be expected to be most affected (Hayenga et al.).

Data and Procedure

Six case studies of pork plant closings were conducted (table 1). Weekly prices for equivalent grades and weights of market hogs (U.S. No. 1's and 2's, weighing 200-230 pounds) were obtained for markets in areas near to the closed plants. Except for St. Louis and Oklahoma City, sources of price data other than USDA terminal market data had to be used for the case-study markets, because the plants that closed were located far from a terminal market. In these situations, prices were obtained (on a confidential basis) from either 2 or 3 buying stations that supplied hogs to competitors and that were within 40 miles of the plant that closed. These prices were compared with a simple average of weekly prices for several control markets which were high-volume markets and unlikely to have been affected by plant closings in their area or by the plant being studied several hundred miles away. Weekly prices in the first 5 test markets were compared with average weekly prices for 6 terminal markets including Indianapolis, Sioux Falls, Sioux City, Omaha, South St. Joseph, and Kansas City. Because of Storm Lake's proximity to 3 of these markets, Storm Lake prices were compared with average weekly prices for terminal markets at Peoria and St. Louis, and direct markets in Illinois, Indiana, and Ohio.
Table 1. Case Study Plant Locations, Dates Closed, Dates Reopened (if applicable), Control Markets, and Study Periods

<table>
<thead>
<tr>
<th>Plant Location</th>
<th>Closing Date</th>
<th>Reopening Date</th>
<th>Control Markets</th>
<th>Study Periods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Madison, WI (Oscar Mayer)</td>
<td>9-15-78</td>
<td>N.A.</td>
<td>Group 1</td>
<td>3-25-78 to 9-15-78 to 9-15-79</td>
</tr>
<tr>
<td></td>
<td>9-15-78</td>
<td>9-15-79</td>
<td></td>
<td>N.A.</td>
</tr>
<tr>
<td>St. Louis, MO (John Morrell)</td>
<td>12-23-80</td>
<td>N.A.</td>
<td>Group 1</td>
<td>8-30-80 to 12-23-80 to 12-23-80</td>
</tr>
<tr>
<td></td>
<td>12-23-80</td>
<td>3-20-82</td>
<td></td>
<td>N.A.</td>
</tr>
<tr>
<td>Rochelle, IL (Swift, now FDL Foods)</td>
<td>12-26-80</td>
<td>8-31-81</td>
<td>Group 1</td>
<td>9-6-80 to 12-26-80 to 8-31-81 to 6-4-83</td>
</tr>
<tr>
<td></td>
<td>12-26-80</td>
<td>8-31-81</td>
<td></td>
<td>N.A.</td>
</tr>
<tr>
<td>Davenport, IA (Oscar Mayer)</td>
<td>6-4-81</td>
<td>N.A.</td>
<td>Group 1</td>
<td>1-3-81 to 6-4-81 to 6-4-83</td>
</tr>
<tr>
<td></td>
<td>6-4-81</td>
<td>6-4-83</td>
<td></td>
<td>N.A.</td>
</tr>
<tr>
<td>Oklahoma City, OK (Wilson Foods)</td>
<td>8-13-81</td>
<td>N.A.</td>
<td>Group 1</td>
<td>8-23-80 to 8-13-81 to 8-13-81 to 3-20-82</td>
</tr>
<tr>
<td></td>
<td>8-13-81</td>
<td>8-13-81</td>
<td></td>
<td>N.A.</td>
</tr>
<tr>
<td>Storm Lake, IA (Hygrade, now IBP)</td>
<td>10-23-81</td>
<td>9-25-82</td>
<td>Group 2</td>
<td>5-2-81 to 9-23-81 to 9-25-82 to 9-25-82 to 3-21-83</td>
</tr>
<tr>
<td></td>
<td>9-25-82</td>
<td>9-25-82</td>
<td></td>
<td>3-31-83</td>
</tr>
</tbody>
</table>

1 Not Applicable.
2 Includes Terminal Markets at Indianapolis, Sioux Falls, Sioux City, Omaha, South St. Joseph, and Kansas City.
3 Includes Terminal markets at Peoria, St. Louis and Direct Markets in Illinois, Indiana, and Ohio.

Analyses of the first 2 case-study markets (Madison and St. Louis) revealed that the main effects of the structural change were observed within 6 months after a plant closed. Similarly, adding price information for more than 6 months before a plant closed did not change any of the results. Because of this and because some of the direct buying stations did not have price records that went back in time any further, most of the analyses were done by using a 6-month period before and a 6-month minimum period after the structural change in the market. In a few instances, where the period under study for one market overlapped with the period of study for another market and there was the possibility of additive price impacts, a longer period was studied. In the Rochelle and Storm Lake cases, the period of analysis was extended to evaluate the impact of reopening the same plants. Hence, this is the first study, to our knowledge, that reports on the apparent price impacts of initially closing and subsequently reopening the same plants (about 4 months later for Rochelle and nearly 11 months later for Storm Lake).

An ordinary least squares (OLS) procedure incorporating binary or dummy indicator variables was used to test whether the price difference between the local and comparison markets changed significantly in the time intervals (usually biweekly) following the plant closing for as long as data were available (at least 6 months in all cases). The basic model utilized was:

$$ PD_t = a_0 + a_i T_i + \mu_t $$

where,

- $PD_t =$ price difference (in dollars per hundredweight) between the local market being studied and the comparison markets for week $t (t = 1, 2, ..., n)$,
- $a_0 =$ the intercept term which is the average of $PD_t$ for the 6-month period preceding the plant closing,
Ti = the ith time interval (usually biweekly) following the plant closing (i = 1,2,...,m) such that

\[ T_i = 1, \text{ if } t \text{ is in the ith time interval,} \]
and
\[ T_i = 0 \text{ otherwise,} \]

ai = the estimated change in the weekly price difference during the ith time interval when compared with the pre-closing price difference, and

\[ \mu_t = \text{error term.} \]

As specified, the model could be estimated once for each case-study market (without having to be re-estimated several times - once for each time period) and could be used to test for significant changes in the level of price differences over time (using t tests on the coefficients of the dummy variables). In addition, the model could be used to detect the speed and magnitude of arbitrage in the markets studied. A more detailed explanatory model could not be specified and estimated due to lack of data on hypothesized explanatory variables (other than a plant closing variable) such as changes in relative slaughter levels or changes in the relative degree of buyer concentration in the relevant local markets. While seasonal differences in relative prices were not accounted for directly in the individual studies, the different closing dates for the 6 plants studied suggest that the aggregate results for the 6 plants, collectively, are unlikely to have been significantly influenced by seasonal influences.

Empirical Results

The price impacts associated with the closing of hog slaughtering plants are summarized in table 2. Reported in the table are the estimated ai coefficients from the specified model. 1 There was no immediate (within two weeks) significant lowering of prices in any of the test markets. There eventually was a significantly lower price observed for at least a 2-week period in 4 of the 6 markets. However, there were only a small number of periods (no more than 6) of significantly lower prices in these 4 markets, and they usually occurred several weeks after a plant had closed. The shortest time that it took for a significant price decline to occur was in the Storm Lake market (3-6 weeks), and the longest time was in the Madison market (17-20 weeks). The significantly lower price period in the Rochelle market was only for 2 weeks and seemed to be an aberration from the preceding and subsequent price patterns in that market. Relative prices in both markets on the fringe areas of the Corn Belt (Oklahoma and Wisconsin) trended lower gradually and bottomed out at a significantly lower level 9-10 weeks later in Oklahoma and 19-20 weeks later in Wisconsin before returning to preplant-closing levels. 2 The Storm Lake market area experienced lower prices in general during the 11 months prior to reopening, but they were significantly lower only in 6 two-week periods. There was no significant price impact associated with plant closings in the other test markets which were located in the Corn Belt and major hog producing areas. Hence, those reductions that were significant were found infrequently. With a 95 percent confidence test, there was a 1-in-20 chance that one would have found a significant difference when there was none.

There was no noticeable price impact associated with the Rochelle plant reopening in that market. This is consistent with the lack of an apparent price impact when the plant had closed earlier. Prices in the Storm Lake market gradually increased to above-normal levels (27 cents per hundredweight above) as the plant was reopened and brought back to expanded production.

Summary and Implications

The 6 case studies analyzed suggest that producer and policymaker concerns about the

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1 Durbin-Watson statistics did not reveal any significant autocorrelation. R^2 statistics are not reported because the model is not intended to be an explanatory model.

2 An analysis of the impact of this plant closing independent of Ward’s study was conducted. Ward reported a slightly longer period of initial impact. This may be due to differences in the control markets that were selected for comparison purposes.
Table 2. Changes from the Pre-Closing Period in Weekly Price Differentials Between Local Markets and Comparison Markets by Time Period After Plant Closings

<table>
<thead>
<tr>
<th>Period After Closing No. of Weeks</th>
<th>Period After Closing No. of Weeks</th>
<th>Period After Closing No. of Weeks</th>
<th>Period After Closing No. of Weeks</th>
<th>Period After Closing No. of Weeks</th>
<th>Period After Closing No. of Weeks</th>
<th>Period After Closing No. of Weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Madison</td>
<td>St. Louis</td>
<td>Rochelle</td>
<td>Davenport</td>
<td>Oklahoma</td>
<td>Storm Lake</td>
<td></td>
</tr>
<tr>
<td>1-2</td>
<td>1-2</td>
<td>1-2</td>
<td>.17</td>
<td>-.29</td>
<td>-.24</td>
<td>.27</td>
</tr>
<tr>
<td>3-4</td>
<td>3-4</td>
<td>3-4</td>
<td>-.17</td>
<td>-.21</td>
<td>.18</td>
<td>.38</td>
</tr>
<tr>
<td>5-6</td>
<td>5-6</td>
<td>5-6</td>
<td>-.26</td>
<td>-.29</td>
<td>-.04</td>
<td>.14</td>
</tr>
<tr>
<td>7-8</td>
<td>7-8</td>
<td>7-8</td>
<td>-.20</td>
<td>-.31</td>
<td>-.102*</td>
<td>.14</td>
</tr>
<tr>
<td>9-10</td>
<td>9-10</td>
<td>9-10</td>
<td>-.29</td>
<td>-.21</td>
<td>.16</td>
<td>-.29</td>
</tr>
<tr>
<td>11-12</td>
<td>11-12</td>
<td>11-12</td>
<td>-.51</td>
<td>-.09</td>
<td>.05</td>
<td>-.26</td>
</tr>
<tr>
<td>13-14</td>
<td>13-14</td>
<td>13-14</td>
<td>-.46</td>
<td>-.25</td>
<td>-.13</td>
<td>.07</td>
</tr>
<tr>
<td>15-16</td>
<td>15-16</td>
<td>15-16</td>
<td>-.20</td>
<td>-.38</td>
<td>-.13</td>
<td>-.13</td>
</tr>
<tr>
<td>17-18</td>
<td>17-18</td>
<td>17-18</td>
<td>-.60*</td>
<td>-.03</td>
<td>-.07</td>
<td>23-71f</td>
</tr>
<tr>
<td>19-20</td>
<td>19-20</td>
<td>19-20</td>
<td>-.91*</td>
<td>.27</td>
<td>.46</td>
<td>15-16</td>
</tr>
<tr>
<td>21-22</td>
<td>21-23</td>
<td>21-23</td>
<td>-.50</td>
<td>.31</td>
<td>.65</td>
<td>19-20</td>
</tr>
<tr>
<td>23-24</td>
<td>23-33a</td>
<td>23-33a</td>
<td>.36</td>
<td>34-35b</td>
<td>.12</td>
<td>21-31</td>
</tr>
<tr>
<td>25-26</td>
<td>34-35b</td>
<td>34-35b</td>
<td>.12</td>
<td>36-45c</td>
<td>.00</td>
<td>27-28</td>
</tr>
<tr>
<td>27-52</td>
<td>36-45c</td>
<td>46-64d</td>
<td>.07</td>
<td>46-64d</td>
<td>.27</td>
<td>29-30</td>
</tr>
</tbody>
</table>

*Significant different at 5% level.

aPeriod after Davenport closing (6/4/81-8/13/81).
bPeriod after Oklahoma closing (8/13/81-8/27/81).
cPeriod after Rochelle reopening (8/27/81-11/7/81).
dPeriod after Dubuque closing (11/7/81-6/4/83).
ePeriod after Rochelle reopening (8/13/81-11/7/81).
fPeriod after Dubuque closing (11/7/81-10/16/82).
gPeriod after Dubuque reopening (10/16/82-6/4/83).
hPeriod after Storm Lake reopening (9/25/82-3/31/83).
impacts on hog prices associated with a single slaughtering plant closing may not be warranted. The closings analyzed usually had either an insignificant or temporary adverse effect on producer prices in the local market. In the few instances where prices were significantly lower, prices usually returned to normal within 6-12 months. This suggests that in these areas, market arbitrage by remaining market participants, including the reopening of 2 of the plants by new owners, generally has been quick and effective.

While these results suggest that market arbitrage in the late 1970's and early 1980's was generally effective in the markets studied, continued declines in plant numbers may lead to different results in some market areas in the future. Cumulative plant closings in a geographic market area sometimes has more of an impact than a single plant closing (Montoya). Economists should continue to monitor the effectiveness of market arbitrage in areas where plants close or open and link it to measures of buyer concentration to determine if there is a critical level of buyer concentration above which there may be significant price impacts due to plant closings.

References


