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Positive Market Effects from a Meatpacking Plant Opening: Perceptions and Reality[1]

Jonathan T. Hornung
Former Graduate Research Assistant, Oklahoma State University

Clement E. Ward
Professor and Extension Economist, Oklahoma State University

The Issue

Economic theory suggests that adding a competitive buyer to a market should have positive effects on competition and prices, *ceteris paribus*. An additional buyer increases market demand, shifting demand to the right, and expands the number of active buyers, reducing average market shares of existing buyers while intensifying bidding competition. Whether or not these positive impacts occur in reality is an empirical question.

The largest pork processor in Canada, Maple Leaf Foods Inc., opened a 45,000 head/week hog processing facility in August 1999 in Brandon, Manitoba. The plant opened during a period of expanding hog production in Canada, of increasing hog exports to the United States, and of increasingly tight processing capacity in the United States (Luby, 1999; Parcell, Mintert, and Plain, 2004). Most previous research on the impacts of meat processing plants has focused on plant closings, and none has estimated the effects of a plant opening under conditions of expanding production and tight processing capacity. Research reported here expands previous work by taking a dual approach to the question. First, two models were used to estimate market price impacts from the plant opening. Second, a survey of Manitoba pork producers provided insight into the perceived market dynamics of the plant opening.

Implications and Conclusions

Empirical results from two models indicated a significant price increase occurred in Manitoba following the opening of a new Maple Leaf Foods plant in Brandon. The price increase occurred in both relative and absolute terms.

Producer perceptions differed regarding impacts of the plant opening. Some perceptions were consistent with the empirical findings while others were not. However, producer perceptions were likely influenced by additional, more recent changes involving Maple Leaf Foods, rather than being simply limited to response to the plant opening in 1999.

With current levels of concentration and consolidation in meatpacking, both in Canada and the United States, packing plant closings are often a concern. Conversely, plant openings theoretically should provide some market relief for producers. Research results indicated the market reacted to the plant opening, despite producers not necessarily agreeing on the ultimate effect it had on market competition and prices.

Background

Expansion of hog production in Canada over the past 20 years is clearly evident. Canada processed 13.9 million hogs and exported another 0.2 million hogs in 1980 compared with processing 19.7 million hogs and exporting 4.4 million hogs in 2000 (USDA-Foreign Agriculture Service). Growth in the central Canadian provinces (Ontario, Manitoba, and Saskatchewan) enabled expanded exports of feeder pigs and finished hogs to the United States.

Expansion of hog processing capacity in Canada trailed hog production expansion. In the United States, packer consolidation, a trend toward fewer and larger plants, and closure of less efficient plants combined to reduce excess processing capacity (Anderson et al., 1998; Ward, 2002). At the time of the plant opening in Manitoba, hog processing capacity in both Canada and the United States was considered tight by most market analysts.

Market structure changes in the livestock-meat industry, and their impacts, have long been issues of academic and practical importance (Ward, 2002). The Manitoba plant opening represented a relatively rare opportunity to study market dynamics within a concentrated industry with little excess capacity. While the addition of a processing plant in southern Manitoba theoretically should increase competition for hogs and with it hog prices, actual effects depend on the reaction by rival firms in the market. In particular, the marketplace could anticipate the plant opening and begin adjusting prior to the expected change. Results of this study are intended to contribute to understanding and anticipating market dynamics and adjustments to structural changes in concentrated markets.

Secondary Data

Weekly data from August 15, 1998 to September 16, 2000 were used for the analysis (110 weeks), both following previous research and in lieu of transaction data. The study compared prices 55 weeks before and 55 weeks after the plant opening, a procedure comparable to prior research (Love and Shuffett, 1965; Ward, 1982; Hayenga, Deiter, and Montoya, 1986). Weekly data for pork cutout values, hog byproduct values, live- and dressed-weight hog prices, head slaughtered, and slaughter hog weights were obtained from several Canadian and U.S. sources, including Agriculture and Agri-Food Canada, the George Morris Centre, Saskatchewan Agriculture, Livestock Market Information Center, and the U.S. Department of Agriculture (Hornung, 2004). U.S. slaughter hog prices, pork cutout values, and hog byproduct values were converted to Canadian dollars per 100 kg. Slaughter hog weights in pounds were converted to kilograms. Market areas included Manitoba, Ontario, Saskatchewan, and Iowa/southern Minnesota.

Price Impact Models

Two models were used to estimate the effect of the plant opening on absolute and relative market prices (Hornung, 2004). One was a price difference model estimated by OLS regression corrected for autocorrelation (SAS Institute, 2001). The other was a partial adjustment model estimated by OLS.

Price Difference Model

Price impacts from plant closings and openings have previously been estimated by measuring the change in price differences between the market where the plant event occurred and adjacent markets (Love and Shuffett, 1965; Ward, 1982; Hayenga, Deiter, and Montoya, 1986). The model used in this study was a combination of the models used in the three prior studies. The model was

(1) Price difference $_i$ = f (Slaughter difference $_i$, Plant open, Week 56-57, Week 58-59, Week 60-61, Week 62-63, Week 64-65, Week 66-67),

where *price difference* is the respective difference between the weekly average Manitoba slaughter hog price and the weekly average slaughter hog price in the i^{th} comparison market (Saskatchewan, Ontario, and Iowa/southern Minnesota)*, slaughter difference* is the respective difference between weekly number of hogs slaughtered in Manitoba and weekly hog slaughter in each of the other three (i^{th}) markets, *plant open* is a zero-one dummy variable associated with the plant opening date*,* and $week_{t=56\text{-}57}$ to $week_{t=66\text{-}67}$ are a set of six, zero-one dummy variables for two-week periods after the plant opening. Six, two-week periods were chosen based on the time taken for markets to adjust to plant closings in previous studies. The focus of this model was on the *plant open* variable, i.e., whether or not there was a significant price change associated with the opening of the hog slaughtering plant.

Partial Adjustment Model

A partial adjustment model was also estimated to measure market impacts in each respective market. The distributed lag model developed by Nerlove to measure demand and supply elasticities has had other recent applications, e.g., measuring the demand adjustment to adverse information (Dahlgran and Fairchild, 2002) and estimating price discovery dynamics (Carlberg and Ward, 2003). The model was estimated for Manitoba, where the plant event occurred, and for Saskatchewan, Ontario, and Iowa/southern Minnesota. The model was

(2) Price $_i$ = f (Pork cutout value, Head slaughtered $_i$, Slaughter hog weight $_i$, Price lagged $_i$, Byproducts value, Plant open, Quarter 2, Quarter 3, Quarter 4),

where *price* is the weekly average slaughter hog price in the i^{th} market, *pork cutout value* is the weekly average pork cutout value, *slaughter volume* is the weekly number of hogs slaughtered in the i^{th} market, *slaughter hog weight* is the weekly average slaughter hog weight in the i^{th} market, *byproducts value* is the weekly average value of hog byproducts, *price lagged* is the weekly average slaughter hog price for the previous week, *plant open* is a zero-one dummy variable for the week the plant opened, and *quarters 2, 3,* and *4,* are quarterly dummy variables (i.e., quarter 2 is April, May, June; quarter 3, July, August, September; and quarter 4, October, November, December). The focus of this model was on the partial adjustment coefficient for the *plant open* variable, which indicates the marginal price adjustment after the plant event. This coefficient can then be used to determine the length of market impacts when it is believed that the recovery from an event was distributed over several time periods.

Price Impact Results

Results are presented here in summarized form; complete results are available in Hornung (2004). Prices and slaughter differed sharply in some cases before and after the plant opened (table 1). Both absolute and relative prices increased in Manitoba after the Brandon plant opened, as did hog slaughter. A key question is whether or not these changes were due to the plant opening per se.

Estimating the effects of the plant opening with a price difference model indicated a significant price difference increase of $6.80 to $10.18 per $C/100 kg in two of the three market comparisons (Manitoba-Ontario and Manitoba-Iowa/southern Minnesota). The Manitoba-Saskatchewan price difference increase was not statistically significant. The set of two-week dummy variables failed to detect any consistent pattern. However, in the Manitoba-Ontario and Manitoba-Iowa/southern Minnesota models, price differences decreased during the two weeks after the plant opening.

The partial adjustment models found that prices in three markets increased $6.58 to $11.26 per $CAN/100 kg after the opening (Manitoba, Saskatchewan, and Iowa/southern Minnesota). The price increase in Ontario was not statistically significant. Ninety-five percent of the price increase effects in the three markets lasted from three to eleven weeks.

Table 1 Variable Means before and after the Plant Opening

Variable	Mean before opening	Mean after opening
Price diff.: Manitoba minus Saskatchewan[1]	7.707	10.891
Price diff.: Manitoba minus Ontario	-1.500	4.874
Price diff.: Manitoba minus Iowa/southern Minnesota	19.083	29.238
Slaughter diff.: Manitoba minus Saskatchewan[2]	36.863	52.242
Slaughter diff.: Manitoba minus Ontario	-19.330	-8.972
Slaughter diff.: Manitoba minus Iowa/southern Minnesota	-502.199	-461.897
Hog price: Manitoba	111.041	160.258
Hog price: Ontario	112.541	155.384
Hog price: Saskatchewan	103.335	149.367
Hog price: Iowa/southern Minnesota	92.084	131.951
Hog slaughter: Manitoba	55.757	69.692
Hog slaughter: Ontario	75.087	78.664
Hog slaughter: Saskatchewan	18.893	17.450
Hog slaughter: Iowa/southern Minnesota	556.573	531.589
Pork cutout value	165.535	203.367
Slaughter hog weight[3]	117.068	118.363
Pork byproduct value	33.437	34.786

[1] Prices are in C$/100 kg.
[2] Slaughter is in 1,000 head.
[3] Weight is in kilograms.

Competition Impact Perceptions

The models discussed above determined the absolute and relative price changes associated with the plant opening. However, the models do not indicate underlying market dynamics associated with the plant opening. Therefore, a survey was conducted to identify producer perceptions of factors believed to underlie the measurable price effects. These factors include changes in number of buyers bidding on hogs, changes in slaughter capacity, and changes in the relative competitive advantage of packers in the region. A key question is whether or not perceptions of affected producers match the resulting price increase measured by the preceding models.

Producer Survey

Hog producers within 400 km of Brandon, Manitoba, and members of the Manitoba Pork Council were surveyed in November 2003. Of the 273 Canadian hog producers surveyed, 80 useable surveys were returned, a response rate of 29.3 percent. Hog producers in

western Manitoba were asked a few basic questions (e.g., size of operation, distance and direction from Brandon, extent of marketings to various packers, and extent of cash-market use in 1999/2000). In addition, hog producers were asked to rate their extent of agreement or disagreement on a nine-point, Likert scale (from strongly agree to strongly disagree) for several statements regarding market-related impacts associated with the plant opening.

Ordered Logit Model

An ordered logit model was chosen to analyze the level of agreement in producer responses to two central statements. Estimation of the model was by maximum likelihood in SAS (SAS Institute, 2001). The ordered logit model estimated the effect each independent variable had on the probability or likelihood of producers responding in a specific ranking group (from 1 to 9) for the dependent variable; that is, the level of agreement or disagreement with each statement. In contrast, regression analysis indicates the effect independent variables have on explaining the variability in the dependent variable. The procedure followed in this study was similar to previous research having ranked dependent variables (Misra, Huang, and Ott, 1991; Grunewald, Schroeder, and Ward, 2004). Recall for the level of agreement there were nine possible responses, ordered from 1 (strongly agree) to 9 (strongly disagree).

The two key statements were (A) *the plant opening had NO noticeable effect on marketing or pricing hogs from my finishing barns* and (B) *the addition of the Maple Leaf plant caused higher hog prices in the region.* Note that one statement focused on impacts where the producer is located, while the second focused on regional price effects. Independent variables were respondents' finishing barn characteristics and perception responses to other statements. The ordered logit model was

(3) Opinion_i = f (Distance, Size, % Sold to Maple Leaf, % Sold on the cash market, Opinion C, Opinion D, Opinion E),

where *opinion* is the level of agreement to the two (i^{th}) statements, *distance* is the distance from Brandon, *size* is the number hogs marketed in 2000, *% sold to Maple Leaf* is the percentage of hogs marketed to Maple Leaf Foods during 2000, *% sold on the cash market* is the percentage of hogs marketed on the cash market in 2000, and *opinion c*, *opinion d*, and *opinion e* were respondent reactions on a nine-point scale to three other perception statements. Producers were asked whether the number of buyers increased after the plant opened in *opinion c*, whether slaughter capacity in Manitoba became less of a problem when the plant opened in *opinion d*, and whether rival packers lost their competitive advantage with the addition of the Maple Leaf Foods plant in *opinion e*.

Ordered Logit Results

Only partial results are shown here; complete results can be found in Hornung (2004). Table 2 shows estimation results from the ordered logit model. How producers responded

Table 2 Ordered Logit Model Results for Perceived Local Market and Regional Price Effects[1]

Independent variable	Local market effect coefficients	Regional price effect coefficients
Distance	0.0009 (0.004)	-0.0075* (0.005)
Size	0.00007 (0.00007)	-0.00005 (0.00007)
% sold to Maple Leaf	-0.004 (0.006)	0.0028 (0.007)
% sold in the cash market	0.0036 (0.005)	0.0036 (0.006)
Opinion C – number of buyers bidding regularly	0.006 (0.104)	-0.413** (0.118)
Opinion D – hog slaughter capacity	-0.004 (0.076)	-0.319** (0.095)
Opinion E – competitive advantage of rival packers	0.139* (0.081)	0.099 (0.095)
Likelihood ratio	4.70	37.94

[1] Numbers in parentheses are standard errors.
Significance levels are **=0.05, *=0.10.

to the statement that other packers lost their competitive advantage when the plant opened significantly affected the likelihood of respondent hog producers agreeing that there was no local market effect from the plant opening. Distance from the new plant and perceptions regarding two market reaction statements to the plant opening affected the likelihood of agreeing that the plant opening increased hog prices in the region. The two statements related to the perceived increase in number of buyers regularly bidding on hogs and the potential lessening of capacity problems after the plant opened.

Parameter estimates from ordered logit models can be used to create marginal probabilities (Misra, Huang, and Ott, 1991). The marginal probabilities show how the probability of a particular agreement level changes as the independent variable increases from its mean. Results related to the marginal probabilities, using *opinion a* as the dependent variable (i.e., no perceived impacts where each respondent was located), are summarized below. Some results were as hypothesized (nos. 1, 2, 3) but others were unexpected (nos. 4, 5).

1. Producers who thought the number of buyers increased following the plant opening and packers lost their competitive advantage were more likely to agree there were noticeable impacts from the plant opening.
2. Producers who sold a larger percentage of hogs to Maple Leaf Foods were more likely to think there was no noticeable effect after the plant opened.

3. Producers who sold a larger percentage of hogs on the cash market were more likely to think there was a noticeable market effect following the plant opening.
4. Producers who agreed that slaughter capacity became less of a problem after the plant opened were more likely to agree there was no noticeable effect from the plant opening.
5. Producers farther from the plant tended to perceive there was a noticeable market effect from the plant opening.

Results related to marginal probabilities, using *opinion B* as the dependent variable (i.e., perceived increase in regional market prices), are summarized below. Again, some results were as hypothesized (nos. 1, 2, 3) while others were unexpected (nos. 4, 5, 6).

1. Producers who agreed that the number of buyers increased after the plant opened tended to agree that prices increased following the plant opening.
2. Producers who agreed that slaughter capacity became less of a problem after the plant opened were more likely to agree that the plant opening caused higher prices.
3. Producers who sold a larger percentage of hogs to Maple Leaf Foods tended to think the plant opening did not cause higher prices.
4. Producers who tended to agree that other packers lost their competitive advantage after the plant opened were more likely to think that prices did not increase.
5. Producers farther from Brandon tended to agree that higher prices resulted when the plant opened.
6. Producers who sold a larger percentage of hogs on the cash market tended to think the plant opening did not cause higher prices.

Model Results Compared

Overall results from the two approaches (price difference and partial adjustment models with secondary data vs. the ordered logit model with survey data) differed somewhat. For example, producers who responded to the survey all experienced the same plant event, yet several disagreed that the number of buyers increased, capacity concerns were lessened, or that rival packers had less competitive advantage after the plant opened. Each of these factors potentially, and likely all in combination, contributed to the absolute and relative price increase from the plant opening, as was generally confirmed by the price difference and partial adjustment models.

One reason for the discrepancy might be that producers who responded to the survey may not have limited their perception of the impacts to the months immediately following the plant opening. Other market changes subsequent to the plant opening could have

affected their market impact perceptions. For example, since the Brandon plant opened, Maple Leaf Foods has acquired rival packers in Manitoba, including a major purchase just prior to when the survey was mailed (Carr, 2003). Second, in the time since the plant opened, the percentage of hogs owned by or contracted by Maple Leaf Foods has increased. These two factors may explain why some producers did not perceive the plant opening effects to be the same as those theoretically expected or found with secondary data estimates.

The two models estimated with secondary data relatively consistently indicated prices increased in Manitoba after the plant opened, both in relative and absolute terms. The ordered logit model indicated that producers' perceptions of the plant opening impacts were influenced by how they perceived factors underlying the estimated price effects.

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Endnote

[1] The authors acknowledge cooperation from the Manitoba Pork Council, without whose assistance the hog producer survey likely would not have been possible.