MARKET ADJUSTMENT INSIGHTS: PRIMARY VS. SECONDARY DATA

Clement E. Ward
Department of Agricultural Economics
Oklahoma State University
Stillwater, OK 74078
Phone: 405-744-9821
Fax: 405-744-9835
Email: ceward@okstate.edu

Jonathan T. Hornung
Department of Agricultural Economics
Oklahoma State University
Stillwater, OK 74078
Phone: 405-744-9821
Fax: 405-744-9835
Email: jon_hornung@hotmail.com

Selected Paper prepared for presentation at the Western Agricultural Economics Association Annual meeting, Honolulu, Hawaii, June 30-July 2, 2004

Market Adjustment Insights: Primary vs. Secondary Data

Abstract
Producers, researchers, and policy makers have an interest in market effects from meatpacking plant closings and openings. This paper presents results from a study taking a dual approach to determining impacts from an anticipated hog slaughtering plant opening and an unexpected fed cattle slaughtering plant closing. Secondary data are used in a price differences and partial adjustment model. Primary data are used in a logit model. Results indicate a clearer price effect from the plant opening than the plant closing. Primary data provide additional insight into the dynamics related to the two plant events.

Keywords
Fed cattle, Hogs, Market dynamics, Meatpacking, Price impacts

Introduction

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

Previous research on effects of meatpacking plant openings and closings has focused on the relationship between prices in the market where the plant opened or closed compared with other benchmark markets (Love and Shuffett; Ward; Hayenga, Deiter, and Montoya). These are akin to event studies which are common in the finance literature to estimate event impacts on stock prices (MacKinlay). While appropriate and relatively easy given access to public (i.e., secondary) data, market participants and analysts often perceive market competition effects and dynamics that cannot be identified with available published data. Secondary data may be aggregated to the point where it masks underlying effects among rival buyers and their suppliers.

Primary data may be required to explain the underlying "how" and "why" of market impacts and dynamics.

This paper compares findings from two methods of estimating market impacts from two similar but opposite, independent events. One approach uses secondary data both in a price difference and partial adjustment model to estimate price impacts from a meatpacking plant opening and closing. The other approach uses primary data in a logit model to estimate factors influencing perceptions of market impacts from the same events. Then the question "what, if anything, did the primary data contribute to understanding market impacts and dynamics" is addressed.

The first event was opening a hog slaughtering and processing plant in Brandon, Manitoba by Maple Leaf Foods in August 1999. This plant opened during a time of expansion in the Canadian hog industry and at a time of little excess capacity in the U.S. hog slaughter industry. The second event was closing a fed cattle slaughtering and fabricating plant in Garden City, Kansas by ConAgra, damaged by fire in December 2000. This plant was located in the geographic heart of cattle feeding, an area of concentrated beef production, and where slaughter capacity was not an issue.

The overall objective of this research was to determine the market effects of a plant closing in the beefpacking industry and a plant opening in the porkpacking industry. A secondary objective was to determine what contribution to understanding market dynamics is gained from analyzing primary data in combination with secondary data.

Previous Research

Event study analysis has developed into a widely used method of examining the reaction of prices to some known or unknown event. The use of event study analysis has been common

in finance research, most of which have determined the impact on a firm's value from a specified event (MacKinlay). This methodology can either test the market's efficiency response to increased information or the effects of a firm's financial position from the occurrence of some event (Binder; MacKinlay). MacKinlay's review of event study literature determined that in a normal market, prices would respond to new information. This is similar to a study by Tsetsekos and Gombola that was intended to determine the impacts from the closing of domestic and foreign plants. They found that the announcement of a plant closing had a negative impact on the market. However, this research dealt with the impacts on stock price instead of the impacts on input prices.

Three previous studies have estimated price impacts from meatpacking plant closings and openings. Love and Shuffett estimated the price impact from losing a porkpacking firm at the Louisville terminal market in 1965. Local packers merged, leaving one packer to purchase 80% of the hogs sold at the terminal market. They compared weekly price differences between the Louisville market and similar markets in Chicago and Indianapolis for 69 weeks prior to and 87 weeks following the structural change. Love and Shuffett found that the structural change lowered hog prices in Louisville compared with the Indianapolis and Chicago markets. They concluded that the increased market power for the remaining firm caused a decrease in market competitiveness and a lower price.

Ward completed a similar study on the price impacts from closing a hog slaughtering plant in Oklahoma, in 1981. The plant that closed slaughtered 80% of all hogs slaughtered in Oklahoma. Weekly Oklahoma City terminal market hog prices were compared to Omaha, Kansas City, and interior-Iowa-southern Minnesota hog prices for the year prior to and following

the plant closing. Ward found that after the plant closed prices were lower in Oklahoma City than two of the three comparison markets (Kansas City and interior-Iowa-southern Minnesota).

Hayenga, Deiter, and Montoya attempted to determine what happened to market prices for hogs both when slaughtering plants closed and reopened. Researchers examined six plants that closed from 1978 to 1981 in Iowa, Illinois, Wisconsin, Missouri, and Oklahoma. Two of these plants later reopened. 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. Reopening the plants caused prices in one market to gradually increase to above-normal levels. Hayenga, Deiter, and Montoya found that the closing of processing plants could depress prices. However, they point out that joint effect from numerous closings would likely have more of an effect than a single plant closing. Hayenga, Deiter, and Montoya observed that the reopening of one of plant decreased market power, pushed up prices, and increased excess capacity for four months.

In a study of meatpacking plants exiting the industry, Anderson et al. found that plants in concentrated markets and ones on the outer edges of production are most likely to exit. A similar study by Muth et al. on meatpacking plants exiting due to implementation of Hazard Analysis and Critical Control Points (HACCP) regulations found comparable results. Their model determined that the entry of new slaughter plants would raise input prices, including for slaughter livestock. According to the model, if a new plant opens, the price of cattle or hogs is expected to increase. If higher input prices prevail in a particular market, plants in rival markets would have a cost advantage (Anderson et al.).

Research comparing the results of models using primary and secondary data has been limited. Radtke, Detering, and Brokken estimated the income impacts from increasing the

federal grazing fee. They used data from the U.S. Forest Service as secondary data. Business and households were surveyed to obtain primary data. The impacts from raising the fee were analyzed with both data sets. They found that the secondary data showed impacts higher than determined by the primary data.

Boster compared the use of primary and secondary data for water resource planning using input-output models. Primary data came from a Colorado study on water resources and secondary data were from an Arizona study that used national coefficients. Results from the two input-output models were compared. Boster found similar results using either primary or secondary data.

Reiterating, this study used secondary data in two empirical models estimating price impacts from a plant closing and opening. Then primary data were used in a model to explain perceptions of market participants regarding the market dynamics following the plant opening or closing.

Secondary Data

Weekly data were used to estimate price impacts. Data were collected for 55 weeks prior to and 55 weeks following each plant event; thus, from August 15, 1998 to September 16, 2000 for the Maple Leaf plant opening and from December 11, 1999 to January 12, 2002 for the ConAgra plant closing. This procedure was comparable to previous research (Love and Shuffett; Ward; Hayenga, Deiter, and Montoya). Table 1 summarizes the data variables and sources. Prices for U.S. hogs, byproduct values, and pork cutout values were converted to Canadian dollars per 100 kg. and hog weights were converted to kilograms. Market areas for the hog plant opening included Manitoba, Ontario, Saskatchewan, and Iowa/southern Minnesota; and for the fed cattle plant closing, Kansas, Colorado, Nebraska, Texas, and Iowa/Minnesota.

Price Impact Models

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

Price Difference Model

As indicated, price impacts from plant closings and openings have been estimated by measuring the change in price differences between the market where the plant event occurred and adjacent markets. The model used in this study was a combination of the models used in prior studies. The model is

(1) Price Difference = f (Slaughter difference, Plant event, Week 1-2, Week 3-4, Week 5-6, Week 7-8, Week 9-10, Week 11-12)

where *price difference* is the respective difference between prices in the market where the plant event occurred (i.e., Manitoba and Kansas) and prices in each respective market*, slaughter difference* is the respective difference between hog slaughter in the market where the plant event occurred and in each respective market, *plant event* is a zero-one dummy variable associated with the plant opening or closing date*,* and $week_{t=1\ldots12}$ are a set of six, zero-one dummy variables for two-week periods after the plant opening or closing. 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 is on the plant open variable, i.e., whether or not there was a significant price change associated with the opening of the hog processing facility.

Partial Adjustment Model

A partial adjustment model was also used 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) and in estimating price discovery dynamics (Carlberg and Ward). The model was estimated for the market where the plant event occurred and each respective comparison market. The model is

(2) Price = f (Wholesale cutout value, Slaughter volume, Slaughter animal weight, Lag price, Byproducts price, Plant event, Season 2, Season 3, Season 4)

where *price* is the weekly slaughter livestock price, *wholesale cutout value* is the weekly average boxed meat cutout value, *slaughter volume* is the weekly number of slaughter livestock processed, *slaughter animal weight* is the weekly average weight for slaughter livestock, *byproducts* is the weekly average value of animal byproducts, *lag price* is the weekly slaughter animal price for the previous week, *plant event* is a zero-one dummy variable for the week the plant opened or closed, *season 2, 3, 4,* are seasonal dummy variables. The focus of this model is on the partial adjustment coefficient 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 slowly distributed over many time periods.

Primary Data

Two surveys were conducted. One was of hog producers within 400 km of Brandon, Manitoba, and members of the Manitoba Pork Council in November 2003. Of the 273 hog producers surveyed, 80 useable surveys were returned, a response rate of 29.3%. The other was of cattle feeders in a 200 mile radius of Garden City and members of the Texas Cattle Feeders Association, Kansas Livestock Association, or Colorado Livestock Association in August, 2003.

Of the 186 feedlot managers surveyed, 100 useable surveys were returned, a response rate of 53.8%.

Each survey instrument contained a few basic questions (e.g., size of operation, distance and direction from the affected plant, extent of marketings to various packers, and extent of cash-market use prior to the plant event). In addition, survey participants were asked to rate their extent of agreement or disagreement with several statements about market impacts from the plant opening.

Market Perception Model

An ordered logit model was estimated to determine factors affecting the probability of producer agreement with two statements in each survey (Hornung) as in previous research (Misra, Huang, and Ott; Grunewald, Schroeder, and Ward). The two statements were: (A) *the plant opening (closing) had NO noticeable effect on marketing or pricing hogs (fed cattle) from my finishing barn (feedlot*); and (B) *the addition (loss) of the Maple Leaf (ConAgra) plant caused higher hog (lower fed cattle) prices in the region.* Note one statement focused on impacts where the producer (feeder) is located, while the second focused on regional price effects. Dependent variables were respondent's characteristics and perception responses to other statements. The ordered logit model was

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

where *opinion* is the level of agreement to the two (i) statements respectively, *distance* is the distance from the plant site, *size* is the number livestock marketed, *% sold to the plant owner* is the percentage of livestock marketed to the plant owner, *% sold on the cash market* is the percentage of hogs marketed on the cash market, and *opinion c*, *opinion d*, and *opinion e* were

respondent reactions to three other perception statements. Producers were asked whether the number of buyers increased (decreased) after the plant opened (closed) in *opinion c*, whether slaughter capacity in Manitoba (Kansas) became less (more) of a problem when the plant opened (closed) in *opinion d*, and whether packers lost (gained) a competitive advantage with the addition (loss) of the opened (closed) plant in *opinion e*.

Results and Discussion

Secondary Data – Results are summarized here but complete results are available in Hornung. Estimating the effects of the plant opening in Manitoba with a price difference model indicated a significant price difference increase of $6.80 to $10.18 per $CAN/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.

For the Kansas plant closing, results were less clear. The price difference model indicated an unexpected significant price difference increase of $0.30 per cwt for one market comparison (Kansas-Texas), a significant decrease as hypothesized of $0.37 per cwt. for another (Kansas-Nebraska), and no significant difference for the third (Kansas-Colorado). Coefficients on the set of two-week dummy variables were rarely significant and exhibited no consistent pattern.

The partial adjustment models for the plant opening found that prices in three markets increased $6.58 to $11.26 per $CAN/100 kg after the plant 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 3 to 11 weeks.

Fed cattle prices in just one market (Texas) were significantly lower, $0.92 per cwt. after the plant closing. The lower prices were estimated to last 5 weeks. No significant differences were found for Kansas, Nebraska, or Colorado.

In summary, models estimated with secondary data showed reasonably consistent positive price impacts with the anticipated opening of the hog slaughter plant in Manitoba. Conversely, however, similar models showed little market price impacts with the unexpected fed cattle slaughter plant in Kansas. These results suggest capacity and other market structure characteristics are important in market dynamics following significant plant events. In Manitoba, slaughter capacity was tight and producers had relatively few, nearby alternatives to market to large, efficient plants. In Kansas, there was no capacity problem and more alternative packers, including ConAgra's plants in Texas, Colorado, and Nebraska.

Primary Data – Results for the descriptive variables regarding respondents and their marketing practices (size, percent marketed to the firm owning the affected plant, and percent marketed in the cash market) were infrequently significant with either the plant opening or closing models. One exception was distance from the affected plant. Producers farther from the plant event tended to think there was a noticeable market effect from the plant opening (closing).

Parameter estimates from ordered logit models can be used to create marginal probabilities (Misra, Huang, and Ott). Marginal probabilities show how the probability of a particular agreement level will change as the independent variable increases from its mean.

Using *Opinion A* as the dependent variable (i.e., no perceived impacts where each respondent was located), results of the marginal probabilities were:

1. Producers (feeders) who thought the number of buyers increased (decreased) following the plant opening (closing) were more likely to agree there were noticeable positive (negative) price impacts from the plant opening (closing).
2. Producers who agreed that slaughter capacity became less of a problem after the plant opened were more likely to agree there were no noticeable effects from the plant opening. Conversely, feeders who agreed that slaughter capacity became more of a problem after the plant closed were more likely to agree there were noticeable effects from the plant closing.
3. Feeders who agreed that rival packers gained a competitive or psychological advantage with the plant closing were more likely to agree there were noticeable impacts from the plant closing.

The second model used *Opinion B* (i.e., a perceived increase (decrease) in regional market prices with the plant opening (closing)). The distance variable was significant in the plant opening case but not for the plant closing. Hog producers farther from the plant tended to think there was a positive regional price effect from the plant opening.

Results of the marginal probabilities for the perception variables were:

1. Producers (feeders) who agreed that the number of buyers increased (decreased) after the plant opened (closed) tended to agree that regional prices increased (decreased) following the plant opening (closing).
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 did not cause higher regional prices. Conversely, feedlot managers who agreed that capacity became more of a

problem after the plant closed were more likely to agree regional prices were adversely affected after the plant closing.

3. Feedlot managers who agree that captive supplies became more of a problem when the plant closed were more likely to agree there were noticeable effects from the plant closing.

In summary, feeders and producers located farther from the plant event tended to perceive more market impacts than those closer to the plant. That finding may be influenced by how boundaries of plant procurement regions are altered by plant openings and closings.

Producers and feeders agreed that as number of buyers increased (decreased) with the plant opening (closing), there was more likely to be a market effect where they were located as well as on regional prices. However, their views on effects from changes in capacity differed. That may be related to the relative importance capacity limitations were present in each market and how changes in capacity affected the market. Relieving capacity constraints were perceived to have less effect than increasing capacity limitations. Limiting capacity may have a greater marginal impact than relieving capacity constraints. Feedlot managers tended to be more sensitive to the effects from the plant closing on buyer psychology or competitiveness and captive supplies than hog producers were for the plant opening. Any gain in rival firms' competitive advantage was perceived to have adverse market effects. This, too, may be consistent with the perceived impacts from capacity changes. Marginal impacts from reducing competitiveness and increasing captive supplies may be greater than market changes having reverse effects.

Summary, Conclusions, and Implications for Research Data

The primary implication of this research is that use of secondary data, while less costly, relatively easy to access, and insightful, is at the same time limiting. Here, primary data, while more costly and difficult to access, provided supplemental insight into market behavior and impacts which were not revealed by simply using secondary data alone.

A major unanswered question pertains to the marginal value of primary data relative to the marginal costs in terms of supplementing research that can be undertaken with secondary data. The issue is not that research with aggregated, secondary data provides incorrect inferences, though it may. The core issue is whether or not secondary data alone can complete the entire story that research with primary and secondary data together may combine to reveal.

References

Anderson, D., B. Murray, J. Teague, and R. Lindrooth. "Exit from the Meatpacking Industry: A Microdata Analysis." *American Journal of Agricultural Economics.* 80(1998):96-106.

Binder, J.L. "The Event Study Methodology Since 1969." *Review of Quantitative Finance and Accounting.* 11(1998): 111-137.

Boster, R.S. "The Value of Primary versus Secondary Data in Interindustry Analysis: An Arizona Case Study Emphasizing Water Resources." Ph.D. dissertation, University of Arizona, 1971.

Carlberg, J.C, and C.E. Ward. "Alternative Theories and Empirical Approaches to Price Discovery: An Application to Fed Cattle." *Journal of Agricultural and Applied Economics.* 35,3(2003):457-469.

Dahlgran, R.A. and D.G. Fairchild. "The Demand Impacts of Chicken Contamination Publicity-A Case Study." *Agribusiness.* 18(2002): 459-474.

Grunewald, S., T.C. Schroeder, and C.E. Ward. "Cattle Feeder Perceptions of Livestock Mandatory Price Reporting." *Review of Agricultural Economics*, 26(2004): forthcoming.

Hayenga, M., R. Deiter, and C. Montoya. "Price Impacts Associated with the Closing of Hog Slaughtering Plants." *North Central Journal of Agricultural Economics.* 8(1986): 237-242.

Hornung, J. "Market Effect from Opening and Closing Meat Processing Facilities." Unpublished M.S. thesis, Oklahoma State University, May 2004.

Love, H.G., and D.M. Shuffett. "Short-Run Price Effects of a Structural Change in a Terminal Market for Hogs." *Journal of Farm Economics.* 47(1965): 803-812.

MacKinlay, A.C. "Event Studies in Economics and Finance." *Journal of Economic Literature.* 35(1997): 13-39.

Misra, S.K., C.L. Huang, and S.L. Ott. "Consumer Willingness to Pay for Pesticide-Free Fresh Produce." *Western Journal of Agricultural Economics* 16(1991):218-227.

Muth, M.K., S.A. Karns, M.K. Wohlgenant, and D.W. Anderson. "Plant Entry and Exit from the Meatpacking Industry During Pathogen Reduction and HCCP Implementation." Paper Presented at AAEA annual meeting, Chicago IL, 6-8 August 2001.

Nerlove, M. "Distributed Lags and Estimation of Long-Run Supply and Demand Elasticities: Theoretical Considerations." *Journal of Farm Economics* 40(1958):301-311.

Radtke, H., S. Detering, and R. Brokken. "A Comparison of Economic Impact Estimates for Changes in the Federal Grazing Fee: Secondary vs. Primary Data I/O Models." *Western Journal of Agricultural Economics* 10(1985): 382-390.

SAS Institute. *SAS™ system under Microsoft Windows.* Release 8.2. SAS Institute Inc., Cary, North Carolina. 2001.

Tsetsekos, G.P, and M.J. Gombola. "Foreign and Domestic Divestments: Evidence on Valuation Effects of Plant Closings." *Journal of International Business Studies.* 23(1992): 203-223.

Ward, C.E. "Price Impacts of a Structural Change in Pork Processing-A Case Study in Oklahoma." *Current Farm Economics.* Oklahoma State University Agricultural Experiment Station, 1982, pp. 3-9.

Table 1. Data Descriptions and Sources

Variable	Description	Units	Source
Cattle	KS, TX, CO, NE, IA		
Price, KS, TX, CO, Omaha	FOB live, 1100-1300 lb fed steers, 35-65% choice	$US/100 lbs	AMS*
Slaughter, KS, TX, CO, NE, IA, MN	Federally inspected steer and heifer slaughter	1000's head	NASS
Boxed Beef Value	Reported value for 600-700 lb carcasses	$US/100 lbs	AMS*
Weight	Average weight for 35-65% choice steers from TX/OK, KS, CO, NE, IA/MN	lbs	AMS*
ByProduct Value	Average total steer byproduct value	$US/100 lbs	AMS*
Hogs			
Manitoba Price	Dressed barrow and gilts	$CAN/100 kg	Manitoba government
Alberta Price	Dressed barrow and gilts	$CAN/100 kg	
Ontario Price	Dressed barrow and gilts	$CAN/100 kg	AgriCanada
Saskatchewan Price	Dressed barrow and gilts	$CAN/100 kg	Saskatchewan government
US Prices	Live, 240-280 lbs, 49-52% lean	$US/100 lbs	AMS
US Slaughter	Federally inspected barrow and gilt slaughter	1000's head	NASS
Canadian Slaughter	Federally inspected barrow and gilt slaughter	1000's head	AgriCanada
Cutout Value	Average price for pork cutout	$US/100 lbs	AMS*
Weight	Average live weight for Negotiated hogs	lbs	AMS*
ByProduct Value	Average total hog byproduct value	$US/100 lbs	AMS*

*Data gathered and compiled by the Livestock Marketing Information Center (LMIC)