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# ***Staff Paper***

## **Assessing the Impact of a Hog Slaughter Plant Closing: The Thorn Apple Valley Case**

**Kellie Curry Raper**

raperk@msu.edu

**Laura Martin Cheney**

cheneyl@msu.edu

**Meeta Punjabi**

punjabim@msu.edu

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Department of Agricultural Economics  
MICHIGAN STATE UNIVERSITY  
East Lansing, Michigan 48824

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# **Assessing the Impact of a Hog Slaughter Plant Closing: The Thorn Apple Valley Case**

Staff Paper 2000-27, 15 pages

by

Kellie Curry Raper  
Laura Martin Cheney  
Meeta Punjabi<sup>1</sup>

## **Abstract**

In 1998, Thorn Apple Valley ceased slaughter operations at its Detroit, Michigan plant, the state's only major hog packing facility. We examine the plant closing's local impact via an investigation of whether prices received by Michigan hog producers decreased relative to hog prices in the Eastern Corn Belt.

**Keywords:** market structure, agricultural prices, hog slaughter

**JEL Classification:** D40, Q11, Q13, L1.

Until recently, Michigan pork producers enjoyed the advantages of having a major pork packer operating within their state. However, in summer 1998, Thorn Apple Valley (TAV) announced that it would discontinue hog slaughter at its Detroit-based facility and concentrate its efforts solely on its meat processing operations (Smith, 1998).<sup>2</sup> On July 24, 1998, Thorn Apple Valley, the nation's seventh largest pork packer with a 14,000 head/day slaughter capacity, closed its doors to market hogs. Two noteworthy issues emerged as a result of TAV's decision. First, Michigan pork producers, many of whom had shared a long-term business relationship with TAV that began in the 1950's, were left scrambling to find alternative outlets for their market hogs. Second, many producers believe, and

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<sup>1</sup>Authors are assistant professors and graduate research assistant, respectively, of Agricultural Economics at Michigan State University. Senior authorship is not assigned. This manuscript reports research conducted by the Michigan Agricultural Experiment Station, Michigan State University.

<sup>2</sup>As a point of clarification, Thorn Apple Valley discontinued its fresh pork operations (i.e., slaughter operations) on July 24, 1998. However, the company continued to own and operate its meat processing businesses in Michigan, North Carolina, Arkansas and Oklahoma until the entire company was sold to IBP, Inc. in July 1999.

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anecdotal evidence suggests, that when TAV closed its doors, Michigan producers lost the live hog price advantage they enjoyed relative to their counterparts in other areas of the Eastern Corn Belt. If this is in fact true and lower relative prices persist, the slaughter plant's closing could have long-term implications regarding the profitability and viability of Michigan pork producers.

The objective of this study is to empirically investigate this second issue: has there been a change in the relative price received by Michigan producers following the closure of TAV's kill floor? Specifically, this study attempts to go beyond the rhetoric and anecdotal evidence and empirically examine: (1) the magnitude and direction of the difference between prices received by Michigan producers and their Eastern Corn Belt counterparts in the pre-plant-closing period, (2) whether or not this difference changed in the post-plant-closing period, and (3) whether this difference became more variable in the post-plant-closing period. To do this, it is first necessary to describe the importance of Thorn Apple Valley to the region's pork industry. Next, theoretical background is provided as a foundation for developing an empirical model. The third section outlines the data and model used in the investigation. Finally, empirical results, conclusions and further research directions are offered.

### ***Thorn Apple Valley and the Region's Pork Industry***

Thorn Apple Valley was an integral part of the Michigan pork industry and was the only major hog slaughtering facility in the state. TAV's Detroit-based facility procured live hogs primarily from Michigan, Indiana, Ohio, and Ontario with the Michigan pork industry supplying approximately two million of the four million hogs slaughtered at the facility annually (Peterson, 1996). Michigan Livestock Exchange (MLE), the state's major livestock marketing cooperative that handles approximately 70% of Michigan produced hogs, had a long term marketing agreement with TAV to supply the packer with hogs (Smith, 1996). In fact, the long term goal was for MLE to procure 100% of the hogs used by TAV.

However, low hog numbers in the state left TAV scurrying to locate hogs in neighboring and fringe states, as well as in Canada. When TAV shut down its slaughter floor in 1998, they were killing less than 12,000 hogs per day, well under their 14,000 head capacity. Clearly, the low hog numbers in the state and TAV's aggressive bidding for hogs placed upward pressure on the live hog prices in the state. But the more interesting questions are whether or not hog prices in Michigan were indeed higher than in other Eastern Corn Belt states and what happened to Michigan's live hog prices when TAV was no longer aggressively bidding for hogs.

### ***Literature Review***

From a Michigan perspective, the regional market structure in hog slaughter changed abruptly when Thorn Apple Valley exited slaughter. The literature suggests that this abrupt change in market structure could have two impacts: (1) a change in the basis between the price received by Michigan producers and the price received in the remainder of the Eastern Corn Belt and (2) an increase in the variability of the basis received by Michigan producers. The impacts of similar market structure changes in regional livestock markets are investigated in the literature; however, examples are sparse and focus primarily on changes in relative prices. Three previous studies useful to this analysis are Love and Shuffett (1965), Ward (1983), and Hayenga, Deiter and Montoya (1986). Love and Shuffett investigate the impact on producer prices in a Louisville terminal market when one of two major buyers exits the market in May, 1960, leaving one buyer procuring approximately 80 percent of the hogs marketed. Using data from January, 1959 to December, 1961, they report a significant decline in relative weekly prices in the post-exit period. Ward examines the impact on Oklahoma hog prices when Wilson Foods, the state's only hog slaughterer, exits the market in August, 1981. He finds that hog prices in the adjacent Oklahoma City terminal market initially declined relative to other markets based on weekly price

data from August, 1980 to August, 1982. However, evidence of the price decline lessened over the one-year period following the plant closing. Hayenga, Deiter, and Montoya use a case study approach to investigate relative price impacts of six major hog slaughter plant closings that occurred from September, 1978 through October, 1981. Their results indicate that plant closings' relative price impacts are temporary or insignificant in the markets studied.

Industrial organization (IO) theory suggests that high buyer concentration may translate to low producer prices and, conversely, that lower buyer concentration may result in higher producer prices (Greer, 1992). This concept is of particular interest when considering regional markets. There is evidence from the broiler industry that in regions where buyer competition is intense, growers may gross 20% more than their counterparts in areas dominated by a single processor (*Wall Street Journal*, January 4, 1990). Marion and Geithman (1995) find similar evidence in the live cattle market. In a study of thirteen regional feedlot-packer markets, live cattle prices were three percent less in the most concentrated region versus least concentrated region. Price behavior in the Australian wool market lends credence to the proposition that regional buyer competition can raise producer prices as well. Simmons and Hansen (1997) find that grower prices are higher when competitive small firms remained in the market to compete with "large" buyers, even when the "large" buyer enjoys a cost advantage.

Michigan producers' belief that they had a price advantage over other Eastern Corn Belt producers can be supported by a discussion of overlapping procurement regions with spatially linked prices. According to Schroeder (1997), "rational choices by market participants of sellers selling to the highest bidders make prices spatially linked." Though Michigan could in many ways be considered its own regional market, TAV's procurement region overlapped the procurement region of other Eastern Corn Belt slaughter plants to a certain degree. In particular, TAV was in direct competition for Michigan

hogs with IBP's Logansport, Indiana plant after its 1996 opening. TAV had to then compete more vigorously for Michigan hogs to maintain slaughter rates near capacity. Packers are strongly motivated by excess capacity to bid aggressively against competitors for hogs since capacity utilization rates significantly affect costs per head slaughtered. According to Hayenga's (1998) recent survey of large hog slaughter and processing firms, packers are willing to bid significantly higher prices for hogs when capacity utilization is less than 80 to 90 percent.<sup>3</sup> Hayenga also points out that plants with the most variable sources of hog supplies are most vulnerable, particularly those in fringe areas of production. As a packer in a fringe area of production, TAV likely faced a disadvantage in procurement as compared to plants located in more concentrated production areas. However, TAV's disadvantage may have resulted in relatively higher hog prices for Michigan producers as compared to their Eastern Corn Belt counterparts.

Since TAV's exit from hog slaughter, IBP's Logansport plant is no longer in direct competition for Michigan hogs. As "fringe" producers in the Eastern Corn Belt, it is expected that Michigan producers now become more vulnerable to the daily slaughter needs of Eastern Corn Belt plants. The plausible outcome of this vulnerability is higher price variability. If plants are in need of market hogs to meet daily capacity, they will be willing to procure Michigan hogs at high prices. However, if plants are operating at capacity, they will offer low prices to Michigan producers. Essentially, Michigan producers become "residual suppliers" and, thus, are subject to high price variability. If this is true, it should be reflected in the variance of the basis between Michigan live hog prices and Eastern Corn Belt live hog prices during the post-TAV closing period.

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<sup>3</sup>TAV's capacity utilization rate was likely between 75 and 85 percent when they ceased slaughter operations in 1998.

## *Data and Analysis*

To investigate the magnitude and direction of the difference between prices received by Michigan producers and their Eastern Corn Belt counterparts, it is first necessary to construct a time series of prices in the respective regions. In an ideal situation, one could use weekly prices and define the price difference as  $D_t = P_t^{MI} - P_t^{ECB}$ , where  $D_t$  is the Michigan hog price in period  $t$  minus the Eastern Corn Belt hog price in the same period. However, since weekly Michigan prices are no longer publicly reported, monthly prices are used in the study. The monthly Michigan price is compared to the monthly Eastern Corn Belt price (excluding Michigan) and leads to the following model:

$$(1) \quad D_t = \beta_1 C_t + \beta_2 TAV + \beta_3 Q_1 + \beta_4 Q_2 + \beta_5 Q_3 + \beta_6 Q_4 + v_t.$$

Here,

- D = price difference defined as the monthly average Michigan live hog price less the monthly weighted average Eastern Corn Belt (excluding Michigan) live hog price;
- C = monthly capacity utilization in the Eastern Corn Belt market, excluding Michigan;
- TAV = zero-one dummy for pre- and post-plant-closing of Thorn Apple Valley;
- $Q_i$  = zero-one quarterly dummy,  $i = 1, 2, 3, 4$ ;
- t = price reporting month.

Because price differences between the Michigan market and the Eastern Corn Belt market may be impacted by changes in plant capacity and changes in capacity utilization other than that of TAV, monthly capacity utilization for the Eastern Corn Belt, excluding Michigan, is included.<sup>4</sup> Likewise, because there is the potential for seasonal differentials between the Michigan and Eastern Corn Belt markets, quarterly dummy variables are included. To better account for production cycles, quarters are defined as Q1 = December, January, February, Q2 = March, April, May, Q3 = June, July, August, and Q4 = September,

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<sup>4</sup>Capacity utilization is defined as total monthly federally inspected slaughter divided by monthly slaughter capacity. Monthly slaughter capacity is defined as daily slaughter capacity times monthly network days.



October, November. All monthly price data are obtained from National Agricultural Statistics Service's *Agriculture Prices Annual*. For purposes of the study, the Eastern Corn Belt, excluding Michigan, is defined as Indiana, Illinois, and Ohio. This is consistent with regional definitions used by USDA's Agricultural Marketing Service. Live hog price for barrows and gilts is used and is reported in dollars per hundredweight. The Eastern Corn Belt price used to determine the variable D, the price difference, is a weighted average of the prices in Indiana, Illinois and Ohio where weights are based on each state's monthly slaughter as a percentage of the region's total monthly slaughter. Weekly slaughter by state is reported by USDA's *Livestock, Meat and Wool Weekly Summary and Statistics*. Weekly slaughter is aggregated across the Eastern Corn Belt states, excluding Michigan, to monthly slaughter (in thousand head) for purposes of this study. The time period analyzed is January, 1995 to May, 2000.

Three questions are investigated under this model. First, what is the general trend in the price difference, D, over time? Second, in the post-plant closing period, did the price differential change? A priori, one would expect  $\beta_2 < 0$ . This would imply that when TAV exited fresh pork production, the price advantage enjoyed by Michigan producers decreased. Similarly, one would expect  $\beta_1 < 0$ . When slaughter utilization in the Eastern Cornbelt increases, one would expect less aggressive bidding for Michigan hogs. Alternatively, when slaughter utilization decreases, one would expect TAV and other Eastern Corn Belt packers to be aggressively bidding for hogs in the Michigan market.<sup>5</sup> The third question we investigate is whether price variability changed post-TAV-closing. We analyze the impact of TAV's closing on the variability of Michigan prices as well as on the variability of the relative price

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<sup>5</sup>It is assumed that although a change in slaughter rates in the Eastern Corn Belt will affect both the Michigan and Eastern Corn Belt price, the impact will be greater on the Michigan market because of TAV's aggressive bidding to keep Michigan hogs coming through their plant. For instance, when the IBP Logansport plant moved to a double shift, both the Michigan and Eastern Corn Belt price may have increased, but it is expected that the increase in the Michigan price was greater than that in the Eastern Corn Belt and therefore the difference between the two prices increased.

difference between Michigan and the rest of the Eastern Corn Belt. This is done through tests of unequal variance for pre- and post-TAV closing values of the Michigan average monthly price and of the dependent variable, D.

### ***Empirical Results***

Figure 1 charts the basis between Michigan average monthly live hog price and the Eastern Corn Belt average monthly live hog price from January, 1995 through May, 2000. The chart reveals that Michigan producers have, in general, enjoyed a positive basis over their Eastern Corn Belt counterparts. That basis appears to be even greater in the period where TAV and IBP-Logansport were directly competing for Michigan hogs (September, 1995 to July, 1998). The chart also indicates that the basis may indeed have become more variable after TAV's closing in July, 1998.

When equation (1) was estimated, mild first order autocorrelation was present in the OLS model (coefficient for the residuals was 0.08). In addition, when a Chow test for structural change was performed on equation (1), excluding the TAV variable, the test indicated that a structural break appeared around April, 1999, approximately 8-9 months after the closing of TAV. Consequently, equation (1) was re-estimated with two corrections. First, the variable TAV was decomposed into two parts: TAV1, a binary variable set equal to 1 from July, 1998 through March, 1999 to correlate with TAV's closing, and TAV2, a second binary variable equal to 0 prior to April, 1999, and 1 thereafter to correlate with the structural change indicated by the Chow test. Econometric results for this model are presented in equation (1A) below. Second, a Yule-Walker procedure was used to correct for first order autocorrelation. Standard errors are reported in parentheses beneath parameter estimates.

$$(1A) \quad D_t = -0.801 C_t - 0.138 TAV_1 - 0.821 TAV_2 + 2.529 Q_1 + 1.814 Q_2 + 1.000 Q_3 + 2.093 Q_4$$

$$(0.699) \quad (0.398) \quad (0.333)^* \quad (0.730)^* \quad (0.712)^* \quad (0.675) \quad (0.764)^*$$

The model estimation results in a total  $R^2$  of .60, a regression  $R^2$  of .55, and a Durbin-Watson statistic of 1.93. An asterisk indicates significance at the 5% level.

Overall, the signs of the coefficients are as expected. Both TAV's plant closing and increases in capacity utilization have negative impacts on the basis enjoyed by Michigan producers over Eastern Corn Belt counterparts. The parameter estimate on  $TAV_1$  suggests that in the immediate months following the plant closing, a loss in basis of approximately \$0.14 per hundredweight was experienced. However, this coefficient is not statistically significant. What is interesting, however, is that in the second period following the plant closure, from April 1999 to May 2000, a loss in basis of \$0.82 per hundredweight is indicated by  $\beta_3 = -0.821$ . Moreover, this basis loss is statistically significant at  $\alpha=.05$ . This basis loss likely reflects the fact that Michigan producers no longer reaped the benefits of competitive bidding for their hogs after a major buyer exited the geographical market.

Monthly capacity utilization negatively impacts the basis as indicated by  $\beta_1 = -0.801$ , but is not statistically significant at  $\alpha=.10$ . This suggests that, all else constant, a one percent increase in capacity utilization in other Eastern Corn Belt states decreases the basis for Michigan producers by 80¢/cwt. Alternatively, decreases in Eastern Corn Belt capacity utilization lead to an increased basis for Michigan producers. This result suggests that buyers in other Eastern Corn Belt states bid more aggressively for geographically distant Michigan hogs when capacity utilization is lower. A likely motivation for this is to keep plants operating at a lower cost level. When capacity utilization is higher, those buyers are more likely to fill slaughter hog needs with relatively near markets and thus, bid less aggressively for Michigan slaughter hogs.

Another interesting result from the model is that Michigan producers appear to enjoy a greater basis in the first and fourth quarters (\$2.53/cwt. and \$2.09/cwt.) than in the second and third quarters (\$1.81 cwt. and \$1.00/cwt.). This finding is somewhat surprising given that, during the time period analyzed, many pork producing regions in Michigan, particularly Southwest Michigan, still had a significant outdoor and seasonal farrowing compared to their Eastern Corn Belt counterparts. One would expect the greater percentage of spring and summer farrowings to lead to increased Michigan market hog supplies in the first quarter, a lower Michigan price, and therefore a smaller basis. However, empirical results suggest the opposite pattern. This leads one to believe that differences in production systems between regions either may not be as significant as was first thought or may not have significant influence on the basis. It is plausible that tighter hog supplies in the summer months lead to expanded geographical procurement markets due to increased competition for market hogs and therefore a tightening of the basis. Further investigation is needed to determine to what degree geographical procurement markets overlap and whether that overlap is consistent across quarters.

The question of whether Michigan producers faced a more variable basis or a more variable monthly average price in the post-TAV closing period than in the pre-TAV closing period is addressed through a test for equal variances. The dependent variable, D, is split into two samples based on TAV's closing date to assess whether the variability of the basis between the Michigan price and the Eastern Corn Belt price changed. Sample variances are calculated and an F test is conducted where  $F = s_{\text{post}}^2 / s_{\text{pre}}^2$  to determine whether the variances for relative price differences across the two time periods are equal. For the pre-TAV closing period,  $s_{\text{pre}}^2 = 0.982$  while  $s_{\text{post}}^2 = 1.798$  for the post-TAV closing period. Visual inspection of these values along with Figure 1 leads to the conclusion that the post-TAV closing variance of D is higher than that of the pre-TAV closing period variance and is confirmed by the test. In

this case,  $F_{42,23} = 1.83$  and has an associated p-value of 0.04, indicating that the null hypothesis,  $H_0: s_{\text{post}}^2 \leq s_{\text{pre}}^2$  is rejected. For the time period included in our econometric estimation, the variance of monthly relative price differences is higher in the post-TAV closing period than in the pre-TAV closing period. This result is as expected since TAV's exit from slaughter decreased the competitive bidding for Michigan hogs, leaving Michigan as a residual supplier to the Eastern Corn Belt market because of geographical location. Although this test reveals that the basis is more variable following TAV's closing, the test does not reveal the source of the variability.

To determine whether the Michigan average monthly price is more variable post-TAV closing than pre-TAV closing, a similar test is conducted. For the Michigan average monthly price, the variance during the pre-TAV closing period is  $s_{\text{pre}}^2 = 59.456$  while the post-TAV closing period has a variance of  $s_{\text{post}}^2 = 54.294$ . The associated F value is 0.913 with a p-value of 0.58. Thus, we do not reject that the variance of the Michigan average monthly price is the same across both pre- and post-TAV closing periods. This result is opposite of our expectation; however, it is possible that using monthly data smooths out some of the variability and that the use of more frequent data points would give a different result.

### ***Conclusions and Future Research***

TAV's Detroit plant closing is consistent with Drabenstott, Henry and Mitchell's (1999) findings that meat packing is shifting away from metropolitan Midwest sites to more rural Midwest sites. In general, the industry has shifted from the eastern Corn Belt to the more rural western Corn Belt. As the concentration of packing plants follows the livestock production migration, questions arise as to the impact of the geographical shift on producers in 'fringe' states such as Michigan. The TAV closing provides the opportunity to examine this issue first-hand. Our results indicate that Michigan hog

producers did enjoy a higher price for market hogs than other Eastern Corn Belt hog producers. When TAV exited slaughter, Michigan's price advantage appears to have diminished, yet is still positive. This change in price advantage may well have negative implications for the long-term viability of Michigan's hog industry. The impact of changes in capacity utilization was also examined. Though the magnitude is small and is not statistically significant, increases in monthly capacity utilization rates in the Eastern Corn Belt states excluding Michigan may lead to decreases in the basis for Michigan producers. Additionally, the variability of the Michigan price and of the price difference between Michigan producers and other Eastern Corn Belt producers was examined for the period before and after TAV's closing. Though our results suggest that there is no statistical difference in the pre- and post-TAV closing variance of the Michigan price, we do find that the variance of the basis increases, as expected. This increased variance of the basis in the post-TAV closing period may imply that the degree of market overlap between Michigan and other Eastern Corn Belt states has changed with the closing of a major Michigan plant and that states's status is now that of a residual supplier.

There are number of important caveats raised by the findings in this study. First, it is unlikely that the price impact is the same for producers across Michigan. Relative to producers located near TAV's plant in southeastern metropolitan Michigan, producers located in western and southwestern Michigan have traditionally have more market outlets because of closer proximity to Eastern Corn Belt markets. Unfortunately, state level price data by region does not exist. Thus, this question is difficult to examine empirically.

Second, it is also possible that Michigan hog producers only enjoyed a price advantage during the period when there were two major packing plants (TAV and IBP-Logansport) competing for their hogs. Unfortunately, we are restricted by data in one category to begin our study in January, 1995, just 9

months before IBP-Logansport began operations. However, an extended study with more data prior to IBP-Logansport's opening is needed to empirically determine whether the price advantage existed before that plant's existence.

Third, an additional extension of the study would examine supply side variables as well. Our study includes capacity utilization, defined as slaughter divided by plant capacity, as an attempt to reflect demand for hogs. However, we have not adequately accounted for changes in supply. Such changes should be reflected by market hog numbers in the various regions. This inclusion may be important, particularly in sorting out whether Michigan's price advantage existed prior to IBP-Logansport's opening and what factors may have contributed to that price advantage.

Fourth, the study could be extended to examine whether Michigan is a separate market for slaughter hogs or, if it is an overlapping market with the rest of the Eastern Corn Belt, to what degree does the overlap exist. It is plausible the magnitude of the overlap has changed since TAV's closing. This may be useful in further explaining the full impact of TAV's exit on the region's markets.

Lastly, the questions raised in this study may be more appropriately examined using weekly rather than monthly data. Although monthly might provide a reasonable examination of the issue, weekly or daily data may provide a more accurate investigation of the change in relative prices. In particular, weekly data might provide better insight into the adjustment path that occurred in the post-plant closing period and help to explain the insignificance of the coefficient on  $TAV_1$ . As a result, observations closer in time may also allow an investigation of whether those differences are stable or diminishing over time.

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**Figure 1: Average Monthly Price Difference: Michigan Live Hog Price - Eastern Corn Belt  
Live Hog Price (excluding Michigan),  
January 1995-May 2000.**

