The Effects of the Micro-Market Structure on Illinois Elevator Spatial Corn Price Differentials

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Paper presented at the NCR-134 Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management

Chicago, Illinois, April 17-18, 2000

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Abstract

Corn price differentials among Illinois elevators can often exceed transportation costs. Using primary data, we examine the effects of micro-market structure variables on the differentials in bids prices offered by Illinois elevators. Our findings suggest the existence of a highly developed, responsive market of competing firms, operating in an industry that can be characterized by monopsonistic competition, and to some extent by seasonally induced market power. Local supply conditions, firm productive efficiency, and their operating practices influence price differentials. Further, firm type, final market destination of the grain, and period of the marketing year affect price differentials.

Keywords
Market structure, Corn price differentials

Introduction

Over the past 30 years, the structure of the U.S. grain industry has undergone considerable change. Sparked by expanding exports, marketing margins increased as the demand for marketing infrastructure exceeded the supply. As firms struggled to adapt to the increased demand, investments were made in facilities to handle and ship large volumes for export. However, these facilities came on line as exports began to decline (Jones, 1998), creating excess capacity. The excess supply of marketing infrastructure increased competition, lowered marketing margins, and led to many mergers, acquisitions, and plant closures. Pressure on local elevators also increased as farmers grew in size and began to ship to sub-terminals or other end users. Unit train rates in the 1970s fostered the development of sub-terminals, and encouraged some country elevators to modernize their rail load out facilities, putting pressure on country elevators that did not modernize their facilities to change their marketing practices or to leave the industry (Dahl, 1998). Later, rail deregulation allowed for flexible rate structures, eliminating much of sub-terminal rate advantages. In short, a combination of large investment in the 1970s, and changes in export demand, in marketing channels, and in the structure of rail rates have caused consolidations, closures, and acquisitions in the grain industry. As firms struggle to achieve lower costs associated with larger volumes, this pattern will likely continue.

Increased concentration in the grain industry has raised questions regarding the performance of the industry. At the producer level, these questions are manifested by concerns that a lack of competition at the local level may be adversely affecting producer prices. Over time, several researchers (Jones, 1971; Davis and Hill, 1974; McCully, 1999) have investigated the relationship between producer price and the micro-market structure of Illinois local markets to shed light on this issue. All of these studies have been based on primary data, and have

concentrated on identifying the factors that influence producer price differences among elevators in Illinois.

Jones (1971) analyzed the effect of 14 structural variables on corn prices received by producers using data from 37 elevators in the 1969-70 crop year. The motivation for the work was the general concern over price differences that seemed to not be associated with costs in time, space and form. Price data were analyzed using regression procedures, but the findings were plagued by a high degree of collinearity. Nevertheless, Jones concluded that prices paid by elevators were influenced by: the number of bids received during the day; the hedging activity of the firms; and the degree of services provided by the elevator. A larger number of bids per day resulted in higher producer prices, reflecting higher local demand. More sophisticated elevators that actively participated in hedging activities, and provided services beyond simply merchandising also paid higher prices. The availability of different modes of transportation, the size of the firm, and the number of competing elevators within a 10-mile radius during the harvest period did not influence price differences. Interestingly, the number of elevators in the 10-mile radius had a negative effect on price during the period.

Davis and Hill's work, which is clearly the most comprehensive piece, examined the topic more thoroughly, using prices and survey data from a larger number of elevators (41), and a more detailed set of variables (35). They found a highly developed, responsive market of competing firms, operating in an industry structure characterized by monopsonistic competition, and seasonally induced spatial monopsony. Specifically, local supply and demand conditions were influential in explaining price differentials. Firms that hedged, shipped longer distances, and had high turnover ratios offered higher prices. The size of the firm was not related to prices paid, and consistent with the Jones study the number of firms in competing areas was negatively related to price differences. Further, they discovered that cooperatives paid higher prices than private grain firms, and that local support prices were highly influential in determining price.

Here, we revisit the topic of the effect of micro-structure variables on Illinois corn prices using firm and local market data in the hopes of providing insight into the changing nature of the structure of the grain industry on producer prices. A sample of 42 elevators throughout Illinois that participated in the Market News Service (Illinois Department of Agriculture) was surveyed using personal interviews. We collected information on firm operations (firm type, scale, scope, efficiency, market destinations, risk reduction practices), local supply and demand conditions, and local competition that could be matched with daily prices the elevators reported to the News Service. Using both least squares and factor analysis, we investigate the relationship between corn price and the set of micro-market structure variables. In addition, we compare our findings to Davis and Hill's findings to assess whether the influence of these micro-market structure variables has changed dramatically over time.

The analysis provides insight into the price relationships faced by producers in their local markets, suggesting which outlets might be most attractive. Further, the findings shed light on the effect of industry consolidation on micro-level price relationships, and provide some indication of what might be expected as further structural changes in the industry occur.

The organization of the paper is straightforward. In the next section, we provide a discussion of theoretical considerations used in the analysis. This is followed by a discussion of the data and its characteristics. We then discuss the empirical methods, the adjustments made to the data, and the empirical models used in the estimation. This is followed by a presentation and discussion of the results, and their implications.

Theoretical Considerations

Within the context of the efficient market paradigm, prices in space, form, and time should differ by no more than the costs of transportation, transformation, and storage. Prices may vary within a band too narrow to provide profit opportunities from arbitrage over space, form, and time. Examination of county elevator bid prices data suggests that in the grain industry prices cannot be completely explained by these cost factors.

The cause of price variability among country elevators has been classified into four general categories: 1) differences in availability and cost of transportation; 2) differences in operating costs; 3) differences in local demand and supply conditions; and 4) market power. Categories 1, 2, and 3 provide an economic rationalization for price differentials (Davis and Hill) but price differentials can exist only if there is some degree of market power to hold customers at a lower bid price. Category 4 implies that the firm is using market power to increase profits or returns to management.

Theory suggests that some elements of geographical monopsony can exist in the elevator industry by virtue of the spatial relationships among firms (Faminow and Benson). The extent to which this provides market power depends not only on physical distances from producer to an elevator and competing firms but on the farmers' opportunity costs and delivery costs at various seasons of the year. Consequently, perfect competition does not provide a satisfactory norm for evaluating performance in this industry with economies of size and where firms are competing for product only at the periphery of a market area.

Transportation costs

Of the four categories of variables listed above, transportation is the one most frequently used in explaining geographical differences in price. Spatial prices in the perfect market would be assumed to differ by no more than the cost of transportation between any two points (Bressler and King). This should not be accepted as evidence of adequate performance without a more detailed explanation, because price differentials well within the limits of transfer costs may still represent monopsony profits (i.e., profits above the required returns to factors) of a magnitude greater than acceptable norms. Transportation cost between two points can at times be considerably larger than the gross margin of the elevator at either of the points. In addition, transportation cost is a valid measure of the limits of price differentials between two elevators only if grain can logically flow from the low-price point to the high-price point. Ultimate destination and use, cost of handling and routing for transshipment, and seasonal fluctuations in storage space often make shipment between two particular points infeasible despite a price differential greater than the cost of transportation.

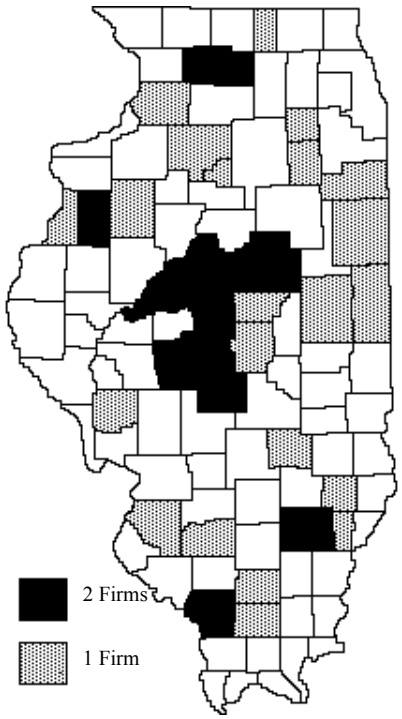
Operating costs

Under perfect competition the producer would presumably sell to the elevator with the highest bid with no knowledge of, or interest in, their costs of operation. Differences in costs would have to be absorbed in the returns to one of the fixed factors of production. High cost firms are usually absorbed or abandoned. Many of the variables in this study were indicators of or closely associated with costs of operation. Utilization of space, volume of business, production density, and type of firm should all reflect differences in operating costs and efficiency. To the extent that these explain price differences, they are evidence of the presence of market power – not necessarily the abuse of market power.

Demand and supply

Local demand and supply conditions may also affect prices paid to farmers. Elevators with direct access to a higher priced market or located in an area of high livestock demand may have seasonal opportunities for sales that can be passed on to farmers in the form of higher prices (Hill). Fluctuations in local supply relative to other regions or time periods are reflected in prices, especially if fixed resources cannot be adjusted to match the supply on hand. Response to seasonal supply is evidenced by wider margins and lower flat price at harvest, as farmers' primary interest is unloading the grain quickly at the closest dump pit and elevator managers are trying to slow deliveries to match drying, storage, and shipping capacities that fluctuate on a daily basis (Davis)

Figure 1. Distribution of Surveyed Firms



Market power

Concern over the abuse of market power stems from the ability to vary prices to producers beyond the movement of the market. While producers can understand adjusting prices as a result of costs, they are not as accepting of lower prices in response to lack of competition for the available supply. Harvest gluts provide the opportunity for firms with market power to adjust prices to the lowest level the market will bear.

Data and Adjustments

The market structure data were collected through a survey of 42 Illinois elevators located throughout the state during the summer 1998 (Figure 1). The survey corresponded closely to Davis's original instrument, and was reviewed by a panel of industry experts, and pre-tested with elevator managers before it was administered. The elevators interviewed are participants in the Market News Service (MNS) program to collect representative daily prices for Illinois, and as such were selected to accurately represent the prices offered to farmers. Fifteen elevators that participate in the MNS price collection program were not interviewed either because the firms declined to participate or could not be

scheduled during the interview period. However, a comparison of bid prices for elevators that participated and those that did not participate in the survey demonstrated little difference. Using a t-test, we could find no difference between the respondents and non-respondents prices at conventional levels of significance. Further, the firms that were not surveyed were spread throughout the state and were a mix of firm types and ownership. Hence, exclusion of these elevators should not reduce the representativeness of the sample.[1]

Based on the work by Davis and Hill, the elevators were surveyed to identify potentially relevant market structure variables related to the concepts of: 1) local competition; 2) firm type, firm efficiency and scale, and the nature and scope of their operations; 3) local supply and demand; 4) market destinations of their grain sales; 5) and transportation availability and use. Table 1 provides a summary of the relevant statistics for the continuous and discrete variables (e.g. do you hedge your purchased grain immediately?, 1 = yes, 0 = no). A more detailed description of the variables is available from the authors.

Daily number 2 yellow corn prices were assembled for the 1996-1997 crop year (September 1996 - August 31, 1997) for each of the elevators. The average daily price for the elevators was $2.75/bushel, with a standard deviation of $0.25/bushel. The simple correlations among the prices at the responding elevators are quite high ranging from 0.92 to 0.99. This is somewhat in contrast to the data used by Davis and Hill, and is likely attributable to the availability and transmission of market information, and the increased consolidation in markets.

Figure 2 provides a visual presentation of the movement of the average price bid to producers and its standard deviation through the period of analysis. The temporal variation in prices is categorized into 3 periods, the harvest (September 3 - November 5), distribution (November 6 - July 7) and new crop adjustment (July 8 - August 31) periods. In general terms, these periods reflect the influence of the old and expected crops on the current year price. During this year, the harvest period was heavily influenced by relatively poor U.S. and world corn production in the previous year, and by extremely small predicted and actual ending stocks. Corn had to be severely rationed in the last quarter of the previous crop year which is reflected in the initial high corn prices. Corn prices then declined to more moderate levels as it became clear that actual corn production would exceed the USDA August crop estimates. The market appears to have fully adjusted to harvest conditions as prices firm up after November 5, 1996. During the distribution period, prices were relatively steady due to strong domestic consumption, but began to move up slightly during the New Crop adjustment period as information on expected production suggested a slightly lower level of output.

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[1]Two multinational firms with two facilities each declined to participate for confidentiality reasons. The extent of the effect should be minimal since they comprised only 7 percent of the total population. Two cooperative firms with two each facilities, also refused to be included in the survey.

Table 1. Summary Statistics of Market Structure Variables

Analysis of Continuous Variables

	Average	Minimum	Maximum	Standard Deviation
Competition Related				
Size of Supply Area	17.0	3	90	16.7
Number of Competing Plants Within 10 Mile Radius	3.0	0	7	2.2
Number of Competing Plants Within 20 Mile Radius	7.8	1	29	6.1
Number of Elevators in County	12.8	2	35	8.3
Firm Efficiency Related				
% of Total Storage Capacity that is Upright	88.6%	26.3%	100.0%	17.1%
Turnover Ratio	9.3	0.4	176.2	28.4
Average Annual Utilization of Storage Space	58.4%	25.0%	98.0%	17.1%
% Full At Harvest	95.2%	61.0%	125.0%	11.1%
Local Supply and Demand Related				
Density of Production in the Country	57.9	14.9	81.2	20.2
Yield Per Acre	136.2	88.0	168.0	22.4
% Farm Sales from Grain	74.6%	46.6%	94.8%	11.9%
Market Destination Related				
% of Volume Shipped to in-State Destinations	71.1%	0.0%	100.0%	40.4%
Firm Scope Related				
Volume of Corn Dried/Total Annual Receipts	38.4%	0.0%	89.6%	27.4%
Moisture Discount Rate	$0.55	$0.23	$0.70	$0.07
Merchandizing Margin	$0.07	$0.01	$0.24	$0.04
Storage Rate to End of June	$0.24	$0.16	$0.33	$0.05
% Income from Storage	19.2%	0.0%	60.0%	14.2%
% Income from Drying	17.4%	0.0%	55.0%	13.9%
% Income from Grain	52.3%	20.0%	99.0%	20.5%
Firm Scale Related				
Total Storage Capacity	1,651,381	60,000	7,100,000	1,503,625
Grain Receiving Rate	19,411	2,000	50,000	12,736
Grain Shipping Rate	16,590	4,000	55,000	11,780
Total Annual Grain Receipts	5,597,179	200,000	75,000,000	11,818,304
Transportation Related				
Number of Main Rail Lines to Markets	0.7	0.0	4.0	0.9
% Volume Shipped by Rail	27.5%	0.0%	100.0%	40.2%
Number of Markets Regularly Shipped to by Rail	1.9	0.0	9.0	3.0

Analysis of Discreet Variables

Market Destination Related	Observations
Primary Market Out of State	12
Primary Export	5
Primary IL Processors	14
Primary Se Markets	6
Risk Avoidance Related	
Hedge Immediately	27
Speculate On Some Corn	8
Firm Scope Related	
Store Grain for Farmers	37
Grain Source from Farmers & Elevators	16
Feed Sold	15
Seed Or Chem Sold	21
Grain Sales to Farmers & Terminals	33
Transportation Related	
Ship Rail	11
Ship Barge	4
Firm Type Related	
Cooperative	20
Multinational	10
Single Plant	9
Subterminal	7

In general terms, prices among elevators vary by location in the state. The average daily range of prices was $0.29/bushel with a standard deviation of $0.09/bushel. Most of this variation is likely attributed to where the firm is located in the state, and must be removed to analyze how market structure variables influence the bid prices. To adjust elevator prices, we use the "posted county price" (PCP) provided by the Farm Service Agency. The PCP is an estimated price that reflects the average cash price a producer would receive for grain in their county on a specific day. The prices are based on relevant terminal markets, and a commodity differential that varies by commodity and county. The posted county prices provide what should be an average daily cash price for the county where each firm is located. Subtracting the posted county price from the elevator price provides a price differential or margin reflecting the price offered by each elevator adjusted for the spatial component.[2] Table 2 provides a summary of the adjusted corn prices for the full year, and by period of the year.

Table 2. Summary Statistics of Adjusted Prices

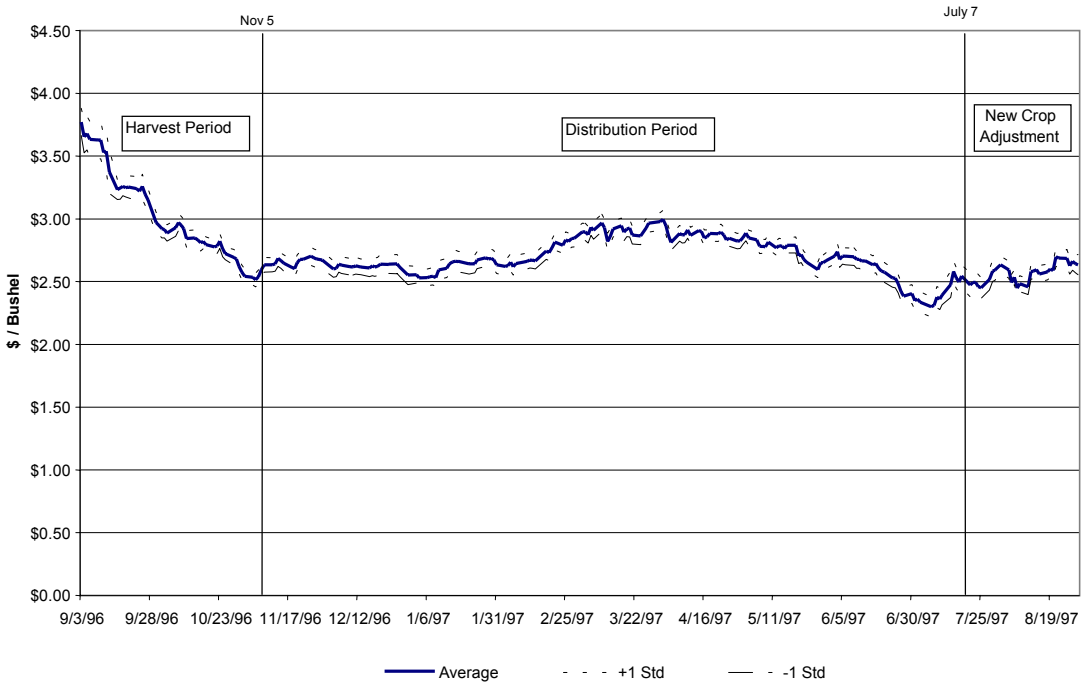
Time Period	Average	Minimum	Maximum	Standard Deviation
Harvest Period	($0.036)	($0.115)	$0.124	$0.059
Distribution Period	$0.032	($0.057)	$0.134	$0.045
New Crop Adjustment (1997)	$0.043	($0.064)	$0.170	$0.059
Full Year Average	$0.021	($0.040)	$0.116	$0.041

Empirical Procedures and Results

The relationships between the market structure variables and the adjusted corn price were analyzed using three basic methods: 1) bivariate correlations between the market structure variables and the adjusted prices; 2) regression analysis between selected market structure variables and the adjusted prices; and 3) regression analysis between the market structure variables and the adjusted prices using factor analysis. Regression and factor regression were performed for the three periods identified above. Since the results across the regression and factor regression analysis procedures were quite similar, we focus here on the regression analysis for brevity and ease of interpretation.

[2] We also adjusted the prices by the county loan rates which were used by Davis and Hill. The county loan rates vary spatially in a similar manner to the PCP, since the commodity loan program tries to ensure everyone the same relative price. In the 1996-1997 crop year, the difference between the PCP and the loan rate was $0.79/bushel with a standard deviation of $0.02, but the correlation between the two prices was 0.88 which suggests that they reflect the same concept. The results from that analysis are qualitatively the same as the findings presented here.

Figure 2. Seasonal Price Movements in Corn Price Visually Analyzed



The results of the bivariate correlations in the three distinct time periods (i.e., harvest, distribution, and new crop adjustment) revealed that the direction and magnitude relationships varied considerably over time. In general, for most of the variables the harvest period relationships were smaller in magnitude, and frequently demonstrated opposite signs relative to the other time periods. This suggests that the market structure variables have less influence on price during the harvest period than other periods of the year. These findings are somewhat consistent with Davis and Hill whose findings reflect lower correlations during the harvest period. Since the distribution period is the period with the largest number of price observations, and is the time period when structural relationships should be the strongest, it will be the focus of the presentation, but we will provide some discussion on how the relationships changed in other periods.

Numerous factors may explain price variability. Based on economic theory, local supply and demand characteristics may influence prices paid to producers. Large production relative to demand can reduce local price during the harvest. Prices may also be influenced by number of buyers in a given area. Differences in operating costs among elevators in the presence of monopsony power can be reflected in price differentials. In a competitive market, producers would presumably sell to the elevator with the highest bid regardless of operating cost of the elevator. Many of the variables here are associated with the costs of operation. Variables which reflect scale, and type of firm may reflect differences in operating costs, and efficiency. To the extent that they are important, they may reflect some degree of market power. Finally, location theory and the accessibility of certain firms to transportation that may permit them direct access to higher priced markets may permit them to pass on higher prices to producers.

Specifically, we regress the adjusted price on variables that reflect the scale of the firm, the scope of the firm, the ownership type, measures of productive efficiency of the firm,

measures of local supply and demand, the firm's risk reduction practices, local competition faced by the firm, and the final markets for the grain (equation 1). The categories were selected based on theory and the findings from previous research. The specific measures for each category were chosen based on the bivariate correlations, and to match the variables selected by Davis and Hill.

$$(1)\ \text{Adjusted Price}_t = \beta_0 + \beta_1 \text{Scale}_t + \beta_2 \text{Scope}_t + \beta_3 \text{Ownership}_t + \beta_4 \text{Productive Efficiency}_t + \beta_5 \text{Local Supply/Demand}_t + \beta_6 \text{Local Competition}_t + \beta_8 \text{Final Markets}_t + \varepsilon_t$$

The results from the least squares estimation are presented in table 3. The variables appear to explain much of the variation in adjusted prices among the elevators, with an adjusted R-square of 0.821. The residuals of the estimated model were examined for normality using the Jarque-Bera test and the Shapiro-Wilk's test (1965), for misspecifications using the using the Reset test, and for heterscedasticity using the Reset test (McGuirk, 1993).

Under the null hypothesis that the sample's error term distribution is normal, the Jarque-Bera test follows a chi-square distribution with two degrees of freedom. For sample sizes, critical values were calculated by Bera and Jarque (1981), and more recently by Deb and Sefton (1996). Deb and Sefton's critical values are used because of their greater accuracy. At the .05 level, the critical value is 4.74 which is exceeded by the value of the Jarque-Bera statistic, 6.16, and modestly rejects normality. The Shapiro-Wilk's test, which was designed for small samples, essentially can be thought of as the correlation between a probability plot of expected values following a normal distribution, and a probability plot of the actual values. Lower values of the test cause rejection of the null hypothesis. The Shapiro-Wilk's statistic is 0.971 which fails to reject the null hypothesis of normality at the .05 and .10 levels of significance.

Because the Jarque-Bera test is sensitive to outliers (Spanos, 1986), we examined the characteristics of the observations in the tails, and noted some potential for intra firm pricing as a source of the outliers. Our attempts to reduce the problem by including several dummy variables, however, proved unsuccessful. We next considered the possibility of alternative functional forms, and transformations of both the dependent and independent variables (Spanos, 1986), but the situation worsened. In light of our efforts, and the fact that deviation from normality does not appear to substantial, we proceed with the understanding that the quality of inference may be modestly affected.

The results for the other set of tests are more favorable. The Reset test for misspecification that regresses the residuals on the explanatory variables, as well as the second and third powers of the fitted values, could not reject the null hypothesis that the model was correctly specified. Further, Reset test for heteroscedasticity that regresses the squared residuals on the second and third powers of the fitted values, could not reject the null hypothesis that the residuals were homoscedastic.

Signs of the coefficients generally accord with expectations. Several of the firms' practices and characteristics have significant effects on adjusted prices. Firm scope (the percent

of income from grain merchandizing) is significant and negative, indicating that firms that make a larger percent of their income from grain merchandizing, and hence are less diversified in other services, pay lower prices. Since firms are not receiving income from other sources, they may need to generate larger profit from grain merchandizing, resulting in lower prices to producers. Although statistically significant, the effect of firm scope is not highly economically significant. If a firm moved from receiving 20% of their income from grain to 99% of their income from grain (the range of the sample), prices paid would decline by only 0.1 cent/bushel.

Table 3. Regression Results for Adjusted Prices During the Distribution Period

	Initial Specification	Alternate Specification
Constant	2.637E-02	5.102E-02
	(1.538)	(3.570)
Cooperative	-1.477E-02	-1.840E-02
[Cooperative Firm = 1, otherwise 0]	(-2.008)	(-2.400)
Multinational	3.608E-02	3.214E-02
[Firm operates outside the US = 1, otherwise 0]	(3.107)	(2.622)
% Income from Grain	-5.336E-04	-5.800E-04
[Percent of Net Income received from grain merchandizing]	(-3.020)	(-3.097)
Turnover Ratio	9.131E-04	9.192E-04
[Bushels of grain handled at facility/ storage capacity]	(1.570)	(1.482)
Turnover Ratio Squared	-5.122E-06	-4.920E-06
	(-1.677)	(-1.511)
Number of Competitors	-6.195E-03	-4.280E-03
[Competing grain firms in a 10-mile radius]	(-3.478)	(-2.549)
Hedge Immediately	1.467E-02	1.578E-02
[Grain purchases are hedged immediately = 1, otherwise 0]	(2.243)	(2.267)
Grain Receipts	1.183E-10	2.634E-11
[Bushels of grain handled at facility]	(.304)	(.064)
Production Density	4.419E-04	—
[County corn production in bushels/ total county agricultural acres]	(2.300)	
Ship SE	3.308E-02	3.046E-02
[Highest percentage of corn is sold to South East market = 1, otherwise 0]	(3.161)	(2.745)
Ship Export	5.528E-2	5.751E-02
[Highest percentage of corn is sold to Export market = 1, otherwise 0]	(3.725)	(3.639)
$\bar{R}^2$	.821	.796
Jaque-Bera	6.162	4.704
Shapiro-Wilk	.971	.954

t-statistics are in parentheses. Variable definitions are in brackets.

The risk avoidance variable (whether or not a firm hedges it's purchases immediately) indicates that firms that hedge immediately after the purchase of the corn pay $0.015/bushel more

than firms who hedge at a later time. The reduction in risk related costs for firms that follow this practice are passed back to the producer.

The concept of firm productive efficiency is measured by the turnover ratio. A plot of the turnover ratio against the adjusted prices suggested a nonlinear relationship. Our findings indicate that as firms become more efficient, they pay higher prices but at a decreasing rate. While the relationship is not highly significant, the weight of the evidence across other time periods, and specifications suggests its importance.

The firm scale measure (total annual grain receipts) does have a reasonable sign suggesting that firms that handle more grain would pay higher prices, but is not significant to any degree. This may be a result of collinearity with other included variables, particularly firm efficiency which is measured by turnover.

Firm ownership is a significant concept in explaining the variation in adjusted prices. The results indicate that multinational firms pay more than private firms and cooperatives, with multinational firms paying about $0.036/bushel more than private firms. Cooperative firms on the other hand pay $0.015 less than private firms. The findings with regards to the multinational firms appear to be rather robust in this context. One might hypothesize that multinational firms are primarily subterminals located on the river and shipping to export which would influence price. However, the inclusion of a dummy variable to differentiate between subterminals and other firms, did not change the overall findings appreciably.[3] With regards to the cooperative differential, it should be noted that our cooperative prices do not take into account any patronage refunds that farmers receive, nor additional services that cooperatives tend to provide with regard to providing seed, chemicals and other farm inputs.

The nature of the final market measured by the primary market to which corn is shipped (southeast market, export, or Illinois) plays an important role in determining the price producer's receive. The findings show that firms that ship corn out of state pay more. Specifically, firms that shipped their grain primarily to export pay $0.053/bushel more for corn, and firms that shipped to the Southeast pay $0.033/bushel more than firms whose primary market is in Illinois.

Two concepts that are difficult to measure produced unexpected signs. The local competition variable (i.e., the number of competing elevators within a 10-mile radius) was expected to be positively related to price, while the local supply variable (density of corn production in the county) was expected to be negatively related to price. With regards to the local competition variable, Davis and Hill also found a negative relationship and conjectured that since areas of greater supply throughout the state also have more elevators, this variable was actually measuring local relative supply. The sign of the corn density in a county is more

[3] The results from the factor regression analysis do not permit direct measurement of the "multinational" effect because the multinational variable is grouped with other variables such as barge shipping, the importance of the export market, subterminals, turnover ratio, and size of supply area, which tend to reflect the importance of larger river elevators.

problematic to explain, but may be suggesting that county production is not appropriate for measuring local supply conditions. We re-estimated the regression for the distribution period deleting the production density variable and using the number of competitors variable to represent local supply. This is presented in table 3. Note the slight reduction in the adjusted R-square, and the modest changes in the coefficients. In this specification, normality is not rejected at the .05 level of significance, and the other set of tests show no signs of misspecification.

While the results across the regression analysis and the factor regression analysis were similar, the results differed across the periods. The primary difference was during the harvest period when neither the regression model nor the factor regression analysis were highly consistent with the structure of the data. For example, the adjusted R-square in the regression was .143 in the harvest period compared to the .821 in the distribution period. Similarly, many of the coefficients declined in size, non-normality in the residuals became much more prevalent, and the statistical significance of the coefficients declined markedly. While Davis and Hill reported a decline in adjusted R-square during the harvest period the reduction was much less, with a drop from .778 in the distribution period to .557 in the harvest period. Part of the decline in explanatory power may be attributable to the increased variability during the harvest period demonstrated in table 2, but the variability also was high during the new crop adjustment period. These findings may be suggesting that during the harvest period the "normal" marketing patterns and conduct were not be maintained. In light of the negative adjusted prices that existed during the period (table 2), it appears that elevators may have been exercising monopsony power in the market based at the discretion of the individual firm. Finally, the results during the new crop adjustment period were more consistent with the distribution period, registering a higher degree of explanatory power than the harvest period, but with significant non-normality, some sign reversals, and a lower degree of statistical significance.[4]

Concluding Comments

Similar to Davis and Hill we find a highly developed, responsive market of competing firms, operating in an industry structure which can be characterized by monopsonistic competition, and to some extent by seasonally induced market power. Many of the concepts that were used in the Davis and Hill work are still important in explaining the variability in adjusted price, but subtle differences do exist which are a reflection of the changing nature of the marketing system.[5] Both studies identified the importance of local supply and demand conditions, firm productive efficiency, and the operating practices (i.e., risk avoidance, and diversification of services) on prices paid. Major factors affecting producer prices also appear to be the final market destination, and the ownership type. Over a wide range of specifications, firms that ship by rail to the southeast markets, or by barge to export pay significantly more than

[4] The cooperative, and risk avoidance variables changed signs but were not statistically significant.

[5] Due to differences in variable definitions, and procedures used to address spatial price differences, a direct comparison of the research efforts is not possible.

firms whose primary markets are in state. Calculations based on one of Davis and Hill's specifications suggest that firms that ship out of state paid 0.5% more than the average, while our findings support that firms that ship out of state pay about 1.7% more than the average. This would suggest that access to more distant markets is more important in explaining price differences today. Both studies find that ownership patterns have an influential effect on prices. Hill and Davis find the cooperative firms pay more than private firms. However, we find that cooperatives pay significantly less than other firms, and that multinational firms offer higher prices. As identified earlier, the lower prices offered by cooperatives may reflect that our prices do not incorporate patronage refunds, nor the services that cooperatives may offer. The positive effect of multinational firms may reflect the presence of gains from increased productive efficiency and coordination that to some degree are being passed back to producers in the form of higher prices. Finally, our findings also indicate that our systematic market structure variables seem to have smaller impact during the harvest period. This is consistent with Davis and Hill, but our results are more dramatic. During the 1996-1997 harvest period, even in the presence of past poor U.S. and world corn production and tight stocks, prices that elevators were paying were well below the posted county prices. Firms may have been able to exercise monopsonist power at the discretion of the elevator operator.

What are the implications for the future? In all likelihood, during normal periods of supply and demand, the market structure variables (micro-market conditions) will continue to influence prices. Local prices appear to highly reflect these concepts and as such are imbedded in the cost and structure characteristics of the industry. During the harvest period, when local storage capacity is less than the harvest production glut, elevators will be continue to exercise market power. What are the implications of the positive effect of multinational firms on the prices received by producers? Does this suggest that producers should not be concerned about the on going consolidation in the grain industry? Probably some concern is always wise, but it may mean that many of these firms, which have substantial capital investment base their operations on high volume trade. In order to attract that trade it becomes important to offer prices that are attractive relatively to their competitors. Further, industry consolidation may be improving the operating efficiency of firms in the market channel, and at least to some extent passing back these gains to producers. Clearly, there seems to be a tradeoff between the efficiency associated with increased consolidation and the potential for abuse of market power. As consolidation continues, monitoring of the industry seems warranted.

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