THE PRICING EFFICIENCY OF CORN IN A MINOR SURPLUS PRODUCTION AREA

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The U.S. grain marketing system frequently is cited as a fairly good working example of the perfect market concept. In general, research has shown that prices change as predicted, to account for the changes in the time, place, and form of the commodity. Much of the research done on grain prices over space has concentrated on the major grain producing states and/or has been cast in the Judge and Wallace [1] general equilibrium framework. The author reports the results of an analysis of corn pricing efficiency in a minor surplus area (western New York) located in a much larger deficit area (the northeastern U.S.).

Theoretical Guidelines

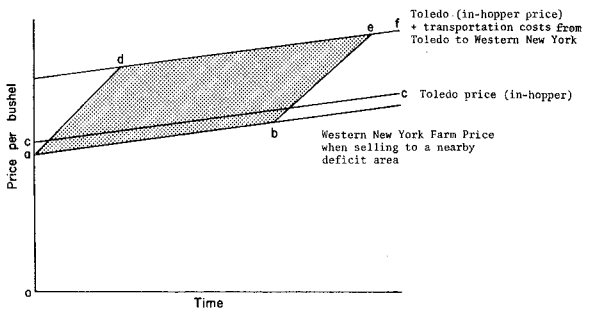
The basic theory behind this analysis is based on a model proposed by Phillips and King [4] in their 1962 study of corn marketing in North Carolina. They divided the state into surplus and deficit regions and evaluated the efficiency of corn prices. The theory applied by Phillips and King is discussed in terms of the New York corn market.

Approximately half of New York's total production of grain corn is in 10 contiguous counties in the northwest part of the state [3]. These are the only counties in the state having grain corn production in excess of annual livestock feed requirements [5]. For some length of time during the corn marketing year these 10 counties constitute a surplus market. As the marketing year progresses from harvest time, the supplies on farms and in local elevators are reduced. During the period when local supplies are low, some corn enters the area from Toledo, Ohio. Toledo is the major surplus market that supplies the entire northeastern United States and is thus the dominant price setter in the Northeast.

During the early part of the corn marketing year, when western New York is in a surplus stock situation, western New York elevators compete with Toledo elevators for corn markets, principally in the New England states.

A general theoretical model that describes the yearly pattern of competitively efficient prices in a market with supply characteristics such as those described in western New York is shown in Figure 1. Starting with the harvest

FIGURE 1. THEORETICAL FARM PRICE LIMITS IN WESTERN NEW YORK



season, western New York elevators attempt to move the surplus corn into nearby deficit markets (New England). The selling prices they quote New England buyers are constrained by the prices quoted by elevators in Toledo, because a New England buyer can obtain all of the Toledo corn desired at the Toledo price plus transfer costs. A western New York elevator therefore deducts the transfer costs from western New York to New England from the total delivered price that New England buyers would pay for corn purchased and transported from Toledo to arrive at the price quoted the New England buyer. The western New York elevator then deducts a "margin" from the price quoted the New England buyer and thus establishes a price at which the elevator will buy corn locally (the posted elevator farm price). The amount of this margin, the difference between the quoted selling prices to New England buyers and posted farm prices,

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will depend on the degree of competitive pressure present in the local buying area. In the case of pure competition, changes in Toledo prices would directly affect local western New York farm buying prices. If there were some degree of oligopsony, changes in Toledo prices might not be directly reflected down to the local western New York farm buying price. Graphically, the western New York farm price during the surplus stock period is depicted by line **ab** in Figure 1. This illustration shows prices rising gradually over time starting from the harvest period. The deduction of western New York to New England transfer costs and the elevator's margin from the delivered Toledo - New England cost of corn yields the western New York farm price slightly below the Toledo in-hopper price in the figure. However, this price relationship would depend on the specific transfer costs and margins involved in shipping to various New England markets, thus the shaded area. The important point is that with competitive pricing of western New York corn, there would be a direct relationship between western New York farm prices and the Toledo price.

At point **b** (Figure 1), western New York farm prices begin to rise at a much faster rate, indicating that the area is losing its surplus stock status. The slope of line **be** implies that the change in the stock situation is not instantaneous.

The final result of the change from a surplus to a deficit market in western New York is that the farm price rises to an upper limit described by line **ef** (Figure 1). Western New York elevators will pay a local farm price that is equal to the western New York delivered cost of corn from Toledo. Of course, western New York farm prices are assumed to be competitively determined.

Empirically, this theoretical model implies that if western New York farm prices are competitively efficient, a simple regression of western New York farm prices on Toledo in-hopper prices will yield a slope coefficient equal to unity. In addition, if a seasonal dummy variable is included for the deficit stock time period it should be highly significant in explaining the Toledo to western New York price relationship if pure competition is operating.

The Analytical Approach

The analytical approach used to evaluate the hypothesized model of corn pricing in western New York is based on research performed by Stifel [6] and by Love and Shuffett [2]. Stifel's study pertained to the marketing of rubber in Thailand. Noting that Singapore is the major world rubber market, he regressed Thai prices on Singapore prices (among other things), hypothesizing that a coefficient of unity for Singapore prices would indicate either perfect competition or perfect collusion in the rubber market. Stifel's reasoning was that because the demand for rubber is a derived demand, competitive prices should exist at each level of the marketing chain. Stifel obtained a coefficient statistically close to unity and then used other evidence on concentration, conduct, and performance to aid in the overall evaluation of marketing efficiency.

Love and Shuffett investigated changes in the relative and absolute levels of hog prices which accompanied a change in the structure of the buying market. Like Stifel, they regressed prices at one level, a deficit producing market, on prices at another level, the closest surplus producing market. As Love and Shuffett were investigating a market that was deficit on an annual basis, they hypothesized that in addition to a slope coefficient of unity they would obtain an intercept equal to the transportation costs between the major nearby surplus market and the deficit market in a regression of deficit market prices on surplus market prices, if pure competition existed. They obtained slope coefficients equal to unity both before and after the structural change in the hog buying market. More important, they observed that the intercept term decreased after the structural change to one dominant buyer. The amount of the decrease was approximately equal to the transportation costs between the nearby surplus market and the deficit market under study. Their conclusions were that before the structural change the market has been paying a purely competitive price and after the structural change the dominant buyer began earning some monopsony profits.

If the theoretical model posed in Figure 1 is a correct representation of the western New York corn market, a regression of western New York buying prices (posted elevator standard number two yellow corn prices) on Toledo in-hopper case prices should yield a slope coefficient very close to unity.[1] Also if western New York closely approaches or reaches a deficit supply situation late in the marketing year, the farm price should improve in relation to the Toledo cash price. The evidence presented by Riggins [5] indicates that western New York approached a zero stock situation from mid-June to the end of September in 1975 and 1976 despite consecutive record grain corn crops. This zero stock situation should cause the dummy variable representing the summer

[1]The regression coefficient of the independent variable equaling unity could also be a result of perfect collusion in price fixing by western New York corn buyers.

months to be highly significant in a regression of New York farm prices on Toledo cash prices if pure competition prevails. If western New York were clearly corn surplus throughout the marketing year or if competition were imperfect in the buying of corn, the western New York farm price would not improve in relation to the Toledo cash price as the marketing year advanced and the dummy variable representing mid-June-September would not be significant in explaining the farm price of corn. If the dummy variable is significant it would yield an adjusted intercept very close to the transportation costs between Toledo and western New York.

The Model

To test the hypotheses, the following equation was estimated:

$$Y_t^i = \alpha_o^i + \alpha_t^i D_t^i + \beta_t^i X_t^i + \varepsilon_t^i$$

where

Y_t^i = the posted paying price to farmers for standard number two yellow corn offered by firm i during time period t
i = firms A, B, C, D, and E
t = the three corn crop periods on which price data were obtained, t = 1, 2, 3
D_t^i = dummy variable, equals one from June to September each corn marketing year and zero the other months
X_t^i = the average weekly Toledo in-hopper cash price for standard number two yellow corn.

Toledo cash prices were obtained from the weekly USDA publication "Grain Market News," and average weekly western New York posted paying prices were obtained from five firms in western New York. These firms provided price data for 1975 and 1976.

The Results

The data are examined by crop years. Therefore, the first set of regressions is for the period January 1975 to September 1975 for firms A-E. The results indicate the dummy variable representing the period of short supply in the late summer months is insignificant in all five equations (Table 1). In addition, the regression coefficients of the independent variables in all five equations are significantly different from unity and firms B-E have very low adjusted R^2 values. These results indicate that from January 1975 to September 1975, the buying prices for corn for these five firms were not closely linked to the Toledo cash price. The data presented by Riggins [5] indicate that western New York was very close to a short corn supply situation in the summer of 1975 and 1976; the fact that the dummy variable is not significant in the January to September 1975 regressions suggests market imperfections.

However, regressions for the period October 1975 to September 1976 (the 1975 crop) have the hypothesized significant seasonality variable for firms A-E (Table 2). And the 1975

TABLE 1. IMPACT OF "IN-HOPPER" TOLEDO CORN PRICE ON NEW YORK FARM PRICES AT VARIOUS ELEVATORS, JANUARY - SEPTEMBER, 1975

Firm	Coefficient of Toledo Price[a] $/Bu.	Seasonal Dummy-Coefficient[b]	Intercept	$\bar{R}^2$	Durbin Watson
A	.755 (9.28)[c]	- 0.407 (- 0.16)[c]	48.25 (2.07)[c]	.70	1.240
B	.413 (3.14)	-15.00 (-1.63)	153.25 (4.09)	.33	0.361
C	.510 (4.02)	0.048 (0.11)	123.05 (3.38)	.29	0.635
D	.651 (5.01)	0.298 (0.08)	94.38 (2.53)	.39	0.644
E	.549 (3.710)	- 3.132 (- 0.70)	113.76 (2.68)	.24	0.554

[a]All of the coefficients were significantly different from unity at the .01 level. There are 35 degrees of freedom in each equation.

[b]The seasonal variable was not significant at the .05 level in any of the 5 equations.

[c]t-values are in parentheses.

TABLE 2. IMPACT OF "IN-HOPPER" TOLEDO CORN PRICE ON NEW YORK FARM PRICES AT VARIOUS ELEVATORS, OCTOBER 1975 - SEPTEMBER 1976

Firm	Coefficient of Toledo Price[a] $/Bu.	Seasonal Dummy-Coefficient[b]	Intercept	$\bar{R}^2$	Durbin Watson
A	0.646 (5.85)[c]	43.35 (11.14)[c]	69.54 (2.43)[c]	.91	0.727
B	0.436 (3.54)	48.65 (11.20)	129.55 (4.06)	.89	0.926
C	0.819 (8.23)	46.67 (13.29)	31.98 (1.24)	.94	0.893
D	1.020 (8.25)	45.71 (10.48)	-13.21 (-0.41)	.93	1.081
E	0.626 (6.69)	37.51 (11.36)	78.64 (3.25)	.92	1.134

[a]For firm D the coefficient was not statistically different from 1.0 at the .01 level. There are 48 degrees of freedom in each equation.

[b]The seasonal variable was significant at the .05 level in all 5 equations.

[c]t-values are in parentheses.

western New York corn crop was the largest harvest on record. The 1975 corn crop regressions also have better adjusted R^2 values, and the coefficients of the independent variable in each equation is generally closer to unity than in the previous year's regressions. In fact, firm D has a slope coefficient of 1.02 for the 1975 crop and its adjusted intercept is 32.5 cents, very close to the 27 cents per bushel freight rate from Toledo to firm d during the summer of 1976. The remaining four firms have slope coefficients very different from unity and their adjusted intercepts are not close to equaling the unit transportation costs from Toledo. Graphic examination of the data reveals that firm D paid competitively efficient prices much earlier in the market year than the other firms, and thus the results are not surprising. However, by the midpoint of the marketing year all five firms were paying competitively determined farm prices and therefore all five firms have the hypothesized significant seasonality variable.

To make the 1975 corn crop data more directly comparable with the nine months of data for the 1974 corn crop, the observations for October-December 1975 were deleted and the 1975 corn crop equation was reestimated. The results conform to those from the equation containing all 12 months of the 1975 corn crop year and therefore are not presented. Briefly, all but firm D have a slope coefficient statistically different from 1.0 and all five firms have significant dummy variable coefficients even though the harvest months were deleted from the base period data.

Firms A, B, C, and E have slope coefficients less than unity for the 1975 corn crop. This finding probably reflects their noncompetitive pricing during the first 6-9 months of the marketing year. In any case, the highly significant seasonal dummies in all five equations indicate that New York farm prices improved in relation to Toledo prices when western New York approached a short supply situation during the summer of 1976. This finding supports the conclusion that during the summer of 1976, western New York corn buyers offered competitively efficient farm prices for corn.

Firms A-D also provided data for the harvest period of the 1976 corn crop year, October 1976-December 1976. Regression analysis of these data indicates that prices paid by firms A-D generally were linked closely to the Toledo cash price (Table 3). The slope coefficients for firms B, C, and D are not statistically different from 1.0. One exception is firm A. The finding that the slope coefficient for firm A is not significantly different from zero implies that firm A's prices were not closely associated with the Toledo cash price. However, the adjusted R^2 value for the firm A equation is only 0.01; in essense no variation is explained. In an attempt to improve on the estimated coefficients for firm A, all the equations were reestimated with data from June 1976-December 1976. During this period, firms A-D paid competitive prices and adding the months of June-September increased the number of observations from 13 to 31. As in the preceding equations a dummy variable was included to account for the hypothesized relative decrease in the New York farm price between the end of summer and the beginning of the harvest period in October 1976.

The regression results on the larger data base indicate that all four firms' prices were closely linked to the Toledo cash price (Table 4). In all equations the slope coefficient is not

TABLE 3. IMPACT OF "IN-HOPPER" TOLEDO CORN PRICE ON NEW YORK FARM PRICES AT VARIOUS ELEVATORS, OCTOBER 1976 - DECEMBER 1976

Firm	Coefficient of Toledo Price[a] $/Bu.	Intercept	R^2	$\bar{R}^2$	Durbin Watson
A	0.207 (1.00)[b]	181.97 (3.78)[b]	.80	.01	0.881
B	0.718 (3.57)	87.85 (2.15)	.60	.55	0.850
C	1.068 (6.59)	- 15.70 (-0.42)	.80	.78	0.773
D	0.990 (5.68)	23.61 (0.59)	.75	.72	2.427

[a]The coefficients for firms B, C, and D were not statistically different from 1.0 at the .01 level. There are 11 degrees of freedom in each equation.

[b]t-values are in parentheses.

TABLE 4. IMPACT OF "IN-HOPPER" TOLEDO CORN PRICE ON NEW YORK FARM PRICES AT VARIOUS ELEVATORS, JUNE 1976 - DECEMBER 1976

Firm	Coefficient of Toledo Price[a] $/Bu.	Seasonal Dummy-Coefficient[b]	Intercept	$\bar{R}^2$	Durbin Watson
A	0.579 (3.31)[c]	34.37 (3.78)[c]	104.04 (2.69)[c]	.89	1.055
B	0.556 (1.95)	29.59 (1.89)	130.95 (1.95)	.67	0.564
C	1.015 (6.34)	23.56 (2.70)	- 1.50 (- 0.04)	.93	0.925
D	0.857 (4.25)	27.27 (2.77)	78.38 (1.86)	.88	1.212

[a]All coefficients were not statistically different from 1.0 at the .01 level. There are 28 degrees of freedom in each equation.

[b]The seasonal variable was significant at the .05 level in all four equations.

[c]t-values are in parentheses.

statistically different from 1.0. In addition, the dummy variable representing the months of June-September 1976 is significant for each firm. Also, the inclusion of the additional data substantially improved the adjusted R^2 value (.89) for the firm A equation. However, only firm C has an adjusted intercept (22 cents) that is close to the unit transportation costs from Toledo. The adjusted intercepts for the other three firms are substantially greater than the transportation costs from Toledo to their western New York locations. Two points can be made about this nonconformity to the hypothesized model. First, this final analysis is on 3 months of data at the end of one marketing year and 3 months of data from the beginning of the next year. Thus the simple model proposed is probably inadequately specified. The second point relates to the significant structural change which took place in the western New York market in the summer of 1976. Two large buyers moved into the area and started buying in June and July of 1976. The prices offered by each firm in Table 4 after the entry of the new firms appears very erratic for the first few weeks. In fact, during a few weeks in the summer of 1976 these firms paid western New York farmers slightly more for their corn than the total cost of corn delivered from Toledo. The model used in this analysis was clearly not meant to take account of this "learning" or readjustment period brought about by the changed market structure.

Conclusions

The results of the regression analysis clearly indicate that western New York farmers sold their corn under more favorable pricing conditions after mid-June 1976 than they did from January 1975 to mid-June 1976. The fact that firms A-E's prices did not improve in relation to Toledo cash prices during the summer of 1975 must be taken as strong evidence of market imperfection in the buying of New York corn during that period. Evidence on the structure of the western New York corn market indicates that two very large new buyers located in western New York during the summer of 1976 [5]. Before their entry, one firm with 13 elevators had accounted for roughly two-thirds of the corn purchased by elevators in western New York. Also, one of the new entrants had previously been the single largest customer of western New York corn shippers.

The fact that this firm internalized this stage of the marketing process combined with an apparent switch to competitive pricing by several firms in western New York during the summer of 1976 must be taken as strong evidence of previous imperfection in the pricing of western New York corn.

In summary, the U.S. grain marketing system is a highly competitive and efficient system. However, evidence does indicate that some spatial monopsony does occur, especially during the harvest season. Several states in the southern U.S., like New York, have significant areas of surplus grain corn production. Research in this area could yield information useful to interested policymakers.

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