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Abstract

Allocative Efficiency in Electronic Marketing for Feeder Cattle

Centralized remote-access markets using computer technology are a possible alternative to conventional markets for most agricultural commodities. This study empirically analyzes the allocative efficiency of such a market for feeder cattle. Results show a statistically significant price level premium in the electronic market over conventional auction markets for feeder cattle.

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Allocative Efficiency in Electronic Marketing for Feeder Cattle

by

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The theory of centralized remote-access markets for agricultural commodities suggests that at the producer-first handler level, a favorable price impact to producers should be realized from centralization compared to conventional markets (Henderson et al). Computerized centralized markets, popularly called electronic markets, disseminate information rapidly to all participants and should dissipate any price effects attributable to spatial oligopsony through centralizing price discovery (Sporleder). This leads directly to the expectation of enhanced allocative efficiency from electronic markets compared to conventional markets, given a potentially competitive market at the producer-first handler level.

A portion of the enhanced allocative efficiency is hypothesized to be due to significant gain in market information by small volume traders relative to large volume traders. Because information is uniformly and accurately distributed to all participants almost instantaneously, sellers rely less on any one buyer's offer price

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and the implicit market information one bid embodies. Access to buyers, especially by small volume sellers, is enhanced. The environment should lead to accurate price differentials over value determining characteristics such as quality, size, and location of a seller's offer. In short, spatial arbitrage is facilitated.

Previous empirical tests of these notions have been conducted on electronic markets for hogs, eggs, and lambs (Lu, Henderson, Holder). Results from these tests have consistently indicated statistically significant average price level increases associated with centralization of the price discovery process. These studies do not represent a sufficient base for generalizations about all agricultural commodities. Even though the means utilized for centralizing price discovery were markedly different across these commodities, the results are consistent with a priori reasoning.

With computer technology applied to marketing agricultural commodities, the price negotiation process can be centralized without the costs of physically centralizing buyers, sellers, or the commodity traded. Each seller's offer is exposed to many competitive buyers simultaneously. Centralized remote-access price discovery is possible whenever the commodity traded can be adequately described by objectively determined value characteristics or grades (Sporleder). This is the case for most generic unprocessed agricultural commodities, where brand identification is not an important value-determining characteristic.

An Electronic Market for Feeder Cattle

From September, 1980 through November, 1981 an experimental electronic market, called CATTLEX for cattle exchange, was operated at about 22 locations in Texas. CATTLEX was a centralized remote-access market, fully computerized, which operated at the offices of producers, auctions, order buyers, and feedlots. Auctions were conducted by the computer at prescribed times for lots described by a third party grader. All lots were offered FOB the seller's choice of location and were sold by description rather than on-site inspection by the buyer. Price levels and differentials across location, sex, weight, and grade were recorded automatically by the computer system and made available immediately to all users.

Empirical Test of Allocative Efficiency Impacts

Increased buyer competition in electronic markets should be reflected in a higher average price in the electronic market than that in conventional markets. To empirically test this hypothesis in the CATTLEX experience, sales over the computerized system were compared with auction market prices.

There are problems with such a comparison. First only twenty-one lots (groups of 10,000 pounds or more) were sold over the electronic market. As a result, the electronic marketing price observations are not plentiful for comparison. Secondly, auction market data,

collected from Federal-State Market News, reports price ranges by sex, weight, and grade. There is no a priori reason to expect the statistical variances of the two data series to be comparable.

Methodology

A seemingly unrelated regression analysis was used to account for potentially unequal variances in each distribution. Seemingly unrelated regression analysis weights each equation and the resulting residuals are used to estimate the variance and covariance of the disturbances. These are then used to calculate the values of the parameter estimates (Kmenta p. 517-529).

Use of seemingly unrelated regression analysis with the limited number of CATTLEX sales necessitated replication of data. This was done by replicating the CATTLEX price for each lot in the auction market which matched on market, sex, grade, and weight category. For example, in San Antonio, in the eighth week, a lot of med-1 steers in the 500-600 pound weight category sold for $74.45 per hundredweight over CATTLEX. The CATTLEX price of $74.45 per hundredweight was repeated x times, where x is the number of auction market prices for med-1 steers in the 500-600 pound weight category which sold in San Antonio. A similar procedure was used to replicate other CATTLEX data.

The coefficients of the auction market and CATTLEX regression equations are estimated by:

$$Y_1 = X_1\beta_1 + \varepsilon_1$$

$$Y_2 = X_2\beta_2 + \varepsilon_2$$

where Y_m is a vector of the sample values of the dependent variable, price; X_m is a matrix of the sample values of the explanatory variables; β_m is a vector of the regression coefficients; and ε_m is a vector of the sample values of the disturbances. In the auction market equation, price is a function of market, week, sex, grade, and weight. In the CATTLEX equation, price is a function of market, week, sex, grade, quantity, and weight.

First, ordinary least squares estimates are computed for each equation. These estimates are consistent but not efficient. Second, the resulting residuals are used to estimate the variance and covariance of the disturbances. Third, these are then used to calculate the generalized least squares parameter estimates, which are efficient. The generalized least squares estimates can then be used to test hypotheses over both quality and space.

Hypotheses

Hypotheses involving both price differentials over qualities and space are possible when comparing CATTLEX and conventional market prices. Since the nature of centralized remote-access markets is to increase the flow of market information, one could expect price differentials over quality characteristics such as weight, sex, or grade to

be different from those in conventional spot markets. A second hypothesis, similar to this, is that price level and/or differentials over space would be different.

Due to the limited amount of electronic marketing sales data, it is appropriate only to test the hypothesis concerning spatial prices. Insufficient observations on CATTLEX sales by sex, weight, and grade necessitated the assumption that price differentials for each of these factors were equal between CATTLEX and conventional spot markets.

The hypotheses of the seemingly unrelated regression analysis are:

1) H_0: $Y_1 = Y_2$

H_1: $Y_1 < Y_2$

where Y_1 is the average price in the auction market

Y_2 is the average price in CATTLEX

2) H_0: $\beta_{11} = \beta_{21}$

H_1: $\beta_{11} \neq \beta_{21}$

where β_{11} is the San Antonio - Amarillo auction market price differential

β_{21} is the San Antonio - Amarillo CATTLEX price differential

3) H_0: $\beta_{12} = \beta_{22}$

H_1: $\beta_{12} \neq \beta_{22}$

where β_{12} is the Sealy - Amarillo auction market price differential

β_{22} is the Sealy - Amarillo CATTLEX price differential

4) H_0: $\beta_{13} = \beta_{23}$

H_1: $\beta_{13} \neq \beta_{23}$

where β_{13} is the North Central - Amarillo auction market price differential

β_{23} is the North Central - Amarillo CATTLEX price differential

One regression equation was estimated for the auction markets and for the CATTLEX market.

Results

In both regressions, the San Antonio market parameter is the price differential between San Antonio and Amarillo, the Sealy market parameter is the price differential between Sealy and Amarillo and the North Central Texas market parameter is the price differential between North Central Texas and Amarillo, Table 1. The sex parameter is the differential between steers and heifers; the grade parameter is the differential between med-1 and med-2 animals; and the weight parameters are the differential between the 400-500 pound category and the 600-700 pound category (WEIGHT 1), and the 500-600 pound category and the 600-700 pound category (WEIGHT 2).

In the auction market model, the intercept, San Antonio market, Sealy market, sex, grade and weight parameters were all found to be significantly different from zero. The North Central Texas market and the week parameters were found to be not significantly different from zero. In the CATTLEX model, the intercept, San Antonio market,

Table 1. Estimates of the Parameters for the Auction Market and the CATTLEX Market.

MODEL: AUCTION MKT

DEP VAR: PRICE R-SQUARE 0.8138

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T RATIO	APPROX PROB>|T|
INTERCEPT	1	39.940065	0.433590	92.1148	0.0001
SAN ANTONIO	1	-3.743763	0.599868	-6.2410	0.0001
SEALY	1	6.809485	0.586148	11.6173	0.0001
N. CENTRAL	1	-0.611393	0.480079	-1.2735	0.2039
WEEK	1	-0.000486193	0.00054996	-0.8841	0.3774
SEX	1	15.487890	0.023913	647.6845	0.0001
GRADE	1	13.202673	0.071037	185.8558	0.0001
WEIGHT 1	1	-0.395336	0.087536	-4.5163	0.0001
WEIGHT 2	1	3.888525	0.030518	127.4188	0.0001

MODEL: CATTLEX MKT

DEP VAR: PRICE R-SQUARE 0.9997

VARIBLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T RATIO	APPROX PROB>|T|
INTERCEPT	1	43.080778	0.104053	414.0281	0.0001
SAN ANTONIO	1	-1.645336	0.040350	-40.7763	0.0001
SEALY	1	6.053504	0.083970	72.0912	0.0001
N. CENTRAL	1	-2.678222	0.033949	-78.8902	0.0001
WEEK	1	-0.000486193	0.0005509591	-0.8824	0.3783
SEX	1	15.487890	0.023956	646.5101	0.0001
GRADE	1	13.202673	0.071166	185.5188	0.0001
QUANTITY	1	0.002805974	0.000376476	7.4533	0.0001
WEIGHT 1	1	-0.395336	0.087695	-4.5081	0.0001
WEIGHT 2	1	3.888525	0.030573	127.1878	0.0001

Source: Computed

Sealy market, sex, grade, quantity, and weight parameters were all found to be significantly different from zero. The week parameter was the only one not significantly different from zero.

Each of the test results in Table 2 is testing whether there is a significant difference between the auction market parameter and the CATTLEX market parameter. The test of intercepts indicates that the CATTLEX price is significantly higher than the auction market price, giving CATTLEX sales an average premium of $3.14 per hundredweight. The test of market differentials is not significant for the Sealy market. The market differentials are, however, significantly different for San Antonio and North Central Texas. In these two markets the CATTLEX price differentials are closer to the transportation differential between markets.

Summary and Conclusions

Compared to conventional geographically disperse low volume markets, enhanced allocative efficiency attributable to centralization of the price discovery process is expected. Based upon theoretical reasoning, price levels from centralized markets would be expected to exceed those of conventional markets largely from broadening information dissemination on market conditions. At the producer-first handler level for agricultural commodities centralizing the price discovery process would tend to dissipate the price impacts of spatial oligopsonies which may exist.

A centralized remote-access market for feeder cattle, operated

Table 2. Results of Tests on Price Differentials Between CATTLEX and the Auction Market

TEST:	NUMERATOR:	54.65539480	DF:	1	F VALUE:	23.2253
INTERCEPT	DENOMINATOR:	2.35326547	DF:	556	PROB F:	0.0001
TEST:	NUMERATOR:	12.63726470	DF:	1	F VALUE:	5.3701
SAN ANTONIO	DENOMINATOR:	2.35326547	DF:	556	PROB F:	0.0208
TEST:	NUMERATOR:	1.73600445	DF:	1	F VALUE:	0.7377
SEALY	DENOMINATOR:	2.35326547	DF:	556	PROB F:	0.3908
TEST:	NUMERATOR:	19.04259193	DF:	1	F VALUE:	8.0920
N. CENTRAL	DENOMINATOR:	2.35326547	DF:	556	PROB F:	0.0046

Source: Computed

at various locations in Texas, was evaluated for hypothesized price impacts. Comparison of price levels in conventional auction markets were made with price levels in the electronic market using seemingly unrelated regression analysis. Results of this analysis indicate that the electronic market cattle sold at a premium over conventional auction market prices. The evidence suggests that spatial arbitrage is facilitated with electronic marketing.

There are qualifications on the analysis. Since the electronic marketing data base was relatively small, results would be sensitive to changes in that data base. Data problems limit confidence in identifying a particular price impact (such as $3.14 per hundredweight as the results of the regression analysis suggest). However, there is ample evidence that prices are statistically significantly higher from the electronic market, even though the precise magnitude is not known with confidence. These results also are consistent with previous empirical results reported for hogs, eggs, and lambs.

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