THE IMPACTS OF MARKET STRUCTURE AND CONTRACTS ON AGRICULTURAL MARKETS

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Abstract

Experimental markets were used to isolate the effects of market structure and contract design on market outcomes. Preliminary results suggest that market structure drives outcomes, and not necessarily contract design. Future research will replicate experiments and add dimensions of market information.

Introduction

Agricultural markets have changed substantially in the last 30 years. This evolution involves both market structure changes (numbers of buyers and sellers and relative market power) as well as innovations in business relationships (vertical coordination through alliances, joint ventures, and contracts). Increased buyer concentration has led some to speculate adverse impacts on producer prices have resulted. Others have argued that contract terms have placed producers at a price disadvantage as well (Xia and Sexton). Of course, absolute price level changes resulting from these changes are difficult to discern due the underlying changes in supply and demand that drive price levels in secondary data.

Policy-makers and market participants would benefit from a better understanding of the impacts of changes in agricultural markets to develop more effective policies and business strategies. However, most work on this subject to this point has been either

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completely theoretical or relies on secondary data that present many challenges to direct hypothesis testing. The objectives of this paper are: (1) to examine the impact of alternative market structures on market performance and (2) establish a base on which to examine the impacts of alternative contract formulations and characteristics on market performance.

Methods

Experimental markets are used to examine the impacts of alternative market structures and contracts on market performance. Experimental methods have the advantage of being controlled, with the experimenter controlling the economic stimuli, allowing for direct tests of hypotheses (Smith; Hudson). For example, one can control the supply and demand schedules of buyers and sellers, and then alter the number of buyers and sellers for a direct test of the impact of market structure.

We use a double-oral auction format in this experiment. This format has the advantages that it is a well-established method for simulating markets, it is easy to modify while keeping other variables (supply and demand) constant, and is easy to implement so as to minimize respondent error. Of course, the experiment loses some of the realism of a complex, functioning market. But, the benefits of control far outweigh the costs of realism loss.

The double oral auction proceeds as follows:

Step 1. Participants are randomly assigned as either buyers or sellers. Buyers are presented with a "demand schedule," which reveals their resale values as shown in Figure 1. One-half of the buyers receive schedule A and one-half receive schedule B. These

schedules represent the resale value for units purchased. For example, for the first unit under schedule A, the participant could purchase that unit and resell it to the monitor for $0.72. Thus, the buyer could purchase the unit from a seller for up to $0.72 and make a profit.

At the same time, sellers are presented with their marginal costs for each unit (again, one-half receive A and one-half receive B). This value represents the amount of money the seller must pay the monitor to sell a particular unit. For example, the first unit under schedule A is $0.48. Thus, the seller could sell that unit for as little as $0.48 and still make a profit. This process was explained to both buyers and sellers using hypothetical values. The object, of course, is to trade units to maximize profits. The equilibrium price and quantity predicted by these supply and demand schedules are shown in Figure 2.

Step 2. The trading session begins with the monitor calling the session open. Participants wishing to make a bid or offer are recognized and their bid or offer taken. Sequential bid improvement is followed such that each subsequent bid must be higher than the previous bid and each subsequent offer must be lower than the previous. Once a bid/offer is accepted, the buyer/seller are recorded along with the transaction price, and trading begins again. Each transaction is for one unit at a time, but each buyer/seller may purchase/sell as many units as desired during the trading round, which lasts five minutes.

Step 3. At the end of the round, buyers and sellers are provided with a new supply/demand schedule, which are just shuffled A/B schedules across rounds. Then, Step 2 begins again. There were 5 trading rounds used in this experiment.

Students were recruited from the undergraduate and graduate populations using standard recruiting techniques and were compensated $5 for their participation. The experiment took approximately 30 minutes to complete and all respondents were paid in cash for their accumulated profits plus the participation fee. Once recruited, students were randomly assigned to one of three treatments as described below.

Treatment 1-Competitive Baseline

The double-oral auction experiment has been used for some time to simulate competitive markets (Smith; Davis and Holt), and comformity of results from this experiment with competitive market predictions is well established. We use it here to establish a competitive baseline with which to compare other treatment outcomes.

Treatment 2-Duopsony

A duopsony market was created in the double-auction format. For this treatment, the original six buyers were aggregated into two buyers by horizontally summing the demand functions for three buyers into one. This process results in an identical market demand function as in the competitive baseline, just with two instead of six buyers. We maintained six sellers in the market to simulate the situation in agricultural markets where there were a larger number of sellers than buyers. We make no generalization here that the ratio of buyers to sellers is representative of any particular market. Rather, our goal was to alter the market structure in the experiment in favor of concentration of buyers to determine whether this change had a significant impact on market prices.

Treatment 3-Contract Market

Contracts within markets have been hypothesized to have significant impacts on market outcomes. A popular contract within cattle markets has been the top-of-the-

market (TOMP) contract (Xia and Sexton). In a TOMP contract, the buyer contracts a quantity of product from the seller for future delivery, but not the price. The contract price is determined by the highest cash/futures market price at some point in time in the future. To simulate this, treatment three was conducted in a number of steps outlined below.

Step1. Buyers and sellers privately determined the number of units they would purchase/sell during the trading period. This information was marked on their recording sheet.

Step 2. Buyers were given three minutes to make *private* contracts with sellers for a fixed quantity.

Step 3. A double-oral auction market (five minutes) was then held for any uncontracted units remaining. If there were no uncontracted units, the market price was determined by a random number generator using a uniform distribution of prices between $0.01 and $1.00.

Step 4. Return to Step 1 and repeat for five rounds.

To be consistent with treatment two, two buyers and six sellers were used. There are two critical variables changing in this treatment.[1] First, respondents must make a capacity choice. In this case, units that were produced/planned purchased in the capacity choice step that were subsequently not sold/purchased in either the contract or auction steps were penalized. Units that were committed to be purchased by buyers but were not purchased were penalized an amount equal to the marginal value of unpurchased units. Units that were committed to be produced but were not sold were penalized an amount

[1] We fully understand that to clearly test hypotheses that we need to change one variable at a time. But, this paper is a report on preliminary work and subsequent treatments will be used to isolate all key variables.

equal to the marginal cost of unsold units. Secondly, this treatment only sold uncontracted units in the auction market, the highest price observed of which determined the market price for that round.

Based on theoretical predictions in the literature, one would hypothesize:

$$P_1 > P_2 > P_3 .$$

That is, one would expect the price in the competitive market to be higher than under the duopsony market. Also, given that only uncontracted units are being sold in the contract market, one would expect that the price in the duopsony market would be higher than in the duopsony with the TOMP contract. In addition to market prices, we also examine the impacts of these market structures on distribution of revenues and profits across participants as well.

Results

Figure 3 shows the results of treatment 1. The horizontal line in the graph shows the predicted equilibrium price for a competitive market. The vertical lines mark the ends of each trading round. The average price across rounds was $0.598 and the average number of units traded in each round was 20.4, both of which conform to competitive market conditions.

Figure 4 shows the results of the duopsony treatment. The average price in this treatment was $0.539 and the average number of units traded was 16.6, both of which were significantly different than the competitive baseline using an un-paired t-test. Thus, as predicted by theory, the concentration of buyers did significantly lower the observed market price holding supply and demand conditions constant.

As would be expected given the price results, producer revenue was higher in the competitive case (Figure 5). There was a more dramatic difference in profits between the competitive and duopsony structures (Figure 6). This result, of course, is because not only did the producers receive a lower average price in the duopsony case, they also sold fewer units. Thus, taken together, the results of these two treatments support the maintained hypotheses that concentration of buyers leads to lower average prices and lower average profits (surplus) to producers.

Figure 7 shows the resulting observed market prices from the secondary market in the TOMP treatment. The horizontal line shows the average market price observed in the duopsony treatment above. Here, the average price observed was $0.557, which is consistent with the average price in the duopsony treatment (not significantly different using an unpaired t-test). However, the average number of units traded (contracted + secondary market) was 22.6, which was statistically greater than under the duopsony treatment. Interestingly, however, the secondary market was only active for three rounds. This result appeared despite the fact that the participants faced a random price if no units were traded. Interestingly, these findings do lend support to concerns about captive supplies, or conditions where all available supplies are contracted outside an open market. But, further testing is needed before conclusions can be drawn.

We examined the income distributional impacts of these different market structures as well by calculating the percentage difference between the resulting allocation from the situation of perfect equity (as defined as an equal distribution of income across all producers). As can be seen in Table 1, the competitive structure generates the most equal distribution of income (either revenue or profits) across

producers. The duopsony and TOMP markets generate comparable, but higher inequality as compared to the competitive case in terms of revenues. But, these structures create substantially more inequality in terms of profits (surplus). Thus, these results suggest that these structures are having important impacts on producer welfare as suggested by the literature.

Conclusions

Our experimental results suggest that the decline in the number of agricultural buyers is having a significant impact on the revenues and profits of agricultural producers. This research is still early in the process of development. At this point, more replications of these treatments is needed to determine the robustness of the conclusions that can be offered.

At the same time, more treatments are need to examine key variables of interest. Planned treatments at this point include:

1. TOMP without penalties for overproduction/overcapacity,
2. TOMP with public disclosure of contracts, and
3. Fixed price contracts with/without public disclosure of terms.

These additional treatments will allow the examination of the impacts of so-called "public disclosure" laws on market prices and producer incomes. Additionally, more replications of each treatment will allow examination of other factors such as personal characteristics of market participants on market outcomes.

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Table 1. Deviation from an Equal Allocation of Income Across All Producers in the Experiment.

	Percentage Deviation from Equal Allocation of Income		
	Competitive	Duopsony	TOMP
Revenue	2.07%	2.68%	2.79%
Profit	1.33%	3.38%	8.64%

Supply and Demand Schedules

	Marginal Revenues		Marginal Costs	
Unit	Buyer A	Buyer B	Seller A	Seller B
1	0.72	0.80	0.48	0.40
2	0.70	0.73	0.50	0.47
3	0.68	0.66	0.52	0.54
4	0.66	0.60	0.54	0.60
5	0.63	0.54	0.57	0.66
6	0.60	0.49	0.60	0.71
7	0.54	0.44	0.66	0.76
8	0.47	0.39	0.73	0.81
9	0.40		0.80	
10	0.32		0.88	

Figure 1. Supply and Demand Schedules for Participants in the Double-Oral Auction Experiment.

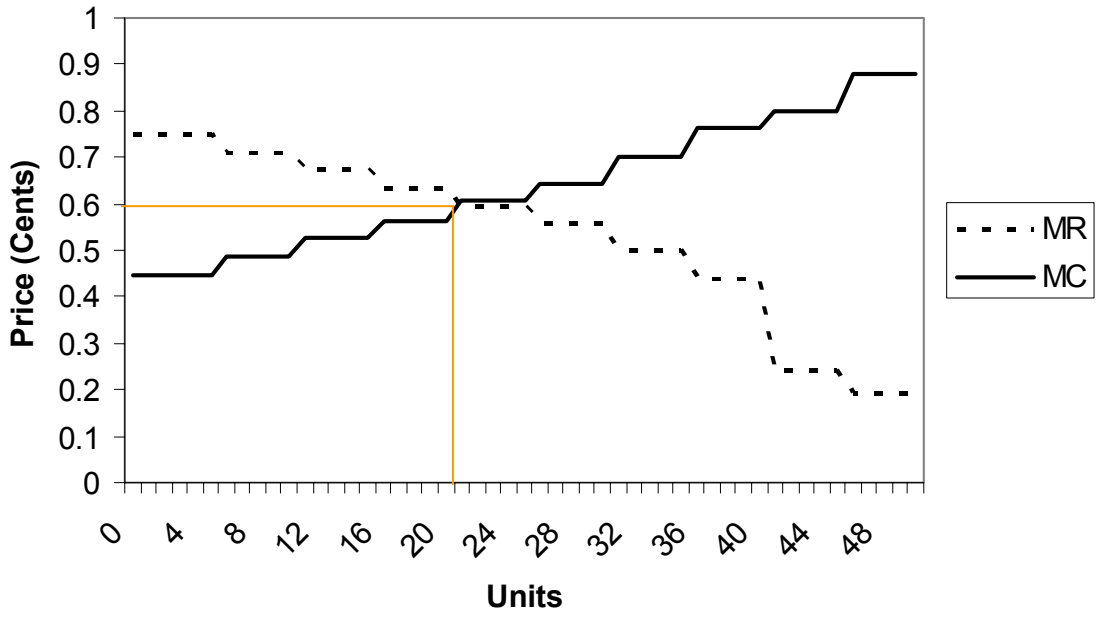

Figure 2. Predicted Equilibrium Price and Quantity from Supply and Demand Schedules Used in the Experiment.

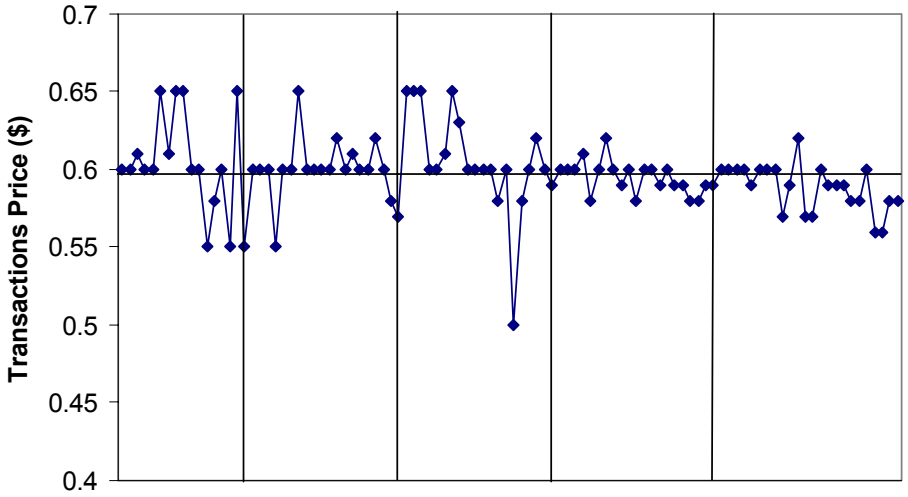

Figure 3. Resulting Transactions Prices of Double-Oral Auction Market Experiment Using Competitive Market Conditions.

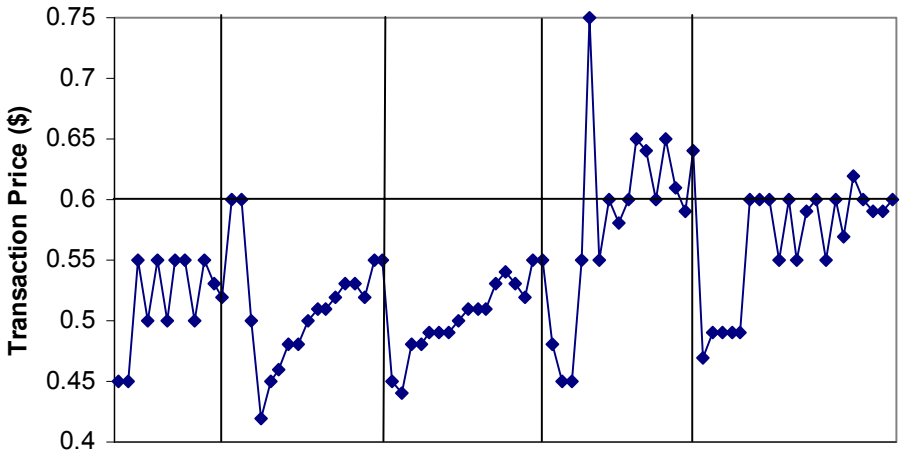

Figure 4. Resulting Transactions Prices of Double-Oral Auction Market Experiment Using Duopsony Market Conditions.

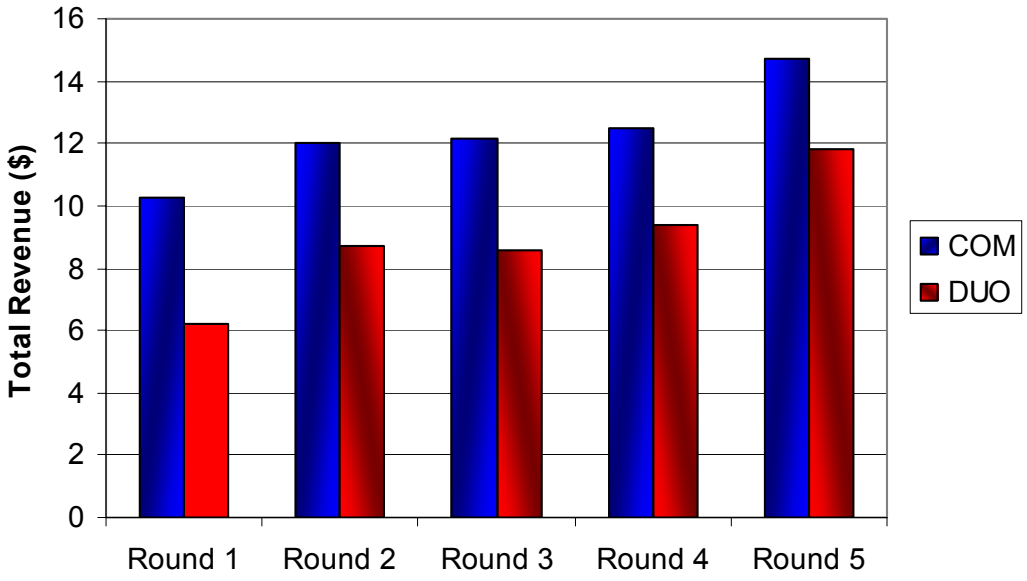

Figure 5. Comparison of Producer Revenue in the Double-Oral Auction Experiment Between Competitive and Duopsony Market Structures.

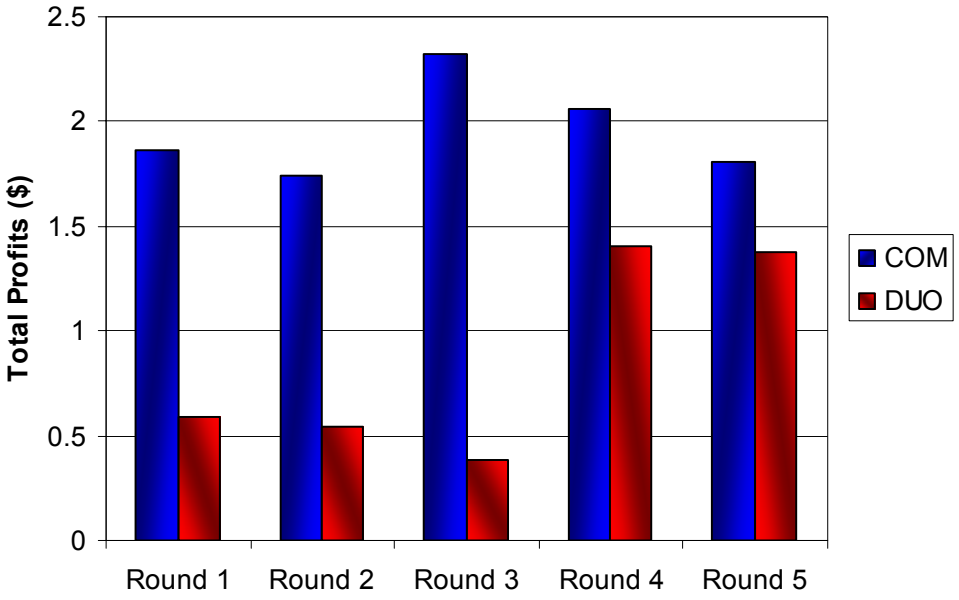

Figure 6. Comparison of Producer Profits in the Double-Oral Auction Experiment Between Competitive and Duopsony Market Structures.

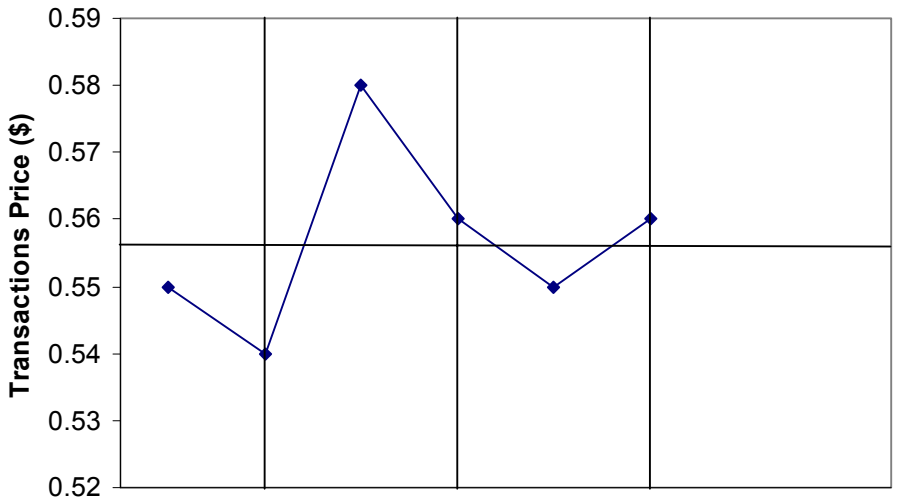

Figure 7. Observed Transactions Prices from the Double-Oral Auction Secondary Market in the Top-Of-The-Market (TOMP) Contract Treatment.