

# IO Experiments

## 1 Introduction

Some of the earliest experiments have focused on how different market institutions affect price and quantity outcomes. For instance, Smith's 1962 paper is a response to Chamberlain's 1948 paper showing how different institutions can yield different outcomes. It is also possible to examine the effects of collusion in experimental markets in ways in which it is not possible in actual markets. First, since values and costs for items are known it is possible to calculate the competitive and joint profit-maximizing prices in the experimental market. This allows observed behavior to be compared with a theoretical benchmark. Second, the degree of communication between market participants can be controlled. Thus, the effect that allowing communication between participants has on market outcomes can be directly observed. We discuss two experimental papers on this topic, one a field experiment using Chamberlain's institution and the other a lab experiment using the double auction used by Smith in his seminal work.

## 2 Sportscard field experiment<sup>1</sup>

There is a list of factors deemed helpful for successful price-fixing arrangements. A subset of that list is: (1) small number of participants (2) stable market conditions (3) explicit communication between participants and (4) observable actions of participants. Another question is how stable the collusive agreements are. A criticism of some of the laboratory experiments is that students were assigned the role of the seller and may not be able to properly identify with that role. One method of answering that criticism is to use participants from a naturally occurring marketplace in the roles that the participants have endogenously chosen. Thus, the field experiment will focus on buyers and dealers at a sportscard show, where the dealers will be assigned the role of the seller in the experiment and the buyer the role of the buyer in the experiment. This is an example of a framed field experiment, as we will see that the authors use an induced values framework but with a non-student subject pool and in a context with which the participants are familiar.

### 2.1 Experimental design

Given that the experiment was conducted at a sportscard show, the sequence of events to participate in the experiment are discussed.

1. Potential subjects are asked if they would like to participate.
2. Once they agree to participate subjects are told the market rules
3. Once they have learned the market rules the actual experiment takes place.
4. At the conclusion of the experiment an exit interview is conducted and subjects are paid.

The experiment lasts about 60 minutes. There is a \$10 participation payment and a commission of 5 cents per trade, in addition to payment for buying (selling) items below (above) value. Buyers were told that 5 rounds would occur and in each round they would receive a card with a value for one unit of the item. Sellers (dealers) received a supply schedule for the item, and had values for either 3 units or 1 unit

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<sup>1</sup>This section is based on List and Price (2006), Conspiracies and secret price discounts in the marketplace: evidence from field experiments, *RAND Journal of Economics*, Vol. 36, pgs. 700-717.

depending on the number of sellers in the session. The item to be traded was a 1982 Topps Ben Oglivie card that had a mustache drawn on it. This defacement of the card should make it essentially valueless to either the buyers or the sellers except for its value in the experiment. Thus, this experiment does NOT rely on homegrown values for the item, but it does rely on sellers trying to sell the card for as much as possible and buyers attempting to purchase the card for as little as possible, tasks with which each is familiar. After each round buyers and sellers are given new supply and demand schedules and another round is conducted. Participants are monitored to prevent communication, except in those treatments in which communication is allowed. The supply and demand curves had a competitive equilibrium of \$13.50 with 7 units trading.

### 2.1.1 Treatments

There are 4 treatments and 3 sessions are run in each treatment. The baseline session, conducted for a previous experiment, has 12 buyers and 12 sellers each with a value for one unit of the good. No communication is allowed in this session. A treatment allowing for market concentration uses the same supply and demand schedule but now has 12 buyers each with a value for one unit of the good and 4 buyers with a supply schedule for 3 units of the good. Again, no communication is allowed. A third treatment has the same 12 buyer and 4 seller setup, but now the 4 sellers are allowed to communicate between rounds. In these 3 treatments each time a transaction is made the price at which the transaction occurred is posted on a board that is publicly available for all to see. In a fourth treatment there are again 12 buyers and 4 sellers and sellers are allowed to communicate, but now there is an imperfect price signal. Rather than posting the true price on the board, a price  $\pm \$3$  is posted on the board.

## 2.2 Results

What follows is a brief description of the results of the experiment.

1. **Result 1:** Competitive price theory adequately organizes data in markets without conspiratorial opportunities

In the no communication treatments average prices for both the 12 seller and the 4 seller treatments were between \$13-\$14 and average quantity was between 6-8 units. Efficiency was around 90%, and efficiency was slightly higher in the 4 seller than the 12 seller treatments.

2. **Result 2:** Seller concentration, without communication, does not unduly affect market prices and quantities but it does result in small increases in market efficiencies and producer rents.

This is consistent with result 1. The increase in market efficiency is likely due to a slightly more organized market, in that now some units were forced to be sold after other units due to each seller in the 4 seller treatment having a supply schedule for 3 units. Think of it this way – if there is a seller with the 8<sup>th</sup> highest cost (suppose it is \$14, above the equilibrium of \$13.50) and a buyer with a value of \$30 finds that seller first, it is possible they complete the first transaction for \$22. In the 4 seller case, this 8<sup>th</sup> highest cost is likely to be the second highest cost of some seller, so if that same individual with a value of \$30 finds this seller first, now the seller will have to sell his lower cost unit (maybe \$8) first.

3. **Result 3:** Seller communication serves to raise prices above competitive equilibrium levels and restrict quantities sold, resulting in greater producer surplus and lower market efficiency.

Prices do tend to fall throughout the round though, suggesting that the cartel is not entirely stable.

4. **Result 4:** When sellers receive only an imperfect price signal, price realizations lie between those of competitive markets and collusive markets with perfect information.

This suggests that individuals are attempting to collude, but that the imperfect nature of the price signal allows/causes collusion to break down.

5. **Result 5:** Buyer experience in the marketplace is a catalyst to thwart anticompetitive behavior.

Buyer experience is measured by the exit survey conducted at the conclusion of the experiment. A buyer is said to be experienced if the product of the number of trades in a typical month and the

years of market experience is more than one standard deviation above the sample mean. Basically, if you have participated in the market for many years or make many trades per month then you are experienced, although high volume traders are at more of an advantage than those who have traded cards for a long period of time (simply because one can make hundreds of trades per month and it is unlikely anyone has 200 years experience of trading in the marketplace). At the individual level, there is no discernible difference between buyer experience and transaction price in the collusive treatments. However, in the aggregate, when an experienced buyer transacts in a period prices are 83 cents lower than those periods when only inexperienced buyers transact. There are of course other potential effects. Perhaps inexperienced buyers are willing to sacrifice some profit for more free time – there is no mention as to what buyers do AFTER they have completed a transaction for the period. If a period lasts 10 minutes and a buyer makes a purchase in the first minute, does this buyer need to sit in a corner for the next 10 minutes or is the buyer free to walk around the show? Again, this is another instance of the precept of dominance – inexperienced buyers may simply be willing to give up 83 cents in order to have 9 more minutes to wander the floor of the card show.

### 3 Double auction lab experiment<sup>2</sup>

A double auction is an institution where buyers and sellers call out “bids to buy” and “asks to sell” for items. One can think of it as a stock exchange, with traders on both sides of the market (hence the term “double”). Outcomes in early double auction experiments were shown to converge to the competitive equilibrium rather quickly, and this convergence was robust for many changes in the parameters used in the experiment. For example, it is commonly taught that a large number of buyers and sellers is needed to ensure a competitive outcome, but in the double auction experiments only 4 participants on each side were needed for a competitive outcome to emerge. A follow-up question is then how communication among participants affects market outcomes, since communication is thought to be a key factor in facilitating collusive outcomes.<sup>3</sup> Isaac and Plott (IP) will focus on 3 questions in their double auction experiments:

1. Is the assumption that people will successfully conspire when the costs to conspiracy are minimal correct?
2. Which model can best be applied to explain the observed behavior?
3. Can any insights be gained from these simple markets that might help existing markets?

#### 3.1 Experimental Design

The basic experimental design is that of a double auction with 4 buyers and 4 sellers. The parameters used in this double auction are shown to produce competitive outcomes when opportunities for conspiracy are NOT present. The treatment then will be to allow sessions where either the sellers or the buyers (yes, buyers can collude) have the ability to communicate with one another and whether or not the ability to communicate leads to collusive outcomes. If the subjects were on the “collusive side” of the market they were able to communicate between rounds of the experiment. The time between rounds lasted 6 minutes, and the information from the previous round remained on the chalkboard (it was an experiment in the late 1970s) for all participants on the collusive side to see. The non-collusive side of the market exited the room before communication was allowed between other participants. Note that there is a 5-cent commission for each trade, meaning that each time a trade is made each participant in the trade receives 5 cents. The significant features of this institutional design are:

1. Participants who can communicate may discuss price-fixing strategies, but there is no government to enforce these strategies and agreements to split up joint profit-maximizing profits are prohibited.<sup>4</sup>

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<sup>2</sup>Based on Isaac and Plott (1981), The opportunity for conspiracy in restraint of trade: An experimental study, *Journal of Economic Behavior and Organization*, Vol. 2, pgs. 1-30.

<sup>3</sup>There are a range of reasons why communication is thought to be important – one is that it facilitates coordination on the joint profit-maximizing strategy and another is that it simply serves an informative purpose to tell others that there is a better strategy.

<sup>4</sup>Note that there is nothing to stop the individuals from splitting up the profits AFTER they have left the experiment.

2. There is a fixed number of buyers and sellers so all participants can be included from the beginning.
3. The costs of organizing market information are low for those who can conspire.
4. Cheaters are easily observable in this environment since bids and asks must be called out.

In addition, the authors use 2 different subject populations. One subject population consists of students at CalTech who have experience in participating in experimental markets and the other consists of students from Pasadena Community College who do not have experience in experimental markets.

## 3.2 Models of behavior

IP propose 5 models of behavior that may be observed.

1. Competitive – The competitive equilibrium outcome emerges. Given the parameters, this implies prices of about 75 cents with 20 trades occurring per period. This equilibrium should be stable across all rounds.
2. Cartel – price discrimination – The conspiratorial side of the market successfully conspire to extract all economic rent from the non-conspiratorial side. Prices decline throughout the round as each sale occurs with the then highest value. The market is efficient (20 trades).
3. Cartel – Single price no. 1 – The joint profit maximizing price without considering the 5 cent commission is set and adhered to. This price is 93 cents if the sellers can conspire and 57 cents if the buyers can conspire. The number of trades should be 12.
4. Cartel – Single price no. 2 – The joint profit maximizing price considering the 5 cent commission is set and adhered to. This price is 85 cents for sellers and 65 cents for buyers with an expected quantity of 16 units.
5. Unsuccessful conspiracy – There is an attempt to collude, but the conspiracy breaks down. This should be marked by high initial prices and then a convergence to the equilibrium price.

## 3.3 Results

### 3.3.1 No conspiracy

The results from the experiments without the opportunity to conspire are as follows:

1. Efficiencies are high and stable near 100%. Volume increases until the equilibrium of 20 is reached.
2. Mean trading prices converge steadily to the equilibrium price, and trades occur both above and below the equilibrium price.

Again, these experimental sessions used the same parameters as those in the conspiracy sessions. Also, the result that the double auction institution produces competitive outcomes has been replicated many times under many different parameter combinations since this paper was written.

### 3.3.2 Conspiracy

The first question to ask is did the subjects attempt to conspire when given the opportunity? The answer is a resounding yes, although it took a few rounds before conspiracy began.

The second question is does attempted conspiracy result in an agreed strategy? Again, the answer is yes, although in one session there was a discussion but no specific strategy to follow. A typical pattern was to propose general strategies in the early rounds and then focus on more specific strategies (e.g. “Let’s price at 90 cents”) in the later rounds.

The third question is whether conspiracy has an impact on market behavior. Using the no conspiracy sessions as the benchmark, the answer is again yes. The path of the average price changes in the conspiracy

markets was different than the path in the no conspiracy markets. The path from period to period in the conspiracy markets did not always change towards the equilibrium price, whereas the path in the no conspiracy markets did. Also, prices were more variable in the conspiracy markets, and volume and efficiency are lower in the conspiracy markets. Also, conspirator profits are significantly different than those predicted by the competitive outcome.

The fourth question is which model best explains behavior. The outcomes in the market are consistent with the single price models, but the fact that prices did not converge to the single price suggests that the models do not quite capture the true nature of the market. Also, although prices decline throughout the period, the price discrimination model does not fit appropriately because profit levels are well below those predicted by the price discrimination model.

The final question is are there any insights to be gained from studying these simple markets? The standard textbook discussion of the features of a market which facilitates collusion, which typically involves a fixed number of sellers and opportunities to conspire, among other things, is correct in that participants will conspire when given the opportunity and that the gains from trade shift towards the side of the market with the ability to conspire. The advantage for the conspirators comes from two places. One is that they eliminate “soft” traders. A soft trader is one who trades early and at prices significantly higher (for a buyer) or lower (for a seller) than the equilibrium price. These soft traders may be extremely risk averse, misunderstand the market parameters, or be using some rule of thumb like a markdown or markup rule. Essentially conspiracy allows for accelerated learning among market participants. The second source of advantage comes from actual attempts to implement a particular strategy or at least discuss potential strategies that would increase profits. This is consistent with the textbook explanation of conspiracy in cartels, that firms conspire to coordinate on a particular strategy. However, it can be seen that collusion tends to break down throughout the periods, suggesting that the market institution itself may have some ability to inhibit collusive activity. Thus, one insight is that if certain institutions are more amenable to collusive activity, and one side of the market is allowed to design the institution, that the participants may choose an institution which is more amenable to collusive activity.

## 4 Linking the two together

The lab and field experiment show fairly similar results despite the differences between the institutions used in their experiments – when sellers are given the opportunity to collude they tend to do so. This should not be surprising, as there is a quote by Adam Smith that reads: “People of the same trade seldom meet together, even for merriment and diversion, but the conversation ends in a conspiracy against the public, or in some contrivance to raise prices.” However, there is little ability to maintain these collusive agreements, particularly when the other side of the market also exhibits some market power or knowledge of the market. Indeed, buyers in the IP lab experiment attempted to form a cartel but when the sellers refused to sell at the low prices the buyers eventually gave in and increased prices. Similarly, experienced buyers in the LP field experiment were able to holdout or search for lower prices. A more thorough discussion of lab results in this area would certainly include Isaac, Ramey, and Williams (1984) and Davis and Holt (1998) as they examine institutions that may be more susceptible to collusive practices.