
Classroom

EXPERNOMICS

Volume 2, Number 2

Fall, 1993

INSIDE THIS ISSUE:

Oligopoly and
Interdependence in
the Classroom

Margaret A. Ray

A Pollution Rights
Trading Game

Rachel Nugent

Book Review:
Experimental
Economics

David J. Hoas

Software Review:
MICRO Call Market

Greg Delemeester

Submissions and/or requests to be placed on our mailing list should be forwarded (by March 1 for our Spring, 1994 issue) to:

Greg Delemeester
Department of Economics
Marietta College
Marietta, OH 45750

(614) 376-4630
Fax: (614) 376-7501

or

John Neral
Department of Economics
Frostburg State University
Frostburg, MD 21532

(301) 689-4265
(301) 689-4386
Fax: (301) 689-4760

BITNET: e2ecner@fre.towson.edu
InterNet: e2ecner@fre.fsu.umd.edu

OLIGOPOLY AND INTERDEPENDENCE IN THE CLASSROOM

Margaret A. Ray *

Recently, I mentioned an interesting little experiment based on a teaching method I had heard about to a colleague. A few months later, the colleague had developed and much expanded the idea into a complete treatment for production and costs. I am hoping that by bringing up another little idea I have come across, I can benefit in the same way!

After discussing perfectly competitive and monopoly market structures, most introductory courses cover oligopolies. I have found that the key to students understanding oligopoly market structures is for them to appreciate interdependence. When I first tell classes that oligopolies are interdependent, they are thrilled to know (after perfect competition and monopoly) that this means no curves (I don't use kinked demand). The thrill is somewhat abated when they realize that it means an alternative treatment is necessary, and it might be "worse" than the curves were. This is where I think it is important to give the students a sense of the behavioral nature of the models as well as to point out that oligopolies are much more common in the economy. This is a great juncture for introducing a classroom experiment or exercise.

My background is in industrial organization, so I admit that I may spend more time covering oligopolies than some. The possibilities I outline here can take from half a class (or less) to several class periods. The Teaching Tips section of the October, 1987 *Economic Inquiry*, outlines a classroom experiment addressing collusion. The article details how to conduct the experiment that places students in a decision-making role that requires them to choose to collude or not to collude. The returns to their decision depend on the decision of the class as a whole. I do something similar in my classes. The difference is that I often don't have enough time to set up the collusion situation and explain the situation to the class, and I like to use a payoff that is realistic and near to students' hearts -- grades. I briefly introduce interdependence, strategic decision-making, strategies, and payoff matrices. I might discuss the prisoners' dilemma before or after the exercise. I tell the students that their assignment is simply to choose their grade for the assignment and write it (and their name) on a small piece of paper and fold it. The grade they receive, however, will depend on the choice of another student with whom they will be randomly paired. I then write a payoff matrix on the board. This one is my favorite.

		Your choice	
		A	C
Your Partner's Choice	A	You: F Partner: F	You: F Partner: A
	C	You: A Partner: F	You: C Partner: C

I collect the folded pieces of paper in a hat. I go to the front of the room and pull out pairs and announce the results. Students that get F's then complain and whine. This is a good time to bring up the analogy to firms in "the real world." There are usually also complaints about the uncertainty and lack of information. This, again, can be related to firms. Also, I point out that

they do have information about their classmates on which to base their decision (what kind of people are they? what is the class average? etc.). Students take a keen interest when their grade is concerned. I don't actually assign a grade from this, but I like them to think I will.

There are plenty of variations that can take place; change the group size, allow discussion, let them choose partners, predetermine partners, or change the payoff matrix. At a minimum, this can be done very quickly. Or it can be expanded to take place over several class periods (leave them with decisions and have them bring them to class the next time). The experiences I have had lead me to believe this exercise is well worth the time it takes, and it promotes much discussion (and sometimes brings in students who never spoke before). It can also be a way to interact with very large classes.

I would be interested to hear about any experiences people have had doing this type of exercise, or any ideas to refine it.

References

Hemenway, David, Robert Moore, and James Whitney, "The Oligopoly Game." Economic Inquiry, Vol. 25, October 1987, p. 727-730.

Note: For anyone interested in research using student decision making with respect to studying and grades, see The American Economist, Vol. 36, No. 2, Fall 1992, "Economic Education, Experimental Methods and the Structure-Conduct-Performance Paradigm."

* *Department of Economics
Mary Washington College
Fredericksburg, VA 22401-5358*

A POLLUTION RIGHTS TRADING GAME

*Rachel Nugent**

The U.S. Environmental Protection Agency (EPA) in recent years has moved toward market-based incentives to achieve pollution reduction. A limited pollution rights market has existed since 1975, but a higher level of activity is expected in response to the 1990 Clean Air Act. Beginning in 1995, power plants nationwide will be forced to cut sulfur dioxide emissions through market incentives provided by the EPA. Such a plan is already operated by the Southern California Air Quality Management District. And in a preview of coming developments, the Chicago Board of Trade is establishing a futures market in sulfur dioxide and other emissions that could eventually provide depth and breadth in the pollution rights market.

The new approach establishes a limited volume of pollution "rights", distributes them among a category of polluters, and allows them to be traded in a secondary market. The intent is to encourage lowest-cost pollution reduction measures to be utilized, in exchange for revenues from selling surplus pollution rights.

A classroom game can be played to demonstrate to students the natural incentives companies have to compare costs of pollution reduction to the cost of obtaining the right to pollute. The appeal is that students often have trouble accepting the concept of an "optimal pollution level" and have no trouble arriving at one through market forces.

The game is motivated by dividing the class into small groups which allows several industries to be established. Each group representing a company within an industry is given a different level of pollution emissions (use only one type of pollutant for simplicity) and different cost of

pollution reduction at their facility. Finally, each company is given a simple formula relating profit levels to output levels. For example, the pulp mill producing at its profit-maximizing level may produce 500 tons per day of sulfur dioxide and face a constant marginal cost of pollution reduction of \$1000 per ton (by installing scrubbers). The pulp mill's profits are \$1 million annually, and each ton reduction in emissions reduces profits by \$2000 (by forcing the plant to reduce output). Companies in other industries emit different levels and face different costs of pollution reduction (see Table 1). The Environmental Czar (you) distributes a select number of pollution rights equally to the companies in one-ton increments. The students are given a limited amount of time to balance their actual emission levels with their allowable emission levels. You have predetermined that some industries will have excess rights, while some will have insufficient pollution rights. Their choices are to install cleaning equipment, reduce output (and thereby emissions), or acquire pollution rights. The students will seek to achieve the required level in the least-cost method. If they do not achieve it during the allotted time period, they are shut down and make no profits (or suffer losses equal to fixed costs) in the next time period.

An equilibrium price will be established for the pollution rights. Depending on how much time they have, there may be initially some dispersion in transaction prices as it takes practice for them to become savvy market participants.

In the next round, the Environmental Czar may remove some pollution rights from the market, either through a mandate for pollution reduction, or because an environmental group has purchased some of the rights from existing companies and removed them permanently from the market. Trading will result in a higher price for pollution rights than the first round. Another round can be played with some of the industries benefitting from improved technology to reduce

pollution. This can be specifically allocated to a few companies as a reduction in

Table 1. Sample Firm Data for the Pollution Rights Trading Game

Firm	Current Output	Current Emissions	Current p	MC of Cleanup	Regulatory Emissions Limit	Pay for Cleanup	Reduce Output
Software	20Q	2 tons/day (.1 ton SO ₂ /Q)	\$200,000 (\$10,000/Q)	\$50,000/ton	1 ton SO ₂	\$50,000	\$100,00
Pulpmill	1,000Q	500 tons (.5 tons/Q)	\$1,000,000 (\$1,000/Q)	\$1,000/ton	250 tons SO ₂	\$250,000	\$500,00
Steelmill	100Q	30 tons (.3 tons/Q)	\$10,000 (\$1,000/Q)	\$2,000/ton	15 tons SO ₂	\$30,000	\$500

Each industry receives tradeable permits for 10 tons SO₂

pollution control costs. The trading will result in a lower price for pollution rights than previously. Finally, increases in demand for the output of some of the firms may lead to increased production, and derived increase in demand for pollution rights. This will cause the equilibrium price to rise.

Taylor, Jeffrey, "New Rules Harness Power of Free Markets to Curb Air Pollution," The Wall Street Journal, April 14, 1992, p. A1.

Tietenberg, Tom H., Emissions Trading. Johns Hopkins University Press for Resources for the Future, Baltimore (1985).

Wald, Matthew L., "Cleaning Up On Pollution," The New York Times, May 17, 1992.

Test Questions

1. Graphically demonstrate the welfare results of choosing an emission trading program to limit pollution as an alternative to command-and-control limitations. Be sure to show the effects on consumers, producers, and social welfare.

** Department of Economics
Pacific Lutheran University
Tacoma, WA 98447*

An expanded version of this paper is available from the author upon request.

2. List the events that would
a) lower the price of an emission permit, and b) raise the price of an emission permit.

3. Suppose you are the Environmental Czar. Design a program to reduce the pollutant nationwide. What are the problems that may occur? (You can expect discussion of region-shifting pollution emissions, and perhaps changes in production methods to reduce a pollutant that may increase other pollutants.)

Readings

BOOK REVIEW

Experimental Economics,
by Douglas D. Davis and
Charles A. Holt. Princeton,
New Jersey: Princeton
University Press, 1993, pp.
xi, 572, \$39.50.

Economists and economic writers have been studying and theoretically modeling markets since the late 1700s and the early 1800s. Yet, the first market experiments did not appear until the mid-twentieth century. This is unfortunate given that experimental methods are means by which economists can evaluate the predictive capacity of technically sophisticated models. Professors Davis and Holt should be complimented on their encyclopedic attempts to bring the reader up-to-date on the principal contributions of experimental research in the economics field. They attempt to: i) provide a perspective on the general usefulness of laboratory methods in economics, ii) discuss the methodological controversies existent in this field, and iii) present information concerning the design features necessary for effective experimentation [p.4].

Though billed as a

textbook, the book is much more. It is a research manual for those being introduced to experimental economics. Since experimentalists tend to classify experiments by both the institution and the subfield of economics that provides the research hypotheses, it may be easiest to describe the direction of the text in this manner [p. 34]. Its primary focus is on the three directions that experimental economics has gone: market experiments, game theoretic experiments, and individual decision-making experiments. Most economists have had some introduction to market experiments. The most familiar is the double-oral auction first conducted by Chamberlin in the 1940s. Hundreds of examples exist to confirm that the double auction, with a variety of designs, various levels of information, and various numbers of traders, will converge to a competitive equilibrium [p. 42]. Game theoretic experiments are generally well known to those working in the area of industrial organization and contract theory. Individual-choice experiments are known to microeconomic theorists studying expected utility theory.

If one is to use this as a textbook for an undergraduate class in

economics, he/she should follow Davis and Holt's suggestion of how to use the nine chapters contained in the text [see footnote 49 on p. 45]. Specifically, in a one semester undergraduate course one may wish to delete, or cover in a summary fashion, the material in chapter 2. Chapters 3 and 4 may then be covered in some detail. Chapters 6 and 7 may also be covered in greater detail. The special topics chapters of 5, 8, and 9 may be covered as time permits depending upon the level of the class. Of particular usefulness are the appendices to chapters that provide detailed instructions for conducting many experiments described in the body of the text. Some of these instructions are for classroom purposes and several are for research purposes.

Chapters 3 and 4 represent the bulk of most people's exposure to experimental economics. The two chapters deal with double-auction markets and posted-offer markets. In over simplistic terms, these chapters deal with the speed and efficiency by which supply and demand schedules converge to an equilibrium price and quantity combination. Reading about the research presented in these chapters

and surveying the accompanying reference sections at the end of each chapter gives the reader a greater appreciation of Vernon Smith's and Charles Plott's enormous contributions to the field of experimental economics.

Since many experiments existing for these types of markets already exist on the University of Illinois NovaNet system, the serious experimentalist will definitely want to become aware of this system's capabilities. Given the number of references made to NovaNet, the one unfortunate comment that can be made about this text is that it does not explain what is available on the NovaNet system in more detail. The benefits of a system such as NovaNet allow for laboratory markets to serve as field tests for such things as electronic stock exchanges [p. 136]. As a final note to these two chapters, the authors caution that due to the complexity of real world markets, the economic experimentalist must be careful in making policy pronouncements from the conclusions generated in experiments.

Though chapter two is one that this reviewer and the authors of the text suggest skipping in an

undergraduate class, the appendix to chapter two contains two experiments that students will find interesting and informative. The first deals with a sequential search experiment that replicates determining a reservation wage. The second deals with what is termed a centipede game. In this game, or experiment, the student's ability to use backward induction optimal choice strategies is tested. Chapter 6 also contains an experiment that most students will find of interest. It is a public goods experiment dealing with investment strategies for private versus public goods. Finally, the Iowa Presidential Stock Market discussed in chapter 7 will interest the economics student as well as the political science student.

In the concluding chapter of the text, Davis and Holt put forward what they consider to be the results of three decades of experimental research. First, in many situations, neoclassical price theory explains observed behavior well [p. 506]. Second, in the design of experiments and markets, institutions do matter [p. 507]. Third, some predictions of game theory are realistic descriptions of human behavior [p. 507]. Fourth,

other game-theoretic predictions have a more restricted range of application [p. 507]. Fifth, apart from institutional specification differences, many results are characterized by a gray area where uncontrollable variables irrelevant to the theory affect outcomes [p. 509]. Finally, experimental economic research and economics are incomplete. Some recurrent anomalies are fundamental challenges left for both economic theory and experimental economic methods [p. 509].

If one is teaching an undergraduate class in experimental economics, this is the text to use. If one is striking out on a new research program in experimental economics, this is the reference work with which to begin. If one is an accomplished experimental economist, this text will give a comprehensive summary of how far the field of experimental economics has come in its short life.

*David J. Hoaas
Department of Economics
Centenary College
Shreveport, LA 71134*

SOFTWARE REVIEW

MICRO Call Market (v1.0)

From the Economic Science Laboratory at the University of Arizona comes a spiffy little microcomputer-based program to assist instructors in doing "hand-run" call experiments in the classroom. The program provides a variety of computational and data display functions and, since it is menu driven, is easy to navigate from function to function.

For the uniform price call market, all buyers and sellers submit their respective bids to buy and offers to sell before the call. At the call, all bids are sorted in descending order and all offers in ascending order. The bid and offer curves are then crossed and the point at which they cross is the single uniform price. All buyers that bid to buy at the market price or above are matched with all sellers that offered to sell at the market price or below. There are four possible ways in which the bid and offer curves can cross to determine the market price. The pricing rule is determined as follows:

$$P = \frac{1}{2}[\min(\text{LAB}, \text{FRO}) + \max(\text{LAO}, \text{FRB})]$$

where LAB = last accepted bid; LAO = last accepted offer; FRO = first rejected offer; and FRB = first rejected bid.

The implementation of the experiment will depend on the computer technology available to the user. Having the program up and running on a PC in the classroom allows the instructor to conduct a complete, multiperiod experiment during a single class period. And, if you have access to a screen projection device (such as a Sharp Computer Projection Panel or an nSight Data Projector), you will be able to take advantage of the several display functions of the program such as graphing the bid and offer arrays and plotting a summary of the period price versus the equilibrium price.

On the other hand, if a PC is not available in the classroom, the experiment may still be run over several days. In this case, the instructor could collect the bids and offers at the end of a class period and then, using the program, calculate the market price in time for the next class when the next round of bids and offers are made.

To prepare a given experiment, the user must

select a parameter set specifying the market environment. The program comes with several pre-defined parameter sets and the ability to allow the user to create their own environment. Each parameter set specifies the number of buyers, sellers, units per trader, trading periods, and the costs to sellers and redemption values to buyers.

The program then creates record sheets for each buyer and seller showing their own private value or cost and allows the subjects to keep track of their profits over the course of the experiment. The program also prints the tickets that buyers and sellers use to submit their bids and offers to the experimenter.

Unlike other software packages available from the Economic Science Laboratory (such as MICRO Monop and Cournot Oligopoly), MICRO Call does not come with any instructions for subjects (although there are on-line instructions for the user). Experiments of this sort ought to have some common set of instructions reviewing the mechanics of the experiment and the meaning of the induced values in order to minimize confusion and

misunderstanding among subjects.

Overall, MICRO Call (v1. 0) is a well-constructed and simple-to-use program to design, process, and display the data from a hand-run

call market. If you are interested in obtaining a copy of this program send your request on department stationary along with a blank, formatted 3 1/2" 1.44 MB disk to:

Shawn LaMaster
Manager, Economic Science
Systems
Development
Economic Science
Laboratory
McClelland Hall, Room 116
University of Arizona
Tucson, AZ 85721

Greg Delemeester
Department of Economics
Marietta College
Marietta, OH 45750

DEPARTMENT OF ECONOMICS,
MANAGEMENT AND ACCOUNTING
MARIETTA COLLEGE
MARIETTA, OHIO 45750

