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Agricultural Economists' Use of Classroom Economic Experiments

Barry J. Barnett and Warren Kriesel

Economics belongs in everyone's education once we have learned how to teach it.

—George J. Stigler

Results are presented from a Web-based survey of instructors in agricultural economics and related departments about their use of, and attitudes about, classroom economic experiments.

Key Words: classroom economic experiments, teaching

JEL Classifications: A20, C25, Q00

A number of economists now use experimental methods to analyze economic behavior (Davis and Holt). Experiments are designed to test various hypotheses derived from economic theory. Experimental approaches allow researchers to control important aspects of the economic environment to which subjects are exposed. This allows for analysis of how individual behavior changes when important aspects of the economic environment are altered. In contrast, data derived from actual market transactions are often at an aggregate level and reflect behavior influenced by any number of institutional and environmental factors that vary over both space and time.

The past half century has witnessed a significant increase in the number of economic researchers employing experimental techniques. Experimental economics research is now published in both mainstream economics journals and specialized journals such as *Experimental Economics*. In 2002, Vernon Smith was awarded the Nobel Memorial Prize in Economic Science for his work with economic experiments.

Early researchers soon realized that economic experiments could also be used as pedagogical tools. However, the use of classroom economic experiments for teaching, rather than research, purposes did not become widespread until the 1990s. Articles on classroom economic experiments have since been published in a number of economics journals. In particular, the *Journal of Economic Education* has published many articles in which instructors describe their experiences using classroom economic experiments. Textbooks that focus on the use of experimental economics as pedagogical tools are now available. These texts contain many widely used economic experiments, along with instructional materials such as suggested assignments (e.g., Bergstrom and Miller). The internet newsletter

Barry J. Barnett and Warren Kriesel are associate professors, Department of Agricultural and Applied Economics, University of Georgia, Athens, GA.

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Classroom Expernomics (Delemeester and Neral) is an extremely accessible source of information on classroom economic experiments, as is the Web site *Games Economists Play: Non-Computerized Classroom Games for College Economics* (Delemeester and Brauer). Both of these sources allow users to search for information on classroom experiments by subject matter.

This article examines the use of classroom economic experiments among instructors in agricultural economics. The article begins with a literature review that focuses on examples of classroom economic experiments and economic concepts commonly taught using experimental methods. The remainder of the article describes results from a Web-based survey administered to agricultural economics instructors.

What Are Classroom Economic Experiments?

Economic experiments are characterized by the use of "laboratory" conditions that allow for the collection of data in a controlled economic environment (Davis and Holt). Controlling various aspects of the economic environment allows for more direct testing of behavioral hypotheses. Laboratory animals have been used in some economic experiments (Walker), but humans are the typical research subjects. Economic experiments have been conducted in a variety of settings, including focus groups, computer labs, casinos, and grocery stores.

University researchers often use students as subjects for economic experiments (e.g., Chamberlin). Occasionally, those experiments are conducted in a classroom setting; yet, it is important to distinguish between experiments conducted primarily for research purposes and those conducted primarily for instructional purposes. The latter are the focus of this article.

There appears to be no widely accepted definition of exactly what constitutes a classroom economic experiment. For purposes of this article, we will assume that classroom economic experiments are activities that, at minimum, meet the following conditions: (1) the activity is conducted primarily for instructional purposes to demonstrate specific economic concepts, (2) the activity involves participants making economic decisions within a somewhat controlled environment, and (3) participants' economic decisions are compared to behavioral hypotheses derived from economic theory. These conditions are intended to distinguish classroom economic experiments from other widely used experiential learning tools, such as case studies, role-playing exercises, and management simulations. Some classroom economic experiments have been computerized (Bernard and Schulze; Wells; Williams and Walker), but most are simple interactive simulations that require a bit of planning but no special supplies or equipment.

Examples of Classroom Economic Experiments

Double Oral Auction

Perhaps the most widely used classroom economic experiment is the double oral auction (DeYoung; Holt; Joseph; Wells). In this experiment, the class is divided into buyers and sellers. The buyers are each assigned a willingness to pay. The various willingness to pay positions are taken from an underlying demand curve that is not revealed to the students until after the experiment is completed. The sellers are each assigned a cost of production position from an underlying supply curve that, again, is not initially revealed to the students. Buyers are instructed to purchase at the lowest possible price as long as that price is less than or equal to their willingness to pay. Sellers are instructed to sell at the highest possible price that is above their cost of production. Transactions occur in an open outcry market structure. One of the primary learning objectives is to demonstrate how price discovery occurs in competitive markets through the uncoordinated activities of individuals engaged in optimizing behavior.

Notice that, based on the conditions outlined above, the activity is, in fact, an experiment. Based on theory, a particular result can

be hypothesized. The controlled economic environment consists of the "rules of the game" (i.e., the market structure) and any performance-based incentives that the instructor might want to introduce. But within this controlled economic environment, the student-participants are free and independent economic agents. Buyers (sellers) choose whether or not to buy (sell) and at what price. To emphasize the experimental nature of this activity, instructors often prepare a sealed envelope that contains a prediction of the equilibrium price. Prior to beginning the experiment, the instructor very publicly asks a student to hold the sealed envelope for safe-keeping. When the experiment is completed after several rounds of trading, the instructor asks the student to open the envelope and read the contents. Thus, it becomes clear that the experiment was testing a prediction based on economic theory.

The basic double oral auction experiment is quite amenable to different institutional structures or different market contexts. An important component of the institutional structure is the amount of information market participants receive about the prices at which transactions are occurring. Varying the amount of information available to market participants demonstrates the role of information in a market economy. Some versions of the experiment even allow participants to purchase information about the prices at which transactions are occurring.

By assigning new willingness to pay (cost of production) positions, the instructor can shift the demand (supply) curve and see if the market attains a new equilibrium position. The instructor can quietly encourage either buyers or sellers to form cartels and engage in collusion. With sufficient performance incentives, cartels will typically break down quickly. Price floors or ceilings can be used to demonstrate how changes in the institutional structure lead to changes in behavior and market performance.

Some instructors employ the double oral auction experiment in a financial market context (Bell; Williams and Walker). By including one riskless asset and multiple correlated risky assets, a financial market version of the double oral auction experiment can be used to demonstrate concepts such as diversification and arbitrage (Adams and Kluger; Shrader and Helgeson). Others have used the double oral auction experiment to demonstrate markets for tradeable pollution permits (Stephenson and Langdon; Walbert and Bierma) or the effects of positive externalities on market transactions (Hazlett).

Symmetric Game Experiments

Symmetric game experiments are so named because participants all face the same economic dilemma. The two most common examples of symmetric game experiments are voluntary contribution experiments and oligopoly market experiments.

Voluntary contribution experiments are typically designed to demonstrate why competitive markets can fail to produce socially optimal quantities of nonexcludable, nonrival, public goods. Examples of voluntary contribution experiments are found in Brock; Holt and Capra; Leuthold (1987, 1993); Nelson and Beil; Sulock; and Williams and Walker. Students are endowed with goods (e.g., small amounts of money or extra credit points) that they can choose to either keep or contribute toward provision of the public good. Each participant faces a classic "prisoners' dilemma" payout matrix. The entire class will be significantly better off if the public good is provided but each individual has an incentive to free-ride and not contribute toward provision of the public good. The experiment typically consists of a specified number of rounds. In each round, participants choose whether or not to contribute to provision of the public good. The public good is provided if the total contributions summed over all rounds exceed some predetermined threshold. Individual contribution decisions are confidential. However, following each round, a running total of contributions is revealed.

A typical outcome is that contributions diminish in later rounds because participants know that the experiment will end soon. Thus, an interesting variation on the experiment is

to make the number of rounds (the time horizon) indefinite. A random process, such as the role of a die, can be used to determine whether or not the experiment will continue for another round (Nelson and Beil). In this case, the threshold for provision of the public good is specified in percentage, rather than absolute, terms.

Another variation forbids communication between participants except after certain prespecified rounds (Nelson and Beil). When communication is allowed, if contributions are below the rate required to provide the public good, students will often plea for their fellow participants to contribute more. The effect of these pleas on contribution rates, if any, tends to dissipate quickly. Also, it is not uncommon for those who argue most eloquently for increased rates of contribution to be the most egregious free-riders.

Participants in oligopoly markets are also faced with a symmetric game where the production decisions made by each firm affect all of the other market participants. Classroom experiments that demonstrate the game-theoretic aspects of oligopoly markets are described by Hemenway, Moore, and Whitney; Holt and Capra; Joseph; Meister; and Sorenson. Eckalbar describes a duopoly market experiment. Variations of oligopoly/duopoly market experiments employ indefinite time horizons, allow collusion among market participants, or both (Meister). Another variation allows participants to monitor each other's production decisions (Hemenway, Moore, and Whitney). Sorenson describes an oligopoly experiment played over the course of an entire semester. The experiment involves repeated interactions with an indefinite time horizon, contact between firms in multiple markets, and the availability of detailed information about each firm's pricing decisions. These features add realism to the experiment and help participants escape the trap of prisoner's dilemma outcomes.

Other

The double oral auction experiment and various forms of symmetric game experiments are perhaps the most commonly used classroom economic experiments. However, a number of other classroom experiments have been developed to demonstrate important economic concepts.

Asymmetric game experiments simulate economic situations where different market participants face different dilemmas. These experiments are often used to demonstrate concepts related to principal–agent relationships (Holt and Capra; Netusil and Haupert; Ortmann and Colander). Other classroom experiments address monopoly profit maximization (Oxoby; Wells; Williams and Walker), comparative advantage (Haupert 1996a), diminishing marginal product (Anderson), labor market efficiency (Haupert 1996b), foreign exchange trading in official and parallel markets (Hazlett and Ganje), the relationship between marginal cost and supply (Bernard and Schulze), tradeable pollution allowances (Stephenson and Langdon; Walbert and Bierma), common property resources (Giraud and Herrmann), and rational expectations (Peterson).

An experiment that might be of particular interest to agricultural economists is the multimarket free entry and exit experiment (Garratt). Participants play the role of agricultural producers who can produce one of four possible crops. Free entry and exit leads to equal profits across markets in a multimarket long-run equilibrium. By introducing a government land fallow program, the experiment can be used to demonstrate the difference between accounting profit and economic profit in the presence of opportunity costs. In the simplest form of the experiment, participants make entry and exit decisions by walking to specified areas in the classroom. Thus, participants can observe each other's entry and exit decisions. A variation of the game, that emphasizes the coordination problem, would have participants make entry and exit decisions privately.

Why Classroom Economic Experiments?

Among education specialists, it is now generally agreed that different students have different preferred learning styles. Jung identified four types of learners: feelers, thinkers, sen-

sors, and intuitors. Oltmans identified four learning styles based on the student's preference for concrete versus abstract learning and sequential versus random information processing. The thinkers in Jung's classification and abstract learners in Oltmans' classification would respond very well to a standard lecture format. The others would prefer more "hands-on" approaches to learning. Dobbins et al. cite a study by Oltmans that found that the vast majority of agricultural economics undergraduate students at a major university were concrete learners according to Kolb's classification. Yet most undergraduate teaching is conducted in a lecture format that provides little opportunity for concrete examples or experiences.

Various experiential learning techniques provide opportunities for students to learn by experiencing concrete examples of abstract concepts (Dobbins et al.). Often, these techniques have the additional benefit of increasing students' enthusiasm and motivation (Koontz et al.) because the experiential learning environment creates a "need to know" on the part of the student (Dobbins et al.).

Strengths

Classroom economic experiments offer many of the same benefits as other experiential learning techniques. Experiments provide concrete examples of theoretical concepts (Adams and Kluger; Dobbins et al.; Joyce; Nelson and Beil; Shrader and Helgeson; Stephenson and Langdon; Walker; Wells). They also create an active learning environment of self-discovery (DeYoung; Joseph; Joyce; Ortmann and Colander; Stephenson and Langdon; Walbert and Bierma; Wells) and increase student enthusiasm and interest (Joseph; Shrader and Helgeson; Stephenson and Langdon; Walker). Some report that experiments provide immediate feedback on what concepts students do and do not understand (Wells). The experimental environment also causes students to think of questions that they would not ask in a lecture format (Dobbins et al.; Wells). Some instructors argue that experiments facilitate student retention of important concepts (Joseph; Walbert and Bierma). Others report that experiments help bridge the impersonal gap that often exists between the instructor and students (Joseph; Ortmann and Colander; Stephenson and Langdon).

Economic experiments, as opposed to other experiential learning techniques, have at least two other potential benefits. First, students see the instructor as more than just a lecturer. The instructor becomes a scientist subjecting theory to empirical tests (Wells). Second, experiments illustrate two major themes in economics: theory usually predicts well and institutions matter (Joyce; Ortmann and Colander).

Weaknesses

As with other experiential learning techniques, instructors often raise concerns about the opportunity cost of using classroom economic experiments. Experiments claim scarce classroom time that could be used to cover other material (Bell; Wells). Experiments can also require a significant amount of instructor time outside of class (Bell). Haupert (1996a), however, argues that a good experiment does not cost much time in net because it greatly reduces the number of examples needed to communicate a concept. Also, the time required for an instructor to set up an experiment is largely a one-time, fixed cost. Some argue that classroom economic experiments can become unmanageable with large classes (Shrader and Helgeson).

Among those who use classroom economic experiments, there is significant disagreement about the importance of performance incentives. Those who conduct research using experimental economics emphasize the importance of financial incentives to induce "real-life" behavior on the part of participants (Bolle). Some instructors provide financial incentives for classroom economic experiments (DeYoung), whereas others employ extra credit incentives (Bell; Haupert 1996a; Sorenson; Williams and Walker). However, some argue that if the experiment is well constructed, incentives should not be necessary (Stephenson and Langdon). Shrader and Helgeson report

that in their experience, student evaluations of classroom economic experiments showed no statistically significant differences between those participating in treatments with real financial incentives and those participating in treatments without.

A number of ethical concerns have been raised about the practice of assigning extra credit based on student performance in classroom economic experiments. Experimental outcomes can be affected by luck (Bell) or the ignorance (or spite) of other participants (Sorenson). Stodder expresses concerns about the widely used voluntary contribution experiment described earlier. In debriefing students following the experiment, instructors might tend to discuss free-riding in an admiring normative sense (or alternatively make fun of those who contribute). Stodder argues that when observed behavior does not follow the predictions of theory, careful scientists should think about the validity of their assumptions. If instructors fail to do this, and instead ridicule or penalize (through loss of extra credit) students who choose not to free-ride, they stifle student interest and enthusiasm and present themselves as dogmatists rather than scientists.

Fels expresses frustration that although many instructors use classroom economic experiments, very few have used experimental techniques to test whether classroom experiments actually enhance student learning. Students generally claim that classroom experiments facilitate learning; however, results from the limited number of empirical studies reported in the literature have been inconclusive (Cardell et al.; Gremmen and Potters; Marston and Lyon; Wentworth and Lewis).

Use of Economic Experiments by Agricultural Economists

Between October 1 and November 8, 2002, a Web-based survey was administered to agricultural economics instructors to assess their use of, and attitudes about, classroom economic experiments.[1] An initial e-mail asking instructors to participate in the survey was distributed on October 1 through the listserv maintained for agricultural economics department chairs. The e-mail contained a link to the Web-based survey. Department chairs were asked to forward the e-mail to their teaching faculty. A second e-mail was distributed through the department chair listserv on October 14.

The survey asked respondents to identify the educational institution where they currently teach. Thus, a response from a given institution was interpreted as evidence that the survey request had been distributed among the teaching faculty at that institution. If no responses were received from a given institution by October 21, an e-mail was sent to a faculty member at the institution asking that the survey request be forwarded to the teaching faculty in the department.

Responses were received from 208 agricultural economics instructors at 45 colleges and universities (see Table 1). Nine of the surveys were incomplete and had to be discarded. Table 2 provides summary statistics for the remaining 199 surveys.

Subset: Respondents Who Were Familiar with Classroom Economic Experiments

Slightly over 90% of the respondents indicated that they were "at least somewhat familiar with classroom economic experiments," regardless of whether or not they had actually used them in class. Only those who were familiar with classroom economic experiments were asked to answer the remaining questions on the survey. Respondents were asked to provide Lickerd scale responses to a set of statements about classroom economic experiments. Mean results are presented in Table 3. The results are sorted according to the respondents' experience with classroom economic experiments. The first column of results is for respondents who indicated that they use economic experiments in at least one course that they currently teach. The second column of results is for respondents who do not use economic experiments in any courses that they currently teach but have used them in the past.

[1] A copy of the survey instrument is available from the authors upon request.

Table 1. Number of Survey Responses from Each Institution

Institution	Respondents
Arizona State University	1
Auburn University	6
Clemson University	1
Colorado State University	7
Cornell University	7
Delta State University	1
Kansas State University	10
Lansing (Michigan) Community College	1
Louisiana State University	4
Michigan State University	3
Mississippi State University	5
Montana State University	4
New Mexico State University	3
North Dakota State University	4
Oklahoma State University	6
Oregon State University	3
Pennsylvania State University	3
Purdue University	6
Rutgers University	2
Southern Illinois University	1
Texas A&M University	7
Texas Tech University	1
The Ohio State University	9
University of Arizona	2
University of Arkansas	6
University of California at Berkeley	3
University of Florida	11
University of Georgia	10
University of Idaho	3
University of Illinois	4
University of Kentucky	6
University of Maryland	11
University of Massachusetts	4
University of Minnesota	5
University of Missouri	5
University of Nevada Reno	1
University of New Hampshire	3
University of Tennessee	5
University of Vermont	1
University of Wisconsin	6
Utah State University	4
Virginia Polytechnic Institute and State University	7
Washington State University	7
West Virginia University	3
45 Total Institutions	202

Table 2. Summary Statistics

Average years taught at either undergraduate or graduate level	15.4 years
Recall participating in classroom experiments as students	25.2%
Aside from classroom economic experiments, regularly use other experimental teaching tools	65.8%
Have conducted research using experimental economics techniques	26.7%
Are at least somewhat familiar with classroom economic experiments (regardless of whether or not they have actually used them in class).	90.1%

The third column of results is for those who have never used economic experiments in any course that they currently teach.

Those who currently use experiments believe more strongly, on average, that experiments provide a concrete demonstration of abstract concepts, promote student enthusiasm and interest, and facilitate active learning. Interestingly, even those who have never used experiments tend to agree with those statements. All three groups of respondents tend to agree (although not strongly) that experiments provide quick feedback about what students do and do not understand. In general, all three groups of respondents are uncertain about whether or not a benefit of classroom experiments is that students see instructors as scientists testing hypotheses derived from theory. Those who currently use classroom economic experiments tend to disagree with the statement that classroom economic experiments take too much class time. Those who have used experiments in the past or have never used experiments are less certain about this statement. Both those who currently use experiments and those who have used them in the past tend to disagree with the statement "I am not aware of any classroom economic experiments that are appropriate for the classes that I teach." Perhaps more interesting is that even those who have never used classroom economic experiments were, on average, un-

Table 3. Means of Lickerd-Scale Response to Statements About Classroom Economic Experiments[a]

	Currently Use Experiments (n = 73)	Do not Currently Use Experiments but Have Used Them in the Past (n = 31)	Never Used Experiments (n = 75)
Classroom economic experiments provide a concrete demonstration of abstract concepts	4.51	4.06	3.84
Classroom economic experiments promote student enthusiasm and interests	4.56	4.13	3.91
Classroom economic experiments facilitate active learning	4.47	4.13	3.93
Classroom economic experiments provide quick feedback about what students do and do not understand	3.47	3.32	3.31
A benefit of classroom economic experiments is that students see the instructor as a scientist testing hypotheses derived from theory	2.97	3.17	2.99
Classroom economic experiments take too much class time	2.29	3.19	3.22
I am not aware of any experiments that are appropriate for the classes that I teach	1.56	2.16	3.07
My classes are so large that it would be difficult to use economic experiments	2.04	2.77	2.42
Classroom economic experiments are not very effective unless the instructor provides performance incentives (prizes, extra credit, etc.)	2.25	2.77	2.78
I am opposed to using extra credit performance incentives for classroom economic experiments	2.90	3.16	3.14

[a] From the "familiar with classroom economic experiments" subset. 1 is strongly disagree, 5 is strongly agree.

certain about this statement. This would seem to indicate that a lack of awareness about appropriate experiments is not a major impediment to the adoption of classroom economic experiments. Nor does class size appear to be a major impediment to adoption. All three groups of respondents tend to disagree with the statement "My classes are so large that it would be difficult to use economic experiments." Interestingly, those who have quit using experiments are less likely to disagree with this statement. All three groups of respondents tend to disagree with the statement that performance incentives are required for classroom experiments to be effective. The strongest disagreement comes from those who currently use experiments. Relative to those who currently use experiments, those who have never used experiments and those who have quit using experiments are more concerned about using extra credit points for performance incentives. However, on average, it is probably fair to say that all three groups were largely uncertain about the use of extra credit points as performance incentives.

Results indicate that respondents (who were familiar with classroom economic experiments) averaged teaching 2.2 courses per

Table 4. Respondents' Use of Experiments by Course Level[a]

	% Undergraduate and Split-Level Courses	% Graduate Courses
Currently Use Experiments	34.1	18.4
Have Used Experiments in the Past (but not Currently)	15.5	13.2
Never Used Experiments	50.4	68.4

[a] From the "familiar with classroom economic experiments" subset.

year. Table 4 describes respondents' use of classroom economic experiments. In general, experiments are used more in undergraduate and split-level courses than in graduate courses. Respondents reported using classroom economic experiments in 34.1% of their undergraduate and split-level courses and in 18.4% of their graduate courses. For 15.5% of undergraduate and split-level courses and 13.2% of graduate courses, respondents indicated that they were not currently using classroom economic experiments but had in the past. For over 50% of undergraduate and split-level courses and over 68% of graduate courses, respondents reported having never used classroom economic experiments.

Table 5 breaks down responses about the use of classroom experiments by average class size. Interestingly, courses in which respondents are currently using classroom economic experiments have larger average numbers of students than courses in which respondents are not currently using experiments. This is true of undergraduate and split-level courses as well as graduate courses. This result is consistent with the responses about class size reported in Table 3.

For undergraduate and split-level courses, Table 6 presents responses about the use of classroom economic experiments by course subject matter. Table 7 contains the same information for graduate courses. For undergraduate and split-level courses, experiments are used most often to teach microeconomic theory, marketing and trade, and natural resource or environmental economics. The results are similar at the graduate level, with experiments being used to teach microeconomic theory and natural resource or environmental economics. At the graduate level, experiments are not widely used to teach marketing or trade. They are used to teach agribusiness, which was not the case at the undergraduate level.

Subset: Current or Past Users of Classroom Economic Experiments

Of the 180 respondents who indicated familiarity with classroom economic experiments, 104 indicated that, for the classes they currently teach, they either currently use economic experiments or have done so in the past. This group was asked to identify the specific economic concepts that they had taught using economic experiments. Those responses are shown in Table 8. Note that slightly over half of these respondents indicated that they had used classroom economic experiments to demonstrate the concept of price discovery and market clearing in perfect competition. The double-oral auction experiment, or variations

Table 5. Respondents' Use of Experiments by Class Size[a]

	Average Class Size for Undergraduate and Split-Level Courses	Average Class Size for Graduate Courses
Currently Use Experiments	60.2	20.6
Have Used Experiments in the Past (but not Currently)	45.6	11.1
Never Used Experiments	53.7	12.7

[a] From the "familiar with classroom economic experiments" subset.

Table 6. Respondents' Use of Experiments by Course Subject Matter: Undergraduate and Split-Level Courses[a]

Subject Matter	Currently Use Experiments	Do not Currently Use Experiments but Have Used Them in the Past	Never Used Experiments
Microeconomic Theory	19	3	10
Macroeconomic Theory	2	0	5
Quantitative Methods	1	3	9
Natural Resource and Environmental Economics	16	10	10
Public Policy	2	2	5
Finance and Credit	5	4	11
Marketing and Trade	24	4	17
Risk and Uncertainty	0	2	2
Farm Management	3	0	7
Agribusiness	6	6	22
Agricultural Law and Taxes	0	0	2
Economic Development	1	4	8
Other	9	2	22
Total	88	40	130

[a] From the "familiar with classroom economic experiments" subset.

thereof, is most likely being used to demonstrate this concept. Experiments were being used by at least 25 respondents to teach each of the following concepts: public goods, common property resources, and imperfect competition. Symmetric game experiments are widely used to teach each of these concepts. At least 20 respondents indicated using experiments to teach risk and principal-agent concepts. The concepts are generally taught using versions of asymmetric game experiments.

Modeling the Classroom Economic Experiment Adoption Decision

A simple logit model was used to analyze the classroom economic experiment adoption decision. The value of the dependent variable, *Adopted,* was 1 for the subset of 104 respondents who were current or past users of classroom economic experiments (as described in the previous section) and 0 otherwise.

Four explanatory variables were used to model the adoption decision. *Years* is the number of years that the respondent has taught at either the undergraduate or graduate level. The mean of this variable was 15.4 years (Table 2). Responses ranged from 1 to 40 years. *Years* was hypothesized to have a negative influence on adoption based on an assumption that less experienced teachers might be more willing to adopt innovative teaching methods.

The remaining three independent variables were dichotomous in nature. The variable *Student* was equal to 1 if the respondent recalled participating in classroom experiments as a student and 0 otherwise. It was hypothesized that respondents who experienced classroom economic experiments as students would be more likely to adopt this method in their own classroom teaching. About 25% of respondents recalled participating in classroom experiments as a student (Table 2).

The value of the variable *Experiential* was 1 if the respondent regularly used other experiential teaching tools other than economic experiments (e.g., case studies or management simulation games) and 0 otherwise. The use of other experiential teaching tools was hypothesized to be positively related to the adoption of classroom economic experiments. Almost 66% of respondents indicated that they regularly used experiential teaching tools other

Table 7. Respondents' Use of Experiments by Course Subject Matter: Graduate Courses[a]

Subject Matter	Currently Use Experiments	Do not Currently Use Experiments but Have Used Them in the Past	Never Used Experiments
Microeconomic Theory	6	0	13
Macroeconomic Theory	0	0	0
Quantitative Methods	3	3	19
Natural Resource and Environmental Economics	6	7	6
Public Public Policy	1	3	8
Finance and Credit	0	1	6
Marketing and Trade	1	2	16
Risk and Uncertainty	2	0	3
Farm Management	1	0	0
Agribusiness	4	0	8
Agricultural Law and Taxes	0	0	0
Economic Development	0	0	4
Other	1	2	10
Total	25	18	93

[a] From the "familiar with classroom economic experiments" subset.

than classroom economic experiments (Table 2).

The variable *Research* was equal to 1 if the respondent had conducted research using experimental economics techniques and 0 otherwise. Similar to the reasoning behind the *Student* variable, this sort of prior experience was hypothesized to have a positive effect on the adoption of classroom economic experiments. Approximately 27% of respondents indicated that they had conducted research using experimental economics techniques (Table 2).

Results from the logit model are shown in Table 9. This simple model of the adoption decision performed reasonably well. The model's correct prediction ratio was 76.1%, and the statistics for its overall performance were significant.

Table 8. Concepts Taught Using Classroom Economic Experiments[a]

Concept	Number of Respondents Who Use Experiments to Teach this Concept
Price Discovery and Market Clearing in Perfect Competition	55
Other	32
Provision of Public Goods	29
Pricing and/or Collusion Under Imperfect Competition	27
Common Property Resources	25
Asymmetric Information/Principal-Agent Relationships	21
Elicitation of Risk Preferences and/or Test of Expected Utility Theory	20
Externalities	20
Diminishing Marginal Utility	19
Contingent Valuation and Other Nonmarket Valuation Methods	19
Price Controls or Other Government Interventions in Markets	18
Diminishing Marginal Product	16
Financial Asset Valuation	13
Price Discrimination	11

[a] Number of respondents from the "current or past users" subset.

Table 9. Logit Regression Results for the Decision to Adopt Classroom Economic Experiments[a]

Variable	Beta Coefficient	Standard Error	*t*-Ratio	Marginal Effect
Intercept	−0.5522	0.4216	0.1903	
Years	−0.0259	0.0169	1.5325	−0.0060
Student	0.6367	0.3757	1.6947*	0.1538
Research	2.1705	0.4293	5.0559*	0.4542
Experiential	0.5776	0.3379	1.7094*	0.1432

[a] From the "familiar with classroom economic experiments" subset. Asterisk (*) indicates rejecting the one-tailed hypothesis test at the 5% level or lower. Correct prediction ratio = 76.1%. Likelihood ratio = 45.77, significant at 0.0001 level; $n = 199$.

The variable *Years* has a *p*-value of 0.12, indicating that the null hypothesis of a nonnegative relationship between *Years* and *Adoption* cannot be rejected. The remaining explanatory variables all had the hypothesized sign and were statistically significant.

Table 9 also reports the marginal effects associated with each independent variable. These are estimated by evaluating the regression, *z*, for a one-unit change of the independent variable and obtaining the estimated probability through the logit transformation

$$(1) \qquad p = \frac{1}{[1 + \exp(-z)]}.$$

Comparing this with a baseline probability yields the marginal effect.

For the variable *Years,* the probability was estimated at the means of 15.4 years and again at 16.4 years. The probability of adoption decreased from 0.5226 to 0.5166, for a change of −0.006. For the variable *Student,* the regression was evaluated at the means of all variables, except *Student* was assigned a value of 0, producing a baseline probability of 0.5021. Subsequent evaluation with *Student* assigned a value of 1 yielded a 0.6559 probability, for a marginal effect of 0.1538. Similar calculations were made for the remaining dummy variables.

Conclusion

Many economists now use experimental techniques for research, teaching, or both. This article focused on the pedagogical use of economic experiments. The article began with a review of the literature that emphasized some of the most commonly used classroom economic experiments. The next section summarized much of the literature that describes the pedagogical strengths and weaknesses of classroom economic experiments. The final section of the article described results from a Web-based survey of agricultural economics instructors.

Approximately 90% of survey respondents indicated that they were at least somewhat familiar with classroom economic experiments. Even allowing for some self-selection bias (those who are familiar with classroom economic experiments may have been more likely to respond to the survey), these results indicate that many agricultural economics instructors are familiar with classroom economic experiments. Around 50% of survey respondents indicated that they currently use classroom economic experiments.

Contrary to what one might expect, the survey results indicated that courses in which instructors are currently using experiments have larger average numbers of students than courses in which instructors are not currently using experiments. Lickerd-scale responses to a series of statements about classroom economic experiments reveal some differences between those who currently use experiments, those who do not currently use experiments but have in the past, and those who have never used experiments. Not surprisingly, those who currently use experiments tend to agree most strongly with the statements about the per-

ceived strengths of classroom economic experiments and disagree most strongly with statements about the perceived weaknesses.

More interesting perhaps is that even those who have never used classroom economic experiments tend to agree with statements about the perceived pedagogical strengths of classroom experiments. This begs the question of why these instructors have never adopted this pedagogical tool. The literature suggests that large class sizes could make it difficult to use classroom economic experiments, but the survey results do not seem to indicate that this is a problem for most agricultural economics instructors. Responses to the Lickerd-scale statements provide at least some evidence that those who do not currently use classroom economic experiments are concerned about the opportunity cost, in lost classroom time, associated with using classroom experiments. Relative to current users, nonusers also seem to be less aware of experiments that would be appropriate for the classes that they teach.

A logit analysis of the survey data revealed that adoption of classroom economic experiments is positively related to previous experience with classroom economic experiments as a student, regular use of experiential teaching tools other than economic experiments, and the use of experimental economics techniques as a research tool. Of the explanatory variables included in the logit model, the use of experimental methods in research is the most important determinant of classroom adoption. For faculty who conduct research using economic experiments, the probability of classroom adoption of economic experiments increased from 0.3987 to 0.8529. Thus, increased funding for experimental economics research would likely also lead to more instructors adopting classroom economic experiments, particularly if the funding is targeted to first-time users of experimental methods.

Instructor adoption of classroom economic experiments might also be facilitated by efforts to reduce adoption costs. These costs involve primarily the time required to find or develop appropriate experiments and the time required to prepare any necessary materials. If the experiment is computerized, the necessary programming can be a significant barrier to adoption. Fortunately, most of the time requirements are one-time, fixed costs. Furthermore, once an experiment has been adopted by one instructor, it can usually be easily transferred to other faculty. Thus, if administrators or professional associations want to encourage adoption of classroom economic experiments, they should consider providing resources to assist with the costs of development, preparation, and programming.

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