A NEOPHYTE’S COST-BENEFIT ANALYSIS OF CLASSROOM EXPERIMENTS AND SIMULATIONS IN INTRODUCTORY ECONOMICS

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A Neophyte’s Cost-Benefit Analysis of the Use of Classroom Experiments and Simulations in Introductory Economics*

by

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Abstract

The purpose of this paper is to help instructors who have never carried out classroom experiments to decide whether or not they wish to try such a teaching innovation. This paper does not give the details of how to run various experiments (an annotated bibliography points readers to various useful readings). Instead, it gives a cost-benefit analysis of introducing experiments from the viewpoint of a non-expert who has suffered some of the costs that an average instructor might suffer should they adopt such an approach.

Benefits include (potentially) more learning by students, as well as perceptions by students and instructors that experiments are more realistic, stimulating, and enjoyable than lectures. The costs include lost lecture time, extra preparation time, difficulties with implementation, and monetary costs.
I Introduction

Recently there seems to have been an upsurge in the number of economics instructors carrying out at least some classroom experiments in their introductory classes. I think we can clearly see evidence of this increased interest in classroom economic experiments in the introduction of the experiment-based introductory textbook by Bergstrom and Miller (1997); in the recent articles on classroom experiments in many economics journals (Classroom Experiments, Economic Inquiry, Journal of Economic Perspectives, Southern Economic Journal, and the Journal of Economic Education – see the annotated bibliography); in the extensive collection of economic experiments documented in Brauer (1994); in the special sessions on classroom experiments and simulations at a variety of conferences; and in the user guides now accompanying many textbooks (Deleemeste and Neral (1998), Hazlett (1998a), Ortmann and Colander (1998), Stull (1998)). Indeed, John Taylor’s introductory textbook integrates experiments directly into several chapters.

I think some of this upsurge is due to an increase in the number of researchers doing experimental economics who are extending their research to their teaching, but I also think it is partially due to a lack of satisfaction by instructors with the traditional lecture format. To quote Bergstrom and Miller (1997, p. ix):

> We got tired of it. Lecturing to sleepy students who want to “go over” material that they have already highlighted in their textbooks so that they can remember the “key ideas” until the midterm. We wanted to engage our students in active learning, to exploit their natural curiosity about economic affairs, and to get them to ponder the questions before we try to give them answers. We found that conducting economic experiments in class … was an effective way of getting students involved in economics as a means to understanding their own experience.

In addition, I think recent declining enrollments and majors in economics have spurred instructors to try new techniques such as classroom experiments.\(^1\)

The purpose of this paper is to help instructors who have never carried out simulations or experiments in their classes to decide whether or not they wish to try such a teaching innovation. I am not an expert in the field (I have done no research using economic experiments), but I think this is an advantage in that I am more likely to have suffered some of the costs that an average instructor might suffer should they adopt an experiment-based approach. After two years of doing experiments in introductory economics, and some experience in my third-year macroeconomics class, as well as some extensive reading in the area, I am personally quite convinced of the usefulness of simulations and experiments (although I do not believe they are for all instructors). I am not sure that they raise the overall economic knowledge of the students, although I do believe certain student types will learn more with this methodology. However, I will argue that simulations and experiments provide a more interesting introductory class for students by providing variety in learning, and by making economics more stimulating, and more participatory. I also believe that the experiments and their results make economic models more realistic to students. Students get a better idea that some of the

\(^1\) See Siegfried (1998) for an overview in the U.S. At my university, we peaked at 119 majors in the 1988-89 school year, fell to a low of 42 majors in the in the 1996-97 school year, and have recovered to 74 majors this last term (Winter 1999). Our enrollments follow a similar U-shape.
concepts instructors discuss are useful in explaining the real world – they are always impressed when the sealed envelope is opened to reveal the predicted price and quantity traded, or when it is demonstrated that the consumer pays the same after-tax price under both the buyer-tax regime and the seller-tax regime.

In this paper I am not going to go into the details of *how* to run various experiments. I have included an extensive annotated bibliography that has information on where to find such details for a wide variety of experiments. Instead, I am going to try and give the reader some idea of the practicalities of running experiments and simulations, and I am going to try and provide a little cost-benefit analysis to help you decide if you want to try them. I myself decided to try experiments as a result of various reading I had done on the subject, some sessions I had attended at conferences, and because of a growing perception that just lecturing at introductory students was not achieving enough. I wanted my students to be more enthusiastic, to enjoy introductory economics.

I have chosen to lump simulations, experiments and games together. They consist of some or all of the students involved directly in learning-by-doing, by doing a simulated economic event of some kind. I tend to think of simulations or demonstrations as taking only a few minutes, and as involving a subset of students at the front of the class (e.g. the common property simulation discussed in Section IV below or in Hazlett (1997)), or the entire class involved in a rather passive experiment, such as bidding for a muffin. I think of experiments as involving the entire class in a rather protracted experience, that might take up the entire lecture or lab time, such as a multi-session market experiment. Finally, economic games tend to be contests, such as a macroeconomic game where different student teams might try and end up with the best economy or the best re-election chances. However, I do *not* include in my discussion role-playing, such as is discussed in Lowry (1999) or Oberhofer (1999). In addition, I will tend to focus on experiments that can be run in the classroom, as opposed to experiments that might require computer or internet resources, although I will mention these tangentially.

In Section II of the paper I will discuss the potential benefits of classroom experiments (which include better learning by students, as well as perceptions by students and instructors that experiments are more realistic, more stimulating, more enjoyable, which may lead to more future majors) and the potential costs (which include lost lecture time, extra preparation time, difficulties with implementation, and monetary costs). Section III will discuss some specific concerns with running experiments (class size, timing, presentation of results), while Section IV briefly presents a short, coherent list of classroom experiments and simulations for a typical introductory class. Section V concludes the paper.

II A Cost-Benefit Analysis of Classroom Experiments

Is there a net benefit to an instructor who converts partially or fully to the use of classroom experiments? In this section I will present some of the benefits and costs of adopting an experiment-oriented approach to teaching introductory economics in an attempt to answer this question.

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2 I have tended to omit experiments that seemed overly complex or costly relative to their pedagogical benefit, as well as experiments that deal with economic concepts above the introductory level.
What are the (Potential) Benefits of Classroom Experiments?

1. Students might learn more economics.

Researchers in the education literature have long argued that students learn more if they are taught using “experiential” or “active” learning (Kolb (1984)). This literature argues that this result is especially true if we are interested in long-term retention of knowledge. Instructors who use experiments in their classroom have argued that the experiments are a powerful way to demonstrate basic principles (Noussair and Walker (1998), or that self-discovery is the best way to teach difficult, unintuitive concepts such as the optimal pollution level (Walbert and Bierma (1988)). However, for a long time, as Fels (1993) emphasized, there has been little hard empirical evidence to back up the argument that students will learn more in classes using experiments. More recently, there have been a series of attempts to more clearly test the hypothesis that students might learn more with experiments. Of the eight results listed below, three found that the experiments had no impact, while five found that they had a positive impact, ranging from small to fairly large for the Amsterdam studies.

- Fraas’ (1980) study had a random assignment of students to experiment or lecture sections, and found that the average student did just as well in either the experiment sections (50% of contact hours dedicated to experiments) or the lecture section. However, he found that weaker students (lower pre-test economics score or no high school economics or lower SAT scores) gained much more from the experiments than the lecture-only sections, while the stronger students gained more from the lecture-only sections.

- N. Cardell et. al. (1996) present data from two universities. At Denison University there is evidence that the (computer) laboratory experiments improved results in intermediate macroeconomics. However, at Washington State University the preliminary evidence is of no impact of the experiments in introductory economics.

- In the introduction to their Instructor’s Manual, Bergstrom and Miller (1997) state that their students’ performance on exams is better since the implementation of experiments.

- Frank (1997) found that students did somewhat better on the relevant multiple choice questions if they were in the game classroom, as opposed to the control group.

- Gremmen and Potters (1997) compared randomly-allocated sections of evening classes in Amsterdam. In one set of classes, they replaced 3 hours of lectures with an international macroeconomic game. There is a small sample size here, but nice controls and lots of testing. On a set of multiple choice questions, the experimental group did much better – 8.79/12 compared to 7.42/12 for the control group, for example (statistically significant, and stable over the whole term).

- Holt (1999) noted that the University of Amsterdam had a 50% drop in the failure rate after introducing labs.

- Mullin and Sohan (1999) found no difference between those in a heavily experimental class and a lecture class on average, although those in the experimental

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3 Please note that some of these studies used computer lab experiments, as opposed to classroom experiments.
4 This result backs up my intuition from my own experiences.
class did somewhat better on pollution and competitive market questions. However, they noted strong increases in student and instructor enjoyment in the experimental classes.

The fact we often see only weak effects of the experiments is not unusual – there are many empirical studies finding weak effects of various pedagogical changes. In a full model of student choice, it is easy to show that there will be substitution effects created by pedagogical innovations. For example, if experiments are successful in raising students’ knowledge, students will potentially substitute their time away from the economics class towards other classes or leisure time, reducing the net gain in knowledge (Becker (1982)). Brauer (1994) argues that we should note that this extra leisure time is a benefit to the student, and thus should be part of the overall cost-benefit analysis of the experiment classes.

Almost all of these studies use the results on multiple choice tests as their measurement of economic knowledge. There are arguments that experiments will help with higher-level concepts that are better tested in written answers, so I am not sure that relying on just multiple choice tests in the comparisons is giving the full picture.

2. Students tend to find experiments more realistic, convincing, interesting, and more enjoyable, and as a result, they are more likely to take further economics courses, and to become majors. Some specific types of students gain more from the hands-on, active-learning approach.

Bartlett (1995) argues that declining enrollments in economics are partially due to our inability to attract bright students, especially female students. She argues that introductory courses place too much emphasis on technique, and not enough on motivating why economics is exciting to learn. Similarly, Fels (1993) notes that different students learn in different manners, and that experiments will help those students who learn more when learning is more participatory and less abstract (Noussair and Walker (1998)). The realistic experiences of experiments and simulations are more appealing and useful to some students than abstract theory.

It can also be argued that another benefit of experiments is the enjoyment that students get from the act of participating. Ortmann and Colander (1997) argue that “(e)xperiments make students fell more welcome, and ultimately more receptive.” I have found from surveys done in my own class that my students enjoyed the experiments – many of them stated they enjoyed participating directly in the learning process. Ball’s (1998) students found the experiments exciting, while Wiebert and Bierma’s (1988) students found them “memorable.”

Plott (1998) argues that student tend to think our models are just stories, and probably not true. Experiments help them to see the relevance of economics. He also argues that the goal is to give the students unintuitive results that the model can explain. In market experiments, examples of this might include the convergence to one price, even though the buyers have a wide range of WTPs. Holt (1999, p. 603) states “… the use of classroom experiments provides an important connection between theories and key features of the markets and institutions being studied.”

Hazlett (1998b) argues that we should use experiments only for concepts where the students tend to be dubious of the theory, as the results would be more striking in this
case. (In Hazlett (1998a) she also emphasizes that experiments give inexperienced students a taste of how a market works.) I have certainly found that using experiments to prove the equivalency of a consumer or a producer sales tax was very successful.

3. Experiments tend to open up the students, and lead to much more lively classroom discussions, even in non-experiment sessions.

   Many users of classroom experiments have noted that experiments tend to make students feel much more a part of the class, and that in following sessions they are much likely to participate in classroom discussions. Noussair and Walker (1998) advise carrying out experiments that illustrate anomalies of pure theory (such as the absence of perfect free-riding) to stimulate discussion.

   I have found myself that post-experiment discussion by students often leads to interesting segues into other areas of discussion. For example, in the market experiments when someone complains of the bad endowments they received in the draw of the cards, we can move on to a discussion of family background, or poor weather, and how they might affect well-being in real-world markets. I have also found that experiments lead naturally to situations where I can inject humour into the situation.

4. Many instructors enjoy teaching using experiments.

   Holt (1999) noted that his own confidence in teaching concepts like the efficiency of markets was improved by the good results he got in classroom experiments. Brauer (1996) also noted instructors are likely to enjoy the experiments more than just pure lectures.

5. Instructors may gain research ideas from using classroom experiments.

   As Fels (1993) and Noussair and Walker (1998) have emphasized, classroom experiments will not only lead to experimental research ideas, but the resulting anomalies in the classroom experiments may stimulate theoretical research.

What are the (Potential) Costs of Classroom Experiments?

1. Experiments take up lecture time.

   A single market experiment such as described in DeYoung (1993) takes up at least a 50-minute session to do the actual experiment, plus some time for follow-up discussion. Some of the follow-up could be integrated into an assignment, and certainly the follow-up will replace some of the normal lecture material that you would have covered anyways. However, it is likely that doing an experiment will cost you some lecture time, and therefore must involve reducing some other syllabus material. Realistically, I think if you were to go for the Bergstrom and Miller (1997) approach of a full experimental class, you could really only do it with lab sections (see Mullin and Sohan (1999) for a discussion of their experience). However, I think you can successfully introduce 3-5 key simulations/experiments into an introductory class that will help teach core concepts.

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5 I would like to thank Rob Moir for bringing this point to my attention.
better, and I think you can reduce the lecture time cost by redesigning your coverage of these concepts to integrate the experiment, and dropping one or two peripheral topics.

There is also a related worry that using experiments instead of theory may “dumb-down” the class. Like Ortmann and Colander (1997), I do not agree. I think that relatively sophisticated concepts are often better introduced by using experiments – I think my introductory students better understood sales taxes after the experiment than they ever did when it was a pure lecture concept. However, this is certainly a debatable point.

2. Doing experiments requires a lot of extra prep time.

There is undoubtedly some start-up costs attached to doing experiments, reduced if you can re-use experiments. These start-up costs can also be reduced by learning from the experiences of others – see the annotated bibliography for more details on the available resources.

There will also be costs of taking time to do *ex post* calculations, to make graphs, and to integrate the material into your lecture. Some of this time cost can be reduced by getting the students to do it on an assignment, if you wish – Bergstrom and Miller (1997) have worked hard to write an entire workbook that allows you to do this. In other cases, I have found that I can re-use the same Excel spreadsheet over and over, with the same formulas and set-up, but just new data entered. Often a teaching assistant can do this for you. However, there is definitely a positive cost here.

3. Just like some students will like the experiments, others will hate it.

This dislike might be due to personality (shyness, English as a second language) or perhaps due to a dislike of the noise and bustle. However, I found little evidence of this in my classes – on my most recent survey, 49/55 students who answered felt the experiments were interesting or stimulating. As well, they felt they were useful for learning economics. When asked what they specifically liked, the students advanced the following factors (in order of frequency): the experiments helped them to better understand the concepts, the experiments were “fun”, they enjoyed the social participation, they liked the fact they created a break or change in the routine, and they liked the chance to win money.

4. Some instructors may find it difficult, given their personality types and styles.

I think that this is an important consideration. I think many instructors’ personalities will be such that they have difficulty with the chaos, noise and lack of control of the experiment – it is hard to stand back and let the process evolve as it may. Active learning is a more difficult teaching process for many instructors, since it requires acting more like a coach and less like an instructor. In addition, you probably need to be somewhat outgoing and active during the experiments, encouraging students to trade, moving around the room, etc.

Part of the consideration here is that some instructors might worry that the experiment might fail to work. Well, it might. I have had one or two that did not work out that well. However, I have never had a complete failure, and in each case where I had a partial
failure, it opened up an interesting learning opportunity. My demand curves always slope downwards (although they occasionally have a glitch or two), my market equilibriums converge (although the occasional seller or buyer cannot subtract – but then we can have a nice discussion of how in the real world, this person would go out of business), everyone always overfishes in the common property simulation (if they don’t, we would discuss the benefits of collusion and treaties), etc.

5. It will cost money to provide the incentives.

If you want to get into it big-time, it costs money. Charles Plott at C.I.T. has a $700,000 U.S. grant to run his continuous web-based experiments, and runs it full-time all-year round. Plott got some of his money by convincing the Dean of Arts and Science that since science courses got money for labs, why shouldn’t economics? A similar situation holds at a few other places, for example Michigan Tech (see Joyce (1996)). In addition, Reed College in Portland, Oregon has four lab-sessions a term in its introductory course. See also Cardell et. al. (1996).

However, for the most part it takes very little money to motivate university students – they all have a motivation to truck and barter, to be competitive with each other. Holt (1999) argues that the students’ natural competitiveness will drive them to succeed, while Denise Hazlett (1997) pays them in chocolate, which apparently works well. I myself end up paying a few tens of dollars out each term, by drawing one name and paying them their profits, or paying the most profitable person’s profits, etc.

Some instructors have tried “paying” students by giving them extra credit. I personally do not believe in doing this, and I don’t think the students do either. Holt and McDaniel note that using extra credit is unfair to those who get bad draws of the endowments. In addition, Stodder (1998) has a good discussion of some of the ethical implications of different payment schemes, as well as some discussion of how results might be unintentionally distorted by the chosen incentives.

**What are the net benefits of experiments?**

To summarize, the crucial benefits of using experiments in an introductory class include (potentially) more learning by the students, definitely more enjoyment of the class by the students, probably more students choosing to major in economics, as well as some enjoyment by the instructor, if he/she has the right personality type. The crucial costs include lost lecture time, extra preparation time, and perhaps some out of pocket money.

I think that your own net benefit depends on your personality, and the student population you face. I have found the experiments I have done to be time-consuming the first time around, but less so the second time around. They have all worked very successfully (but not perfectly), and have generated strong interest from the students, as reflected in the student evaluations. I sense while marking final exams that certain concepts have been learned better, but I also realize that I have had to leave out other concepts. This loss doesn’t bother me, given the gains. I feel that my students have learned how quickly a market can converge to the equilibrium price, and how efficient

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6 You can find the website at [http://eeps.caltech.edu/](http://eeps.caltech.edu/).
the market is at excluding high-cost sellers and low-value buyers. I think they understand how common property problems can lead to overfishing, etc. And finally, I certainly enjoy teaching with experiments more than with pure lectures – my students always give me a higher rating on my evaluations for enthusiasm.

**III Some Specific Considerations if You Decide to Run Classroom Experiments**

If you decide to introduce experiments into your introductory class, you might decide to carry out only one or two experiments, or a more moderate amount (I carry out seven simulations and experiments in my introductory class), or you could carry out an entire set of experiments integrated into virtually every topic on the list, along the line of Bergstrom and Miller’s (1997) book (although this might require a lab section for the course). Hazlett (1998a) advises trying just one or two simple experiments the first time around. However, before you make such a decision, you might like to consider some of the following factors.

1. **What is the impact of class size?**

Many experiments discussed in the literature were run in relatively small classes (e.g. DeYoung (1993)), and might be more difficult to run in a large class. Any simulation can be run at the front of the classroom without too much difficulty, as long as the students have good sight lines. However, a market experiment would seem to be more onerous. A trading pit experiment which requires the students to mill around and find each other probably has an upper limit of 40 students participating at one time. I split my class of 80 into two sections, and had them take turns coming down (in the same class). However, a double oral auction can be run with the students remaining in their seats, and thus can be run with larger classes. Bergstrom and Miller’s (1997) website contains instructions on how to run market experiments with large classes. Many other experiments have been adapted for larger classes by altering the amount of repetition or details of the experiment – for example, Leuthold (1993) has adapted Brock’s (1991) public good experiment for a large class, quite successfully.

If you are going to run a trading pit, your classroom will require some open space, either at the front of the class, or created by moving desks. If this is not feasible, then a double oral auction with the students sitting in their seats is certainly possible. It also helps to have one or more teaching assistants, depending on class size, to write prices down on the overhead, to collect contract sheets, to distribute material, etc.

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7 I don’t run a double oral auction because I don’t want the students to think I am pushing them towards the equilibrium price. There is a good discussion of the various market institutions in DeYoung (1993). As he notes, there is lots of evidence that double oral auctions converge faster to the market equilibrium, but the trading pit is in many ways more interesting, and the instructor is not involved in the transactions.

8 In addition, one solution to the class size problem might be to use the Internet or computer labs, as there is software written to do this (see Holt (1999)). Holt (1996) also has a brief discussion of the problem of dealing with large class sizes – he advocates running the experiments in discussion groups.
2. Timing – when should you run the experiments?

I think the timing of when to run the experiments is an important consideration. DeYoung (1993) advocates running the market experiment on the very first day of class, when the students have no theoretical background whatsoever. Bergstrom and Miller (1997) have the students work through examples before the experiment, so they are well-prepared. I tend to fall into between the two extremes (Hazlett (1998a) also advocates this approach). I run the market experiments, for example, after we have covered some material on the maximizing behaviour of buyers and sellers, so that the students are thinking about maximizing net benefits when they enter the experiment, but before the discussion of market equilibrium, so that the students have not studied convergence to market equilibrium, etc. This timing allows for the “surprise” factor that makes learning a bit special, but tends to mean the experiments don’t work out quite so perfectly – for example, students are more likely to make calculation errors, etc.

3. Preventing problems during an experiment.

I have found that you have to monitor what is going on – for example, I keep reminding students during the market experiments that they need to circulate, they need to yell out their offers. I also keep track of the actual contracts, and typically refuse to honour a negative-profit contract (I tell the students I am making up for their lack of real-world experience). One or two negative-profit contracts always slips through, but then we can discuss afterwards what this would mean in the real world, an excellent learning experience. There is almost always someone who keeps trading at a loss – they did not understand the instructions, often because they have English is a second language. However, by the second experiment they are usually doing fine.

4. Presentation of Results

Joseph and Saunders (1970) state that “(p)robably the most important part of the Market Game is the discussion that follows.” If you cannot integrate the material from the experiment into the lectures, and the students’ learning, then at best the experiment is just an amusing diversion. There are a variety of ways that one can tackle this integration. DeYoung (1993) and Bergstrom and Miller (1997) advocate giving the student the missing information (e.g. the reserve prices of buyers and sellers), and then have them do an assignment where they calculate the theoretical equilibrium prices, quantities and total surpluses, and compare these values to the actual values from the experiment. On the other hand, you could incorporate the results into your lectures, and discuss how the results can be explained by the economic theory you are to developing.

DeYoung (1993) emphasizes that your experiment format, and your follow-up presentation should be somewhat different than if this was a research setting. Since you are interested in teaching the concepts, your graphs and presentations should be aimed at the introductory student with no economics background, not at the academic audience.

No matter with approach you pick, I think a small debriefing is required after the experiment, either in the remaining class time, or at the beginning of the next class. Plott (1998) asks the students to advance reasons why we got the price that occurred – he says
this is awfully revealing, and rarely do the students advance an economic reason. Their reasons are a natural springboard to the explanation given by economic modelling. I bring a sealed envelope that I have one of the students open, that reveals a predicted price and quantity (always give yourself a small range).

So far, I have used the lecture follow-up methodology. In the market experiments, I tend to emphasize the individual gains from trade, plus the market’s efficiency in maximizing total surplus. This approach also naturally leads me to a discussion of how and why low-value buyers and high-cost sellers get excluded naturally in the market place, for example. This discussion in turn leads me naturally into questions of initial endowment, and fairness, and a discussion of efficiency versus fairness. Market results in one sense are fair (e.g. high-value buyers buy things), but not in another sense – luck determines why some people are low-value buyers (e.g. low income) or high-cost sellers (e.g. location). I think this comes out more naturally in an experiment setting. Living in a farming province, where the luck of the quality of land your parents left you, or the weather, or the world wheat price makes such a difference, I find discussions of the luck of endowments are especially striking to students. I also find that these post-experiment discussions help to lead into later sections on government intervention for reasons of fairness.

Now that you have considered the cost and benefits of using experiments, and examined some of the specific considerations of doing so, let us turn to the question of which experiments you might like to incorporate into your introductory class.

IV A Coherent Set of Simulations and Experiments to Use in a Single Term Introductory Class

The introductory economics class at my university is a one-term (13-week) introduction to economics, more than a pre-principles class but less than a full-year principles class. Instructors are expected to cover some core concepts (two-thirds microeconomic), but are given a lot of leeway in their approach – the basic idea is to have the instructors teach in a manner that they enjoy, so that this enjoyment can be conveyed to the students. My personal approach is to use a set of simulations and experiments, and to give the students many real-world examples in my assignments and lectures, while other instructors might use a economic history approach, for example.

I have chosen a moderate approach to incorporating experiments into my class, partially due to a lack of institutional resources (no labs, no extra incentive money), and also to provide students with a diverse learning situation – many students still like lectures. As advocated by Noussair and Walker (1998), I have picked basic, simple, interesting experiments that focus on a few key results. My major focus is on the efficiency or inefficiency of the free market in various situations. In addition, I have tried to do experiments that derive demand curves, market equilibriums, consumption functions, etc. within the experiment setting, so that I can note during the subsequent theoretical discussion the empirical support for our theory that we have derived.

In the Fall 1998 class, I carried out the following simulations and experiments, which I think gives a coherent and logical set of experiments:
1. Deriving a demand curve, by auctioning off a muffin (in my 1997 afternoon class on a hot day, I auctioned off a Coke).\(^9\)

   This simulation takes about 5-10 minutes of lecture time. After the auction, I ask my students what factors might have affected the price I received, which leads naturally into the discussion of what creates shifts in demand curves.

2. Deriving a supply curve, by hiring a student to go to the cafeteria and buy me a drink (at the cost of missing some lecture time).\(^10\)

   This simulation takes about 5-10 minutes of lecture time. After the auction, I ask my students what factors might have affected the price I paid, which leads naturally into the discussion of what creates shifts in supply curves.

3. Market Experiment I – deriving market equilibrium, and showing the impact of a supply shift.\(^11\)

   This experiment takes about 50 minutes to carry out, plus whatever follow-up time you wish to dedicate. The immediate follow-up discussion starts by asking the students what they think about the experiment, which often leads into a discussion of the luck of their endowment draws. We also discuss some of the real-world market institutions, such as posted-seller markets, posted-buyer markets, etc. We are then ready to begin the theoretical discussion of market equilibrium, talking about the concept of equilibrium, price adjustments to clear the market, shifts in demand and supply. In later lectures, I constantly relate the discussion back to the examples of the experiment, often re-using the experiment results when discussing shifts in supply, etc.

4. Market Experiment II – showing the impact of a price floor, and then the impact of sales taxes on the buyer and the seller.\(^12\)

   This experiment takes about 50 minutes to carry out, plus whatever follow-up time you wish to dedicate. It is similar to the initial experiment, and I have found it quite successful – in all the times that I have used it, the price paid by the consumer (included taxes) was virtually identical whether the consumer or the producer was taxed!

5. Common Property Simulation – a version of a prisoner’s dilemma.\(^13\)

   This simulation takes about 3 minutes for each round, and you can do more than one if you wish to give the students a chance to collude. I have run a few hundred of these, and it is quite amusing, especially when students agree to collude/co-operate with each other, and then instantly defect!

6. A Public Good Experiment – contributing hypothetical money either to a public investment fund or a private investment fund.\(^14\)

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\(^9\) Based on Brock (1992), who also explains how to extend this simulation to the monopoly situation.

\(^10\) Originally suggested by my colleague, Gary Tompkins.

\(^11\) Based on DeYoung (1993), who kindly shared with me his follow-up assignments.

\(^12\) Based on DeYoung (1993).

\(^13\) Originally seen in a satellite TV session run by Irwin Publishers. A more detailed discussion is found in Hazlett (1997).

\(^14\) Based on Leuthold (1993).
It takes about 5 minutes for the students to fill out the sheet, with calculations done outside of class time. There are many potential alternative experiments, discussed in Leuthold (1993) or Hooas and Madigan (1996).

7. Deriving an aggregate consumption function.\(^{15}\)

It takes about 5 minutes for the students to fill out the sheet. You can also have the students take the sheet home and do the calculations. In both cases where I used this experiment, I derived quite nice consumption functions that I used for future multiplier examples, etc.

Detailed examples of the experimental results can be found in the references. I am also glad to share my results with any interested readers. If you have a pure microeconomics class, I would suggest replacing the consumption experiment with one of the production experiments that derives diminishing marginal productivity – see Neral and Ray (1995), Bergstrom and Miller (1997, Experiment 8) or Hazlett (1998, Experiment 7). If you have a pure macroeconomics class, unfortunately there are not as many experiments. However, in addition to Brauer’s (1998) consumption function derivation, you might try Goeree and Holt’s (1999) circular flow presentation, the money creation experiment by Cameron (1997) or Laury and Holt (forthcoming), and the inflation uncertainty experiment in Hazlett (1998a).\(^{16}\)

Like Holt (1999), if I had only one experiment to do, it would be the Market Equilibrium Experiment. This experiment illustrates how easily the market finds equilibrium, and illustrates the efficiency of equilibrium – maximization of surplus, exclusion of high-cost sellers and low-value buyers, etc. And perhaps most important of all, the students enjoy it – it is a positive part of their experience in introductory economics that they will leave the classroom always remembering.

IV Conclusions

Economics is a difficult topic for many introductory students – they often find it abstract and unrealistic. I think running economic experiments brings realism to many economic concepts, and allows many students a better understanding of the economic models they study. I am unsure that there is a gain in multiple choice test results by the students in experiment-oriented sections, but I do think there is a gain in enjoyment and deeper understanding of economics, with more potential long-term retention of economic knowledge, and more likelihood they will take further courses.

As elsewhere in economics, there is no free lunch when one decides to integrate experiments into the classroom. There is definitely a start-up time cost the first time, and preparation costs each time the experiment is repeated. In addition, experiments take up class time. Even if the experiments mean some concepts are explained differently, in all likelihood you will have to sacrifice at least one or two topics. However, perhaps we need to think a little bit here on our goals in an introductory class. Is it to cover as much material as we can? Or is it to actually teach our students, as opposed to lecture to them? I would argue that the true output function is probably multi-dimensional – we want our

\(^{15}\) Based on Brauer (1998).

\(^{16}\) Hazlett is working on a further set of macroeconomic experiments.
students to learn the material, but we also want them to enjoy economics so they become majors, or take further courses even if they are not majors. After all, recall those falling enrollments! I think classroom experiments help meet these goals – certainly most students seem to deeply enjoy the experiments.

As my final reinforcement of this point, I would like to conclude with the following quotation from Becker and Watts (1995, p. 699):

Great orators should lecture. The rest of us should consider using a variety of teaching methods to actively engage our students and reduce the amount of time we spend lecturing to audiences that are often captive in the short run, but all too willing and able to vote with their feet in the long run, as recent enrollment trends in economics … have shown.
Bibliography (with Partial Annotations)

Reviews of various experimental economics textbooks.


An entire textbook to teach a basic introductory microeconomics course, it includes lab books, good instructors manual, warm-up exercises, etc. It can be used as a supplement, or select chapters can be used in a custom-printed text. (A second edition is due out in August 1999.) In addition, Bergstrom and Miller’s Website is very useful, and includes a downloadable experiment from their book, links to instructors’ webpages, and an archive of previous results. It also includes ideas on how to run experiments in large-lecture formats. Available at [http://zja.hss.cmu.edu/miller/EEP/EEP.html](http://zja.hss.cmu.edu/miller/EEP/EEP.html).

Descriptions of 25 classroom games/experiments, with some evaluation of individual games (including time investments), and an overall evaluation of games. Available on-line at [http://www.aug.edu/~sajmb/welcome2.html](http://www.aug.edu/~sajmb/welcome2.html), it is currently being updated with Greg Delemeester.


Detailed description of the game, including all instructions. Best for a small class.

Description of how to derive a demand curve in a few minutes in class. In
addition, description of how to use the demand curve to derive the optimal monopoly price.


A production decision coordination experiment, with instructions.


*Classroom Expernomics*, an on-line journal edited by G. Delemeester and J. Neral. Available at [http://www.marietta.edu/~delemeeg/expernom.html](http://www.marietta.edu/~delemeeg/expernom.html), it has many issues dedicated to describing and analyzing various classroom experiments. Delemeester’s home page also has links to many experiment pages ([http://mcnet.marietta.edu/~delemeeg/index.html](http://mcnet.marietta.edu/~delemeeg/index.html)).

Excellent theoretical background for experimental economics.


Excellent instructions on how to run a market experiment, with a good description of post-experiment follow-up.

Fels, R. 1993. This is What I Do, and I Like It. *J. of Economic Education* 24 (Fall): 365-370.


Contains instructions on how to run a classroom experiment. Holt has a whole webpage dedicated to his teaching using economic games, with detailed descriptions of games, at [http://www.people.virginia.edu/~cah2k/teaching.html](http://www.people.virginia.edu/~cah2k/teaching.html).

Holt summarizes the symposium’s four games.

A voting paradox experiment, with instructions.

Includes detailed instructions.

Includes descriptions of a variety of simple games, including games that only require a pack of cards.

An extension of Walbert and Bierma that focuses on Coase’s Theorem.


Includes a detailed description of Joseph’s Wheat Game, one of the first classroom experiments, revised and improved from his 1965 article.


A two-market experiment with speculation, that illustrates the law of one price – includes detailed instructions.


Meister, J. P. 1999. Oligopoly – An In-Class Economic Game. *J. of Economic Education* 30 (Fall).


Neral, J. and M. Ray. 1995. Teaching Tools: Experiential Learning in the Undergraduate Classroom: Two Exercises. *Economic Inquiry* 33 (January): 170-174. An experiment from which a production function can be derived, demonstrating diminishing marginal returns. In addition, cost curves can be derived, as well as a PPF.


You can find Plott's work at Caltech's Laboratory for Experimental Economics and Political Science (EEPS), found at http://eeps.caltech.edu/. Features software, experiment results, and you can even login to the experiments yourself.


