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Games Economists Play: A Survey of Non-Computerized Classroom-Games for College Economics
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REVIEW SECTION

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GAMES ECONOMISTS PLAY:
A SURVEY OF NON-COMPUTERIZED 
CLASSROOM-GAMES FOR COLLEGE 
ECONOMICS

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Augusta State University

Greg Delemeester
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Abstract. The bulk of this unusual paper consists of an extensive online annotated compilation of 113 non-computerized classroom-games, most of which can be played within one class period, to assist in the teaching of college-level basic micro and macroeconomic concepts (see http://www.aug.edu/~brajmb or http://www.marietta.edu/~delemeeg).

The paper itself consists of three major sections. The first catalogues, summarizes, and provides sample annotations of the games we collected. Section two makes a number of observations about the games. For instance, we notice an imbalance between games for microeconomics (many) and games for macroeconomics (few). We also detail which standard introductory economics topics are covered well and which are not covered well or missing altogether. For example, we observe that few games exist to present the proper economic role of government in economic affairs. The third section surveys the available literature on the costs and benefits of playing games in the classroom. In particular, our survey reveals that existing studies consider costs and benefits to students and instructors only partially, and we lay out a matrix that should help in the design of improved studies on the efficacy of gaming in the classroom.

Keywords. Teaching; Pedagogy; Classroom; Non-computerized; Games

1. Introduction

A few years ago, Brauer (1994) read a paper at the annual meetings of the Eastern Economic Association in Boston, MA, entitled 'Games Economists Play'. The paper presented a compilation and classification of 25 non-computerized classroom games and was preceded by an interpretative essay. The present paper (and online appendix) is an updated and substantially expanded version of Brauer's paper. An online appendix consists of well over 100 annotated games drawn from nearly 100 references in the literature we surveyed. The paper itself
serves as a guide to and interpretation of the games. We also survey the literature on the efficacy of gaming in the classroom.

Gaming in the classroom has become an established tool of teaching, at least in the USA. Gaming has also become a field of academic study in its own right. Prominent journals devote special issues to the topic, such as the Journal of Economic Education (Vol. 24, No. 4, 1993) and the Southern Economic Journal (Vol. 65, No. 3, 1999). Other prominent journals regularly contain games features, such as Economic Inquiry and the Journal of Economic Perspectives. There is a separate journal devoted to experimental economics (Experimental Economics), a Handbook of Experimental Economics, and a fair number of conferences are solely or partly devoted to games and experimental economics. There is also a newsletter, Classroom Experiments, dedicated to the sharing of economics experiments for teaching purposes. A number of these and other resources have been collected on a web site maintained by Professor Delemester at Marietta College in Ohio (http://www.marietta.edu/~delemester/econlink.html)

The computer — first the mainframe, now the personal computer — has made substantial inroads into or alongside the college economics classroom. Nowadays, textbooks routinely come with CD-ROM software that permits students to manipulate, say, supply and demand graphs or do some simple national-income accounting calculations and simulations, and many professors use presentation software and Internet links as part of their lectures. Grimes and Ray (1993) surveyed the computer-related literature. But computerized games, even if free of financial charge, are often costly. For example, it takes time to set up a computerized game and to learn, run, and monitor it. More importantly, the pedagogical nature of computerized games differs substantially from non-computerized games. One particular advantage of in-class gaming, or so the anecdotal evidence tells us, is that a simulated aspect of an economy is created by students in class. Students thereby learn about the power and depth of fundamental economic concepts as they play the game. This experiential feature of in-class gaming appears to attract many instructors and students. Whereas experimental games are largely a research tool, experiential games are primarily a teaching tool, and it is the latter this paper and online appendix exhaustively survey.

The paper consists of three major sections. The first catalogues, summarizes, and provides sample annotations of the games we collected. Section two makes a number of observations about the strengths and weaknesses of the games we collected. The third section surveys the available literature on the costs and benefits of playing games in the classroom. In particular, our survey reveals that existing studies consider costs and benefits to students and instructors only partially, and we lay out a matrix that should help in the design of improved studies on the efficacy of gaming in the classroom.

2. Three tables
In this section we present three tables to catalogue and summarize the games, and we provide a few annotation samples. Table I suggests a stylized

<table>
<thead>
<tr>
<th>I. THE BASICS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. DEMAND (FOR OUTPUT)</td>
<td>Demand; marginal and total demand curves</td>
</tr>
<tr>
<td>2. SUPPLY (OF OUTPUT)</td>
<td>Supply; production; cost; marginal cost-curves</td>
</tr>
<tr>
<td>3. THE PRICE SYSTEM</td>
<td>Supply and demand; equilibrium price</td>
</tr>
<tr>
<td>4. PERFECT and IMPERFECT</td>
<td>Perfect competition; market clearing; consumer surplus; demand and supply on market clearing</td>
</tr>
<tr>
<td>5. MARKET STRUCTURE, PERFORMANCE</td>
<td>Perfect competition; market structure; consumer surplus; demand and supply on market clearing</td>
</tr>
<tr>
<td>6. INPUT MARKETS</td>
<td>Input markets; labor; land/natural resources</td>
</tr>
<tr>
<td>II. APPLYING THE BASICS</td>
<td></td>
</tr>
<tr>
<td>1. INTERNATIONAL TRADE</td>
<td>International trade in goods and services</td>
</tr>
<tr>
<td>2. CURRENCY MARKETS</td>
<td>The economics of foreign exchange</td>
</tr>
<tr>
<td>III. BEYOND THE BASICS (Imperfections)</td>
<td></td>
</tr>
<tr>
<td>1. MARKET IMPERFECTION INTERVENTION</td>
<td>Price floors; price ceilings; entry/exit; third-party payer</td>
</tr>
<tr>
<td>2. THE ECONOMICS OF INFORMATION</td>
<td>Missing information; asymmetric information; information economics</td>
</tr>
<tr>
<td>3. THE ECONOMICS OF SHOPPING</td>
<td>Institutions and changes in arrangements</td>
</tr>
<tr>
<td>4. THE ECONOMICS OF LAND/NATURAL RESOURCES</td>
<td>Common-pool resources</td>
</tr>
<tr>
<td>5. THE ECONOMICS OF POWER</td>
<td>Externalities (positive, negative) property rights</td>
</tr>
<tr>
<td>6. THE ECONOMICS OF INFORMATION</td>
<td>Information economics; information costs</td>
</tr>
<tr>
<td>7. THE ECONOMICS OF POWER</td>
<td>Institutions and changes in arrangements</td>
</tr>
<tr>
<td>8. THE ECONOMICS OF LAND/NATURAL RESOURCES</td>
<td>Common-pool resources</td>
</tr>
<tr>
<td>9. THE ECONOMICS OF POWER</td>
<td>Externalities (positive, negative) property rights</td>
</tr>
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<td>Information economics; information costs</td>
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<tr>
<td>11. THE ECONOMICS OF POWER</td>
<td>Institutions and changes in arrangements</td>
</tr>
<tr>
<td>12. THE ECONOMICS OF LAND/NATURAL RESOURCES</td>
<td>Common-pool resources</td>
</tr>
</tbody>
</table>

* Games marked with an asterisk work better than others.
also survey the literature of teaching, at least in study in its own right, such as the Journal of Economic Journal that contain games features, Perspectives. There is a perinental Economics), a sac of conferences are solely there is also a newsletter, economics experiments inces have been collected Marietta College in Ohio computer — has made its classroom. Nowadays, that permits students to t simple national-income professors use presentation Grimes and Ray (1993) ted games, even free of takes time to set up a. More importantly, the substantially from non-class gaming, or so the an economy is created by and depth of fundamental ent feature of in-class is. Whereas experimental primarily a teaching tool, ovely survey. catalogues, summarizes, ed. Section two makes a esses of the games we uate on the costs and our survey reveals that its and instructors only the design of improved

Table 1. Principles of microeconomics.

<table>
<thead>
<tr>
<th>I. THE BASICS</th>
<th>GAME #</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. DEMAND (FOR OUTPUT)</td>
<td>1, 2</td>
</tr>
<tr>
<td>• Demand; marginal and total utility; shifting demand curves</td>
<td></td>
</tr>
<tr>
<td>2. SUPPLY (OF OUTPUT)</td>
<td>3, 26, 27, 28, 29, 97, 107</td>
</tr>
<tr>
<td>• Supply; production; cost; marginal cost; cost-curves</td>
<td></td>
</tr>
<tr>
<td>3. THE PRICE SYSTEM</td>
<td>4, 5, 6, 7, 30, 31, 32, 91</td>
</tr>
<tr>
<td>• Supply and demand; equilibrium price and quantity</td>
<td></td>
</tr>
<tr>
<td>4. PERFECT and IMPERFECT MARKETS</td>
<td>6, 91</td>
</tr>
<tr>
<td>• The competitive market; producer and consumer surplus</td>
<td></td>
</tr>
<tr>
<td>• Elasticities of supply and demand; effects on market clearing</td>
<td></td>
</tr>
<tr>
<td>5. MARKET STRUCTURE, BEHAVIOR, and PERFORMANCE</td>
<td>7</td>
</tr>
<tr>
<td>• Perfect competition; market entry</td>
<td></td>
</tr>
<tr>
<td>• Monopoly; single-price; price-discriminating monopoly</td>
<td></td>
</tr>
<tr>
<td>• Monopolistic competition; product differentiation</td>
<td></td>
</tr>
<tr>
<td>• Oligopoly; game theory; strategic behavior; bargaining</td>
<td></td>
</tr>
<tr>
<td>• Input markets; labor; labor unions; capital; land/natural resources</td>
<td></td>
</tr>
</tbody>
</table>

II. APPLYING THE BASICS

1. INTERNATIONAL TRADE

• International trade in goods and services | 4*, 5*, 6*, 7*, 30*, 31*, 39*, 48, 49, 50, 51, 89, 90, 91*, 98, 112 |

2. CURRENCY MARKETS

• The economics of foreign exchange markets | 4*, 5*, 6*, 7*, 30*, 31*, 39*, 64, 91* |

III. BEYOND THE BASICS (Market Imperfections)

1. MARKET IMPERFECTIONS and INTERVENTION

• Price floors; price ceilings; quotas; entry/exit; third-party payer | 4*, 5*, 6, 7, 30*, 31*, 32*, 37, 38, 39, 54 |
• Missing information; asymmetric information; information cascades | 7, 64, 65, 66, 67, 68, 69, 78, 91*, 92, 93, 96, 99, 104 |
• Institutions and changes in institutional arrangements | 14, 33, 39, 100, 102 |
• Common-pool resources | 57*, 58, 70, 75, 76 |
• Externalities (positive, negative) and property rights |
| • Negative externalities | 19, 71, 73, 74, 94, 106, 110 |
| • Positive externalities | 55, 61 |
| • Acquisition of property rights; Coase Theorem bargaining | 32, 72 |
• Public goods; free-rider problem; pareto-optimality | 16, 17, 18, 57, 60, 61, 62, 63, 109 |
• Income and wealth distribution | 12, 13, 14, 54, 56, 57, 88 |

2. THE ECONOMICS OF POLITICS

• Public choice; median voter; cyclical majority; rent-seeking | 14, 15, 58, 59, 108 |

*Games marked with an asterisk could be adapted to these topics. Some adaptations may take more work than others.
(ideal-type) principles of microeconomics course and matches microeconomic topics with available games. Table 2 lists macroeconomic topics and matches those with available games. Table 3 lists the handful of post-principles games we found.

The games were obtained through a literature search, footnote reading, conference attendance and follow-ups, and by encouraging colleagues on an e-mail network to make games available to us or to point us to games they had heard of. We have no doubt that ‘out there’ are many additional games that economists play in the classroom, and readers are encouraged to forward new and old games to the authors.

Table 2. Principles of macroeconomics.

<table>
<thead>
<tr>
<th>Topic</th>
<th>GAME #</th>
</tr>
</thead>
<tbody>
<tr>
<td>Savings/consumption function</td>
<td>87</td>
</tr>
<tr>
<td>Aggregate demand function</td>
<td>81</td>
</tr>
<tr>
<td>Aggregate supply; production decisions based on inflation</td>
<td>79, 83</td>
</tr>
<tr>
<td>Circular flow; microfoundations of macroeconomics</td>
<td>85</td>
</tr>
<tr>
<td>Search unemployment</td>
<td>111</td>
</tr>
<tr>
<td>Balanced budget</td>
<td>58</td>
</tr>
<tr>
<td>Money: monetary institutions; money creation</td>
<td>24, 80</td>
</tr>
<tr>
<td>Monetary policy; rational expectations; un/anticipated changes</td>
<td>25, 86</td>
</tr>
</tbody>
</table>

Table 3. Post-Principles economics.

<table>
<thead>
<tr>
<th>Topic</th>
<th>GAME #</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intermediate Microeconomics</td>
<td></td>
</tr>
<tr>
<td>Pollution-permit trading</td>
<td>19</td>
</tr>
<tr>
<td>Predatory pricing</td>
<td>43</td>
</tr>
<tr>
<td>Employee team coordination and motivation</td>
<td>44</td>
</tr>
<tr>
<td>Bayes’ rule</td>
<td>77</td>
</tr>
<tr>
<td>Game theory and bargaining</td>
<td>18, 29, 101</td>
</tr>
<tr>
<td>Intermediate Macroeconomics</td>
<td></td>
</tr>
<tr>
<td>Bond prices’ inverse relation to interest rates</td>
<td>20</td>
</tr>
<tr>
<td>Consumption/investment tradeoff over several time periods</td>
<td>82</td>
</tr>
<tr>
<td>Money, Credit, Banking (Finance)</td>
<td></td>
</tr>
<tr>
<td>Bond prices’ inverse relation to interest rates</td>
<td>20</td>
</tr>
<tr>
<td>Portfolio diversification</td>
<td>52</td>
</tr>
<tr>
<td>Efficient market hypothesis</td>
<td>53, 105</td>
</tr>
<tr>
<td>Graduate-level</td>
<td></td>
</tr>
<tr>
<td>Labor market; union-management bargaining</td>
<td>21</td>
</tr>
<tr>
<td>Externalities; environment; bargaining</td>
<td>22, 23</td>
</tr>
</tbody>
</table>

Each game is cataloged using the following criteria:

1. Course: e.g. microeconomics, principles of economics
2. Level: 1st year, 2nd year, etc.
3. Subject(s): Principles of microeconomics, intermediate microeconomics, etc.
4. Objective: Pedagogical
5. Contact: Author
6. Abstract: Brief description
7. Class size: Where available
8. Time: Taking time
9. Variations: Game variations

We added a 10th category. Some games come from the good majority of games accessible in any university environment. Where we believe it to have a reasonable copyright law, we quote the original article for instructions, and to glean the students.

Note that game design and communication on the Internet. This may have resulted in almost all games referred to be included in our comprehensive list. We make our online annotation and communication a work in progress. To receive tips directly, you can compare results eventuall.

We provide three examples of trading games in this section. Each illustrates the working of the market, and education and research are particularly interesting.
matches microeconomic topics and matches of post-principles games

search, footnote reading, giving colleagues on an event us to games they had any additional games that

aged to forward new and

GAMES ECONOMISTS PLAY

Each game is catalogued and abstracted according to the following nine criteria:

1. Course: e.g. microeconomic or international economics or public finance
2. Level: Principles, intermediate, advanced/graduate
3. Subject(s): Subject area within economics
4. Objective: Pedagogical objective
5. Contact: Published source and/or person from which game details and further information such as practical game-playing hints for instructors may be obtained
6. Abstract: Brief game summary; on occasion, we have added some material
7. Class size: Where possible, we indicate class size or take a guess
8. Time: Time requirement where known or where we felt comfortable taking a guess
9. Variations: Game variations either suggested by the source or by us

We added a 10th category, called 'see also', to alert users to related games. Some games come from unpublished (in one instance untraceable) sources but the good majority of games are drawn from published sources that are easily accessible in any university library or via its inter-library loan service. To prevent copyright law violations, we could not repeat game instructions at will. Where we believe it to have been within the limits of the reasonable use clause of copyright law, we quoted instructions. The user of our online annotated listing will mainly use it to identify pertinent games but will then need to consult the original article for details such as game setup, player and instructor instructions, and to glean some hints on game interpretation and follow-up with the students.

Note that game designers do not usually make their games available via the Internet. This may happen in future, but for the time being the games we identified come almost exclusively from traditional print sources. However, to make our online annotation as useful as possible, we provide whenever possible an email hyperlink to the original game author or, where available, even a hyperlink to a full online copy of the game itself. This way, readers who may wish to acquire additional information about how to implement a particular game in class may be able to receive tips directly from the author, and reader and author may be able to compare results eventually.

We provide three examples of the annotations. Example 1 is a pollution-rights trading game in which buyers and sellers of pollution rights need to determine the most cost-efficient way of pollution abatement. Example 2 illustrates the workings of official and parallel foreign-exchange markets. Example 3 introduces the notions of search costs, unemployment compensation, and education and their impact on the labor market. The last example is particularly interesting as it aims at microfoundations of macroeconomics.

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Example 1:

Game: #19
Course: Micro
Level: Intermediate and up (perhaps principles, too)
Subject(s): Pollution rights trading
Objective: Students often have trouble accepting, let alone understanding, the concepts of pollution rights and ‘optimal’ pollution levels. The game teaches them that they themselves, like it or not, will arrive at that optimal level!

Reference and contact: Nugent, Rachel. ‘Pollution Rights Trading Game’. Classroom Experiments in the Classroom, 2(2), Fall 1993, pp. 3–5, or contact Dr. Rachel Nugent; Department of Economics; Pacific Lutheran University; Tacoma, WA 98447 [The underlined item is hyperlinked to the full-text version of the game.]

Abstract: Divide the class into several industries (say, software, pulp mill, steel mill). For simplicity, only one polluting substance is considered. All industries are provided with a table detailing current output, current emission, current profit, marginal cost of cleanup per unit of pollution (a constant cost for simplicity), permissible emission levels, a limited number of tradable permits, and cost information on two options: (a) pay for cleanup and (b) reduce output. A third option is to trade the permits at prices the students are to establish as they trade within a given time-period. Nugent (1993) contains a sample table with data and optimal solutions.

Class size: Small
Time: One or more class periods
Variations: Play several rounds; change permissible emission levels; reduce number of permits; and so on.
See also: Games #23, #73, #74, #94, and #110. [The underlined items are hyperlinked.]

Example 2:

Game: #84
Course: Microeconomics, macroeconomics, international economics
Level: Principles and up
Subject(s): Exchange rate controls in a developing country
Objective: Demonstrates that an overvalued currency suppresses trade, benefits importers, and hurts exporters.

Reference and contact: Hazlett, Denise. Economic Experiments in the Classroom. Reading, MA: Addison Wesley Longman, 1999. (Experiment #10); see also Hazlett, Denis and Jeela Ganje. *An Experiment with a...

Abstract: Students are exposed to the real-world goods and services that are valued in the USA and other foreign countries. The foreign currency will be valued.

Class size: 10 to 20
Time: One class period
Variations: None
See also: N/a.

Example 3:

Game: #111
Course: Microeconomics, macroeconomics, international economics
Level: Principles and up
Subject(s): Job search
Objective: To ill...

Reference and contact: Haupert, E....

Abstract: Students are expose...
Students take on the role of traders in a developing country: half are exporters and half are importers. The traders must either purchase foreign currency (dollars) so that they can import goods from the US, or they can sell foreign currency because of exports to the US. The government has established an overvalued exchange rate at which the domestic currency trades with the US dollar. Since the government does not have enough foreign reserves to meet the demand at the official rate, an unofficial parallel market handles the excess demand. A double auction trading institution is used for the parallel market.

**Class size:** 10 to 50 students.

**Time:** One class period.

**Variations:** None indicated.

**See also:** N/a.

**Example 3:**

**Game:** #111

**Course:** Micro, labor economics

**Level:** Principles and up

**Subject(s):** Job search in labor markets

**Objective:** To illustrate the impact of search costs, unemployment compensation, and education on the labor market.

**Reference and contact:** Haupert, Michael J. ‘Labor Market Experiment’. Journal of Economic Education, 27(4), Fall 1996a, pp. 300–308; haupert@ mail.uwmx.edu [Hyperlinked to article abstract and author’s email]

**Abstract:** Students take on the role of new entrants in a job search game. In the base experiment, students ‘search for jobs paying wages in a known range but with an unknown distribution’. Each session lasts 20 periods and begins with a random draw of a wage offer from a 20-card deck of wage offers. Each student searching for a job has the option of accepting the wage offer or rejecting it. If accepted, the student becomes ‘employed’ for the remainder of the session and earns an income equal to the accepted wage offer each of the remaining periods. If the offer is rejected, another random draw is made until all workers are employed or the end of the 20 periods is reached. Students record their earnings and aggregate labor market information (total employed and unemployed) each period. Later sessions introduce search costs,
unemployment benefits, recessions, and education. Discussion can then focus on the impact of each variation on the search behavior of workers.

Class size: Any number.
Time: Three sessions and follow-up discussion can usually fit in one class period.
Variations: None indicated
See also: N/a.

These three examples should provide readers with a sufficient flavor of what to expect in the complete annotated compilation of 113 games (as of September 1999).

3. The games

Rendig Fels (1993), commenting upon a set of games collected in a special issue of the Journal of Economic Education, remarked that the overarching objective of microeconomics lies in transmitting the notion of allocative efficiency: "the crux of the problem ... is how these [games] might fit into an overall teaching strategy ... The typical textbook covers far more economics than beginning students can hope to master ... [and the] problem is to cover a wide range of economics while teaching one important idea thoroughly enough to stick with students for years after the course ends" (Fels, 1993, p. 369). With this comment in mind, Brauer (1994) constructed a generic microeconomics syllabus and matched the then-available games to that syllabus. Remarkably, even then a sufficiently large and varied number of games was available such that a professor could have taught almost an entire principles of microeconomics class purely on the basis of classroom games. The number and complexity of games for microeconomics has increased since then. But as regards macroeconomics and post-principles classes, the yield of available games is much more limited although a number of authors have heeded Brauer's call for more macroeconomics games.

Our compilation and sifting of the games allows us to make the following general observations. First, the overwhelming number of games are written for the principles of microeconomics course (see Table 1). A standard topic that appears underserved is the concept of monopolistic competitive markets (product differentiation). But it is possible to tweak at least two games (#64, #78) to serve in the role of elucidating product differentiation and monopolistic competition in output and input (labor) markets. Other standard topics for which there are few games to choose from include elasticity of demand and supply, especially with respect to the impact on market clearing, and games that would construct a market demand curve from the principles of consumer choice. As fundamental as demand is to microeconomics that seems an odd omission indeed. In contrast, a number of games are available to construct a market supply curve from production and cost principles.

Second, the only large analysis of the proper role of foreign exchange markets. While there are many games on foreign exchange markets, there is a noticeable lack of games that highlight the proper role of foreign exchange markets. For example, games #37 and #38 may have been designed to prevent negative externalities (e.g., pollution) and/or sellers (e.g., tax evasion) that are not explicit in the typical textbook.

Third, games on economic role of government and/or sellers (e.g., tax evasion). The typical textbook covers far more economics than beginning students can hope to master. "The typical textbook covers far more economics than beginning students can hope to master" (Fels, 1993, p. 369).

Fourth, relative to their potential, still very few games are explicitly designed to teach the role of government and/or sellers (e.g., tax evasion). The typical textbook covers far more economics than beginning students can hope to master.

Fifth, at the post-principles level, there are still very few games on international trade, especially with respect to the impact on market clearing, and games that would construct a market demand curve from the principles of consumer choice. As fundamental as demand is to microeconomics that seems an odd omission indeed. In contrast, a number of games are available to construct a market supply curve from production and cost principles.

Sixth, in 1994 it was possible to draw out insights from foreign exchange markets. By addition to games on supply/demand price determination, international trade, and foreign exchange markets, one foreign exchange market (#34), featured in the

Seventh, in 1994 it was possible to draw out insights from foreign exchange markets. By addition to games on supply/demand price determination, international trade, and foreign exchange markets, one foreign exchange market (#34), featured in the

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Second, the only large-scale area of economics that appears ill-served is the analysis of the proper role of government (e.g. regulation; antitrust; public goods). While there are many games that can be easily adapted to impose price floors and ceilings, quotas, and taxes and subsidies that result from rent-seeking, thus highlighting surplus-lowering market intervention by government, few games highlight the proper, surplus-raising, role of government. Market-entry/exit games #37 and #38 might be used to elucidate government’s role in mergers and acquisitions to prevent undue market power. One game deals with the allocative effects of third-party health-care payers (#54). Those dealing with positive or negative externalities (#55, #61, #71, #73, #74) at least implicitly highlight an economically useful role of government, as do the games addressing public goods provision (e.g. #17, #18). It is perhaps best to think about games addressing the economic role of government as distributed across the entire third part of Table 1.

Third, games on surplus-reducing intervention in illegal markets (child pornography, trade in endangered species, illicit drugs, CFCs, cigarette smuggling, stolen goods, and other gray and black markets) are almost nonexistent (#84 and #92 are exceptions), but can be constructed from the basic market-clearing and market-intervention games by imposing costs on buyers and/or sellers (e.g. taxes, penalties). Still, it would be delightful to see games explicitly designed to illustrate markets for prohibited or illegal goods and services. We suspect that students would find such games particularly fascinating.

Fourth, relative to the findings in Brauer (1994) there are now many more but still very few games available for principles of macroeconomics (eleven games instead of two; see Table 2). Collectively, the available macro games impart an impression of assorted ideas; not enough to build a whole macroeconomics course around them. But individually, a number of the macro games are ingenious (more on the macro games further below).

Fifth, at the post-principles level (Table 3), there are, as compared to 1994, more but, again, very few games available (thirteen instead of five).

Sixth, in 1994 it was possible to cover topics such as international trade and foreign exchange markets only by adapting games written as simple double oral-auction (DOA) games. Back then, there were no games specifically designed to draw out insights of special importance to international trade and foreign exchange markets. By 1999 this situation has changed much for the better. In addition to games constructed to illustrate the basic operation of the supply/demand price system, there are about half a dozen games specifically on international trade, including games both to illustrate the pure economics of international trade as well as the political economy of international trade. There is one foreign exchange market game that includes a black market for currency (#84), featured in the preceding section.

Seventh, in 1994 only two games dealt with public goods, externalities, free rider, and similar topics. By 1999 the selection is much better. There are a goodly number of games on negative externalities (especially on environmental economics and permit trading), games to highlight the role of common-pool resources and property rights and coordination and bargaining games. There are even two...
games on positive externalities (subsidies for education, #55, #61). In addition, there are a number of games emphasizing the economic role of institutions (#14, #33, #39).

Eighth, in 1994 only two games addressed income and wealth distribution. By 1999 four more games explicitly address income and wealth distribution.

Ninth, missing altogether in 1994 were games about information. By 1999 more than a dozen games deal with the economics of information, information asymmetries, missing information, and the like.

Tenth, lacking in number in 1994, and still lacking in number in 1999, are games illustrating the concepts of demand and of supply taken on their own. Only two games address as crucial a concept as marginal benefit (demand), and only four games deal with marginal cost (production, cost, and supply) even though marginal benefit and marginal cost are the bedrock upon which the microeconomic notion of allocative efficiency is built. There is room for improvement.

Eleventh, the educational focus and quality of the games has improved. Many games are fairly complex in their pedagogical purpose, yet almost all can be played within a 50 or 75-minute class period. Also, there are now at least two frequent-authors, Denise Hazlett of Whitman College, and Charles Holt (and various associates) at the University of Virginia. A number of textbooks now come with a volume of games supplements, authored, e.g. by Delemeester and Neral (1995), Ortman and Colander (1995), Yandel (1999a), and Hazlett (1999). One textbook (O'Sullivan and Sheffrin, 1998) includes games directly in the textbook. Another textbook (Bergstrom and Miller, 1997) is written as an experimental text only. And Keenan and Maier (1998) contains some 63 experimental activities (which are not separately abstracted in our compilation).

Twelfth, even though there are some oligopoly/monopoly games in which the number of suppliers can be changed — thus permitting the potential construction of a single game to capture the three market structures crucially dependent on the number of suppliers, perfect competition, oligopoly, and monopoly — no one appears to have attempted to construct a single foundational game that, with variations on the theme, could capture almost all topics for an entire introductory course in microeconomics.

Enterprising game designers might consider constructing game modules that can be selectively activated or deactivated. For example, one game module could help construct individual and market demand curves. A second module, played later in the course, could help construct individual and market supply curves from the underlying production and cost schedules. A third module could then take these market demand and supply curves to play a simple double auction game and explicitly direct students to compute buyers', sellers', and total surplus. A fourth module introduces price floors, price ceilings, quotas, taxes, subsidies, etc. and computes the surplus implications. A fifth module introduces preference shifts and technology and/or other cost shifts (and computes surplus implications). A further module would change the slope (elasticities) of the demand and supply curves, compute surpluses, and observe the speed of adjustment necessary to reach equilibrium (i.e. the number of trading rounds needed before a stable equilibrium emerges). And so on.

Further sets of modules (limiting the number of suppliers, skill differentiated goods, positive and negative externalities, and wealth distribution) and professors would then activate/deactivate as instructed.

The harvest of games may disappoint. There is almost as helpful to study microeconomics as macroeconomics. One game (#87) creates data; another builds consequences of inequality; one deals with money and the nature of search-unemployment. Two or more macroeconomics modules build aggregate supply and demand schedules; one or more microeconomics modules build in long-run supply and demand. Neither is there any policy multiplier. Is microeconomics theory pedagogically useful?

As regards Table 4, one might say. For students just beginning, it seems difficult topics, such as motivation game (#87), are worth the opportunity for market clearing games. For advanced students, money, banking, and output market (good, capital, labor) are important.

4. Costs and benefits of games

The question of the benefits and costs of games continues to arise.
In addition, the role of institutions (#14, #55, #61) and wealth distribution. By 1999, information, information number in 1999, are games on their own. Only two (demand), and only four (supply) even though upon which the micro- is room for improvement. Many use, yet almost all can be here are now at least two (e.g. by Delemeester and Charles Holt (and number of textbooks now Hazlett (1999)). games directly in the 1997) is written as an 1998) contains some 63 acted in our compilation). oligopoly games in which the potential construction crucially dependent on the bid-monopoly — no one rational game that, with or for an entire introductory game modules that can game module could help a module, played later in supply curves from the ele could then take these oral auction game and a total surplus. A fourth taxes, subsidies, etc. and others preference shifts and surplus implications). A the demand and supply ment necessary to reach a stable equilibrium emerges). And so on. It is up to the professor to label any module as a domestic output market (goods and services), a domestic input market (raw materials, land, capital, labor), an international trade market, or a foreign exchange market.

Further sets of modules could introduce market structure considerations (limiting the number of buyers, monopsony, or sellers, monopoly), information asymmetries, and product differentiation (for output and for input market, e.g. skill differentiated labor markets). Still further sets of modules for the same foundational game might introduce non-private (common-pool, club, and public) goods, positive and negative externalities, free or easy-riding, and issues in income and wealth distribution. The benefit of a modular game would be that students and professors would have to learn the basic set-up of the game only once and then activate/deactivate desired modules as the course proceeds.

The harvest of macroeconomic games at the principles level (Table 2) is still disappointing. There is no obvious reason why macroeconomic games would not be just as helpful to students as microeconomic games. Game designers either are more enamored with microeconomics games or find them easier to construct than games for macroeconomics. However, the few games that are available pack some punch. One game (#87) creates savings and consumption functions from student supplied data; another builds an aggregate demand function (#81); two deal with the macro consequences of inflation uncertainty (#79, #83); two address real GDP consequences of anticipated versus unanticipated monetary policy (#25, #86); two deal with money and the money creation process (#24, #80); one game examines the nature of search-unemployment (#11); and one game constructs microfoundations of macroeconomics (#85). But none explicitly tries to construct a short-run aggregate supply curve in the sense of distinguishing between input and output prices that drive profit expectations and supply considerations, nor does any game build in long-run supply and the concomitant topics of labor force growth, capital-accumulation, and technology (i.e. the quality of physical and human capital). Neither is there any game illustrating the use and abuse of short and long-run fiscal policy multipliers. Just as games in microeconomics can reinforce major points of microeconomic theory, it would appear that there is plenty of room to develop pedagogically useful games for the macroeconomics classroom.

As regards Table 3 (which lists a handful of post-principles games), we find little to say. For students of microeconomics that have progressed to the intermediate or advanced level, it seems proper to construct games to help illuminate particularly difficult topics, such as predatory pricing (#43) and an employee coordination and motivation game (#44). But other than to nudge students’ memory, it may not be worth the opportunity cost of lecture time to (re)play anything other than a basic market clearing game. A few games — #20, #52, #53, #105 — are appropriate for money, banking, and credit or for a finance course.

4. Costs and benefits of classroom experiments

The question of the value of classroom experiments as an effective teaching device continues to arise. This is particularly true in terms of the opportunity cost of
lecture time. Almost all of the games covered in the compilation can be played within one class period, although often it is unspecified whether one class period means 50 or 75 minutes. Depending on institutional possibilities, some instructors and their departments may consider supplementing their principles courses with a lab requirement — similar to a standard college biology or chemistry class with lab — a solution that appears to work at Reed College in Portland, OR (using four additional 50-minute time-slots during a semester).  

Even though in-class experiments serve, by all anecdotal accounts, as extraordinarily useful stimulants, class time is lost that could have been used to cover economic theory in the standard blackboard style. But, without doubt, students do learn by means of a game. The question is which learning method is more efficient to make students appreciate the power of economic theory and the economic and political consequences this theory implies for the economic organization of human societies. We observe that those who think about the cost/benefit ratio of playing classroom games appear to measure those costs and benefits oddly (e.g. Fels, 1993): the focus is purely on students' presumed benefits (higher exam scores in economics) and instructors' time-cost of learning about, setting-up, playing, administrating, and following up on games. In contrast, we would argue that since there are two parties involved (students and instructor) one needs to think about a two-by-two matrix, representing the costs and benefits of each party (italicized items in the matrix below).

<table>
<thead>
<tr>
<th>Student</th>
<th>Instructor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benefits</td>
<td>a break from the routine; more fun in the classroom; more motivated students; a better reputation for the teaching of economics among students**</td>
</tr>
<tr>
<td>Costs</td>
<td>time-cost of games*</td>
</tr>
<tr>
<td>Notes: * considered in literature; ** not yet explicitly addressed in empirical literature.</td>
<td></td>
</tr>
</tbody>
</table>

The two missing dimensions are the benefit to the instructor — e.g. a break from the routine; more fun in the classroom; more motivated students; a better reputation for the teaching of economics among students — as well as the properly measured benefit to the student: even if economics test scores are not significantly different for students taught with games as compared to students taught without games, perhaps the time cost needed to acquire economics knowledge is significantly reduced and the benefit shows up as higher grades in non-economics courses. Here is an opportunity for valuable research: to our knowledge no one has carried out a study incorporating all four of these facets (costs and benefits to students and to instructors relative to a control group).

King (1999) also points out:

Aside from those benefits, experiments more realism may make , thereby encouraging possibly reversing the instructor's point-of-view on research agenda and experiment days. On the basis of personality types an classroom experiments in lecture. In addition, a of experiments due to additional ideas on the class and a suggestion for class, see King (1999)

The use of classroom terms of their pedagogical response to this call, effectiveness of class examined the impact e that learning effective with little economics background that games at the inte time. Frank (1997) and 'tragedy of the commons' only to a commons experiment days. In terms of experiments due to additional ideas on the lecture on the topic. Frenkel but cautions that the part of the volunteer. Gremmen and Potter game on student learning under games and lect. Their results indicate model than the lecture differential impact with both groups. In terms of learning group indicates a drop over time (with the control neutral). Interestingly, test results and the quality learning in either group.

Bell and Delemeester classes using a double
King (1999) also provides a cost-benefit accounting of classroom experiments. Aside from those benefits mentioned above, King notes that students might find experiments more realistic and convincing than lecture-delivered theory. Such realism may make the classroom experience more interesting and enjoyable, thereby encouraging students to take more economics classes in the future, and possibly reversing the recent decline in the number of majors. From the instructor's point-of-view, classroom experiments may generate ideas for a research agenda and lead to more open classroom discussion, even on non-experiment days. On the cost side of the ledger, King notes that not all instructor personality types are well-suited to handle the sometime chaotic nature of classroom experiments and would rather prefer the certainty of the standard lecture. In addition, some students may not enjoy the social interaction required of experiments due to, for instance, shyness or English as a second language. For additional ideas on the mechanics of integrating experiments into the classroom, and a suggestion for a set of simple experiments for an introductory economics class, see King (1999).

The use of classroom experiments as teaching devices has been called to task in terms of their pedagogical effectiveness (Fels, 1993 and DeYoung, 1993). In response to this call, a flurry of studies have appeared that examine the learning effectiveness of classroom games in economics. While not recent, Fraas (1980) examined the impact of seven games on student learning and interest and concluded that learning effectiveness depended on a student's pre-course knowledge; those with little economics background did better under gaming; those with better economics background did better with lectures, perhaps validating the observation that games at the intermediate level would not be worth the opportunity cost of time. Frank (1997) used student answers to multiple choice questions on the 'tragedy of the commons' to evaluate the learning by a group of students exposed only to a commons experiment and those who were exposed only to a traditional lecture on the topic. Frank found some evidence that the game enhanced learning but cautions that the extra learning may simply reflect a self-selection bias on the part of the volunteer student participants in the experiment.

Greml11en and Potters (1997) examined the impact of a macroeconomic policy game on student learning and also compared student perceptions of learning under games and lectures (as described on questionnaires) with actual learning. Their results indicate that the game group learned more about the economic model than the lecture group as measured by pre and post-test scores and that the differential impact was stable over time (though measured learning suffered in both groups). In terms of student preferences, both the game group and the lecture group indicated a growing preference for their particular teaching method over time (with the overall preference between game and lecture groups about neutral). Interestingly, there was no significant correlation between the objective test results and the questionnaire data on the student's perception of their own learning in either group.

Beil and Delemeester (1999) report results from six microeconomic principles classes using a double oral auction experiment under three different treatments.
The treatments consisted of two sections that were strictly lecture-based, two sections where students participated in an auction experiment in which cash incentives were used, and two auction sections where experimental dollars were converted into grade points. Comparing aggregate test scores on a series of equilibrium analysis questions across the treatment groups, Beil and Delemeester find that the experiments-for-grades group outperformed the no experiments group. When examining scores on a comprehensive final exam, it was the experiments-for-cash group that outperformed the no experiment group, possibly reflecting a spillover learning effect as students grasp a deeper understanding of other material (Wells, 1991).

Mullin and Sohan (1999) report on the Air Force Academy’s experience using experiments in the classroom. Comparing pre- and post-TUCE (Test of Understanding College Economics) scores on classes using experiments with those using a standard lecture format, standard OLS regression results on overall test scores show no significant statistical difference. However, a look at individual test questions using a probit procedure indicated that some topics are better suited for experiments (basic double auction and pollution experiment) while others are not (monopoly, though perhaps a different monopoly experiment may generate better results). Mullin and Sohan also found that students were generally more satisfied with the experiments approach as gauged by responses from course evaluations.

Finally, Yandell (1999b) compared test scores and course evaluations from a microeconomics course that incorporated six classroom experiments with the results from a previous semester’s micro course that relied more heavily on lectures (though it did utilize two classroom experiments). Yandell was able to maintain the same course content coverage in both semesters so as to examine whether student learning and satisfaction was improved without sacrificing coverage. Regression results comparing final exam scores between the semesters did not indicate significant differences. Two-sample t-tests on the course evaluations, however, indicated that students were generally more satisfied with the experimental games approach.

4. Conclusion

Since Brauer’s 1994 paper significant progress has been made in the number, design, complexity, and applicability of non-computerized classroom games, even though this progress is evident primarily for the microeconomics course. In addition, much progress has been made in attempts to measure the pedagogical and learning effects of games with the result (a) that students by-and-large enjoy the gaming approach and (b) that the learning effect as measured by test scores is either neutral or positive, as compared to a lecture style, but is never negative. However, we argue that it is possible that students learn with games the same amount of economics in less time, and consequently devote more time to leisure or their other courses, improving their overall welfare. A proper test of the learning effects of games in the overall time budget and

Finally, it should be always meticulous in proceed. In surveying the literature games are nearly identical were not properly referred to an existing game, please referencing the original article or devotes time to either case intellectual re

The complete set of the

1. http://mcnet.marietta.edu
2. http://www.aug.edu

Acknowledgments

We acknowledge the suggestions from the discussion group on the topic with us. We also acknowledge anonymous reviewers.

Notes

1. By ‘computerized’ we mean computer. Conversely, by performed without the assistance of a computer to a projector (on which more below) we computer to a projector it can be played without
2. Lab-session 1 is a double auction experiment from many sessions and session 4 is a public double aution
3. The experiment, drawn from the
4. The experiments were: a double auction experiment, a production experiment, a production comparative advantage experiment
5. These were a double oral
effects of games in the economics classroom should therefore look at students’
overall time budget and students’ score in non-economics classes as well.
Finally, it should be noted sadly that game designers and publishers are not
always meticulous in properly attributing the source of their gaming inspirations.
In surveying the literature, we noticed a number of instances in which published
games are nearly identical to games previously published by other authors, but
were not properly referenced. If any reader should feel inspired to improve upon
an existing game, please respect the scholarly tradition (and duty) of properly
referencing the original source. Whether one publishes a heavy-duty research
article or devotes time to construct a game that might improve student learning, in
either case intellectual resources were expended that deserve credit and citation.
The complete set of the annotated compilation of the 113 games is available at

1. http://mcnet.marietta.edu/~delemeeg/games/ or at

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with us. We also acknowledge encouraging and useful comments from the Editor and two
anonymous reviewers.

Notes

1. By ‘computerized’ we mean a game that cannot be performed without the assistance of a
computer. Conversely, by ‘non-computerized’ we mean a game that can in principle be
performed without the assistance of a computer even as it may be helpful to have one
around for record-keeping. For example, there are some simple market bid-offer games
(on which more below) where it is convenient, but not necessary, to hook up a laptop
computer to a projector to record and display results as the game proceeds, but the game
itself can be played without requiring the computer as a necessary input.
2. Lab-session 1 is a double-oral auction experiment; session 2 is a market structure
experiments from many sellers to monopoly; session 3 is a product-quality experiment,
and session 4 is a public goods experiment. For details, contact parker@reed.edu.
3. The experiments, drawn from the Bergstrom and Miller (1997) text, were: a basic double
auction, a double auction with a supply shift, a double auction with sales tax, a double
auction with prohibition, a minimum wage experiment, a monopoly posted price
experiment, a production function experiment, and a comparative advantage experiment.
4. The experiments were: a double oral auction, an ultimatum game, a public goods
experiments, a production function experiment, a prisoner’s dilemma game, and a
comparative advantage experiment.
5. These were a double oral auction and a production function experiment.
References


