Classroom

EXPERNOMICS

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Submissions and/or requests to be placed on our mailing list should be forwarded (by March 1, for our Spring, 1998 issue) to:

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Experiments in the Classroom: A Call for Evaluation

Andreas Ortmann [aortmann@bowdoin.edu] and Greg Delemeester [delemeeg@marietta.edu] are in the process of compiling a list of classroom experiments which they hope to make as comprehensive as possible. They would be most grateful if you would let them know what classroom experiments you have used in the past and how they worked for you. Specifically, they would like to know:

- Where they can find the experiment documented
- The environment in which you used the experiment:
  -- class size
  -- principles/intermediate/upper level elective
- The amount of time that it took:
  -- to prepare the experiment
  -- to conduct the experiment
- how effectively the experiment demonstrates the concept(s) it is meant to convey (using an A-F grading scale with A denoting "excellent," B = "very good," C = "good," D = "fair," and F = "poor")
- The overall grade that you would give the experiment (using the A-F scale above).

Both the list of classroom experiments and their evaluations will be made accessible on Ortmann's and Delemeester's websites by the end of the academic year.

Hard Copy Version of *Expernomics* to Become Subject to Subscription Fee

As our mailing list has grown, so has the cost of assembling and mailing each new issue of *Classroom Expernomics.* Now that past and current issues of *Expernomics* are available on the web, we suspect that many of our subscribers are (or could be) availing themselves of the web-based version.

We would like to encourage those subscribers who have access to the web to use that resource (and, not incidentally, help to keep our copying and mailing costs down). On the other hand, we do not want to deny access to a hard copy of *Expernomics* to anyone who does not have access to the web (or to anyone who really *wants* a hard copy, for that matter).

Therefore, beginning with our Spring, 1998 issue, there will be a nominal subscription fee of $5.00 (U.S.) for two years (four issues) for our readers who wish to continue receiving a hard copy of *Classroom Expernomics.* Please use the form below to subscribe.

Subscribe to the New "Experiments in the Classroom" Listserver

If you've ever had a question about running a classroom experiment, but didn't know who to ask, have we got a listserver for you! Shawn Lemaster, Don Wells, and Arlie Williams have created a new listserver to facilitate the use of experiments in the classroom.

To subscribe, send an email message to listserv@listserv.arizona.edu containing only the text "subscribe teachecon Your Name" (do not include the quotes and substitute your name for "Your Name"). Once you have successfully subscribed, you will receive detailed instructions on how to use the listserver to communicate with the other subscribers.

About fifty people have subscribed to this listserver so far, and it should prove to be an extremely useful vehicle for sharing information and expertise on just about any topic related to classroom experiments. We encourage all of our subscribers to check it out.

Beginning with our Spring, 1998 issue, the hard copy version of *Classroom Expernomics* will no longer be available free of charge. A two year (four issue) subscription of the hard copy version will be available for $5.00. To continue receiving the hard copy version, send a copy of this form along with a check or money order for $5.00 (in U.S. funds) payable to *Classroom Expernomics* to:

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Selling Seats Through An English Auction

*G. Dirk Mateer**

The experimental auction highlights the importance of property rights in undergirding the market process. The auction is conducted on the first day that the class meets. The auction process and outcome provides a concrete example of how markets work and an opportunity to relate this to a variety of topics discussed in principles of economics.

At the beginning of the fall semester (1996) students in ten classes at Grove City College were given the opportunity to purchase a seat or seats for the semester. A minimum price of $0.05 was set and the amount bid was collected by the professor in charge. Students who decided not to purchase a seat would either have to lease or purchase a seat from another student or could sit on the floor. Any seats which were not bid on became the property of the professor and could not be used by any student.[1]

Students were told that any money collected from the auction would be used to fund class refreshments as determined by the class. Students were also asked to supply anonymous personal information on their overall grade point average, gender, major, and vision. These control variables were then combined with the information on amount bid and seat location to produce a model of seat selection. Altogether, 292 usable sets of student data (out of 360 students enrolled) were collected.

Winning bids ranged from a low of $0.05 to $20.00 per seat with an average of $3.53! At first glance this result is surprising until it is considered in proper perspective. A typical class requires the purchase of a textbook, notebook, pens and pencils, use of a calculator and other accessories. So by establishing property rights (and requiring students to pay to acquire them) a seat purchase becomes, in effect, a course requirement for most students. The overall bidding behavior suggests that students do care about where they sit.

[1] *The auction starts at the front of the room and moves toward the back. Seats are sold one at a time and the auction proceeds across each row from the side nearest the door to the opposite end.*

Part of the motivation for high bids seems to have been a desire to resell seats at a profit. One explanation is that students overestimated the potential demand for resale. Perhaps some who intended to resell seats were unable to find buyers in classes where there are more seats than students. Several students also bought blocks of seats in order to provide proximate seating for a group of their friends.

Some students bid high prices even when nearby seats were going for much less and then did not even use all the seats that they bought. In some cases, this may reflect their desire to have open seats in front or beside them. Students who bought seats in different parts of the classroom did not change seats during the semester, though some resold those seats to others. Also, some students may have purchased low priced seats in the front row to make sure they had a place to sit and subsequently decided to pay more for a seat in a more desirable location.

Pedagogy

The auction can be very helpful in discussing the notion of scarcity. Students do not immediately recognize that there is a problem of scarcity in a classroom with more chairs than students. However, seats in desirable locations were scarce and the shortage problem was exacerbated since many students desired to purchase more than one seat.

The auction provided an opportunity to discuss alternative rationing methods and inequality. When asked whether the distribution of seats was more inequitable with the auction as compared to more traditional methods of rationing seats (first come, first served), several students pointed out that it was more equitable because everyone had a chance to get and keep a good seat, regardless of how late they arrived to the classroom. As a side note, I would like to point out that since the experiment was formally run, I have set aside a "homeless" area for those who do not wish to buy a seat. The homeless area is the first row at the front of the classroom and is available to any student first come. (If you decide to try this, don't be surprised if the front row is often filled!)

The notion of opportunity cost could be explained in terms of a seat. I emphasize the difference between opportunity costs and sunk costs. The opportunity cost of letting someone else use a seat is either the benefits the owner could get by using it himself (even as a footrest), or what she believes someone else would pay for that seat. Students seem to grasp the notion of sunk costs better than in previous semesters.

The notion of shortages and surpluses could be discussed as well. The professor can ask the students what would have happened if a ceiling price was placed on a particular seat below the market price.

Other issues that could be discussed include the importance of enforcement of property rights in providing an environment where investment is encouraged. Once property rights were established the students showed a high degree of respect for the rights we had agreed upon.

Since the proceeds of the auction are used to purchase refreshments, this enables a further point of discussion: who gets what? The football player may consume four slices of pizza while several students consume only one slice. The football player may have purchased a seat for less than the average price. Hence, one can illustrate that under certain political-economic arrangements the distribution of goods may have little to do with the production of those goods.

Summary Results

A simple OLS regression found that the further back a student sits from the professor the more they are willing to pay for the privilege (38.7 cents extra per row they move back). You can request a copy of Mateer, *et al* (1997) for a complete description of the regression results.

Another aspect of the analysis was to determine if student bids could help explain how well students were likely to do in the course. Data was available from four sections and course grades were matched with the row the student bought a seat in. A simple t-test was run to determine any significant differences. The average GPA in the front row was 3.09, second row 3.12, third 3.08, fourth 3.07, fifth 2.78, and the last row had a GPA of 2.65. Not surprisingly the weaker students gravitated toward the back of the room. Those preferring the last row attain statistically lower grades than those who occupy the first four rows. Ironically, they pay more for the privilege of sitting in the back where they are likely to do worse!

The author would like to thank Ken Stitt and Tracy Miller for their help in administering the auction.

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An Aggregate Demand Driven Macroeconomic Equilibrium Experiment

*Charles Scott Benson, Jr. and Tesa Stegner**

This paper describes a macroeconomic experiment that can be used in the classroom to simulate the impact of consumer spending decisions on a two sector economy. In this simplified specification, low levels of spending result in an unemployment problem whereas high levels of spending cause inflation. Several incentive systems are included to influence the students' behavior. The discussion of the experiment is followed by a summary of the results and some suggested modifications.

I. Introduction

Although numerous experiments have been designed for microeconomic concepts, there are only a limited number of macroeconomic experiments. The existing macroeconomic experiments are based on the microfoundations and are strictly limited to classroom experiments. A review of the literature reveals an exercise designed to derive a savings and consumption curve (Brauer, 1994), a game which examines the budget balancing process (Murphy, 1994), an experiment examining anticipated versus unanticipated money shocks (Hazlett, 1996) and a rational expectations experiment (Ortmann and Colander, 1995).

This experiment simulates the income determination process in a two-sector macro model. Students are allocated a percentage of GDP and must decide what percentage of this income they will choose to spend in each of the following rounds. However, students realize the public good nature of their spending. When students save they receive all of the benefits, but increases in spending only help each individual student by increasing the overall level of GDP and therefore their allocation. Low levels of spending bring about unemployment problems and high levels of spending cause inflationary problems. There are several additional features that could be incorporated into this experiment. The experiment as originally conducted and some suggested additions are presented below.

II. The Setup

The experiment was conducted in principles of macroeconomics classes after the Keynesian multiplier had been discussed. Students were given an information sheet in the previous class period and a sheet on which to summarize the results the day of the experiment. (Copies of these sheets are available from the authors.)

The experiment has twenty players with larger classes having more than one student assigned to each decision making unit. At the start of the experiment, each player is given an identifying letter. The income distribution is then revealed as a specified percentage of GDP and the actual dollar value; students do not have the option of choosing a letter with a high income. The spreadsheet program, including the initial distribution information, is projected on an overhead screen. Given the large number of calculations, this experiment can not be run without the aid of a computer. The spreadsheet program, written in QuattroPro, can easily be adjusted for other specifications and is available from the authors.

The initial equilibrium level of GDP was set at $400,000. The distribution used is presented below in Table 1. GDP for subsequent rounds is determined by summing the spending by each player (consumption spending) and adding a fixed amount for investment spending (set at 25% of initial GDP--$100,000). After any needed adjustments, this figure is allocated to the players based on the original distribution which forms the basis for decisions in the subsequent round.

Table 1. Initial Distribution of GDP

# of Players	% of GDP	Income Level
7	2.5%	$10,000
8	5.0%	$20,000
3	7.5%	$30,000
2	10.0%	$40,000
20	100%	$400,000

There are several adjustments for GDP that may be needed. First, if any players become unemployed, their income for the period is changed to zero and the GDP for the period is reallocated among the other players. Second, if the players'

spending exceeds $300,000 then the value for GDP is adjusted downward (to reflect inflationary pressure). For example, if players' spending totals more than $300,000 in a round, then a player receiving 5% of GDP could receive a maximum of $20,000 in real income. This specification reflects the familiar "L-shaped" Keynesian aggregate supply curve. This simplified aggregate supply curve enables the student to more easily see the results of deficient or excessive levels of spending since there is either an inflation or unemployment problem and not a combination of both.

III. The Play of the Game

At the start of each round players decide how much of their income they choose to spend (and therefore save). Each player is required to spend a minimum of $3,000 in each round out of their current income. Players are not allowed to spend out of their savings unless they become unemployed. The spending choice for each player is collected and the data are then entered into the spreadsheet. After the data are entered, equilibrium income is found; however, additional adjustments may be needed. If consumer spending falls below $280,000 (or remains below this level) then one or more players must be randomly unemployed (or re-employed as the situation warrants). Slips of paper with each player's identifying letter can be drawn from an envelope. This information is then entered into the spreadsheet program so that income can be accurately allocated for the next round. High spending rewards can then be handed out while the players digest the information and make their decisions for the next spending round. It is advantageous to end the game before the end of the class period to avoid a last period problem—students changing their behavior in anticipation of the end of the game.

A. Spending Incentives

The decision to spend more than the minimum amount is influenced by several incentives built into the game. First, the next round's GDP is calculated by summing the spending by the players and a fixed level of investment spending. So the more each player spends, the larger is the GDP pie and the more income each player receives in the next round.

Second, high levels of spending are rewarded. This second incentive reflects the concept of conspicuous consumption; the real world phenomenon that wealthier individuals are able to buy more "toys." The form of this reward varied the two semesters the experiment was run. During the first semester, candy was used as the reward, whereas points were given during the second semester. The candy reward was received if a player spent at least $18,000; if at least $23,000 was spent two pieces were earned; and if spending reached $32,000 in a round three pieces of candy were earned. A result of this constraint is that low income players were not able to spend enough to ever receive a piece of candy. For these people and others in the class that simply did not desire a piece of candy, the only incentive to spend was to increase the size of GDP so they would receive a larger allocation, and to reduce the likelihood of becoming unemployed. Since the end of the game reward was not based on the amount of spending during the game, many students opted to save either in case they became unemployed or to increase their end of the game ranking.

During the second semester the experiment was run, points allocated for high levels of spending were based on threshold levels of spending and the percentage of income spent. A point was received if spending exceeded $18,000 and two points for spending over $23,000. A second reward structure was used so everyone had a chance to earn some consumption points; one additional point was earned if the player spent at least 80% of the available income and another point if spending exceeded 90%. Those earning points were given play money so that these spending points were more tangible.

Finally, if spending is too low, players randomly become unemployed. For every $20,000 that consumer spending falls below $300,000 an additional player becomes unemployed. An unemployed player does not earn any income during the periods in which he/she is unemployed. An individual cannot remain unemployed for more than two consecutive periods, but can become unemployed again in later rounds. If spending remains low for more than one period and more than

one person is unemployed, 50% of the unemployed become re-employed in the next period and new players become unemployed. The distinction between transitory versus permanent unemployment can be brought out by incorporating these different lengths of unemployment. The incentive to spend could be increased if the probability of becoming unemployed increased with each period that the player remained unemployed. For example, an additional slip of paper could be placed in the envelope for each player that does not become unemployed in the current round.

B. Saving Incentives

Two incentives are also built into the game that directly influence the amount saved. First, savings earns an interest payment of 5%. Second, the players' rankings at the end of the game are based on their increase in savings. Each player's percentage of the total savings is compared to their initial allocation of GDP. Players are ranked and points earned based on the difference in these percentages.

IV. Results

This experiment was run in three principles of macroeconomics sections during the Spring 1996 semester and one section during the Fall 1996 semester. The GDP values at the beginning of each round for the various runs of the experiment are listed in Table 2. In the three spring runs an unemployment problem resulted. In Sections 1 and 3, the equilibrium level of GDP was slowly moving back toward a full employment GDP level, whereas in Section 2 no movement back toward full employment was detected in the rounds completed. GDP did decline toward the end in Sections 1 and 3. This occurrence is likely the result of students suspecting the game was about to end, and therefore wanting to increase their savings.

Several students commented during the experiment that this must be what the Great Depression was like and that maybe the government is needed to push their economy back toward full employment. During the fall run, an unemployment situation occurred in the first round, remaining for three periods, followed by an over-correction to an inflationary problem. In addition to providing a basis for a discussion on how aggregate spending influences the economy, the experiment also opens the door for a discussion on the possible role for an active monetary or fiscal policy to correct deviations from full employment.

The results from the spring runs of this experiment suggested that the savings and spending incentives were not compatible; there was too strong of an incentive to save and receive points. This suspicion was confirmed during the experiment's debriefing. Many students stated that they were more interested in receiving points than candy. The incentives for the fall experiment were changed to make the incentives more compatible. Students did appear to respond differently to the incentive structure, confirming the very basic economic principle that individuals do respond to changes in incentives.

Table 2. Experiment Results: GDP at the Beginning of Each Round

	Spring 1996			Fall 1996
	Section 1	Section 2	Section 3	Section 1
Rounds	GDP	GDP	GDP	GDP
1	$400,000	$400,000	$400,000	$400,000
2	$321,000	$286,500	$286,000	$272,300
3	$341,063	$263,453	$272,101	$313,647
4	$336,093	$290,685	$289,471	$378,684
5	$341,778	$299,274	$333,440	$415,194
6	$359,007	$291,341	$321,740	$432,499
7	$327,746	$282,188	$301,752	
8		$267,653		

V. Suggested Additions

There are other options that could be tried to address related macro issues. These options include varying the income distribution. Various income distributions could be examined ranging from an equal distribution to one similar to the United States' current distribution. This could be done to illustrate the results of various income distributions or as a first step toward examining the results of various economic systems (socialism, capitalism, etc.). A second addition could be to include a "safety net" as an element to the game. The funds for the safety net could come from either funds set aside out of GDP (e.g., require that five or ten percent of GDP be set aside each period for entitlement payments) or could simply magically appear (sort of like deficit spending without considering the long run implications). Thirdly, variable interest rates could be added to the game. The interest rate could adjust as the level of savings and investment diverge. For example, for every $20,000 savings falls below investment, the interest rate could increase one percent. This would add a loanable funds market to the analysis. A fourth change could allow players to spend out of either income or savings. The game as originally designed treats savings more as a retirement account rather than a savings account. Enabling students to spend out of savings makes the game more realistic, but also increases the complexity of managing the spreadsheet. Finally, investment could be set as a percentage of GDP rather than as a fixed amount. This may better simulate the actual role that investment plays in an economy.

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This is a revised version of a paper presented at the 71st Annual Western Economic Association Conference, San Francisco, CA, on June 30, 1996, in a session organized by Jeffrey Parker, Reed College, Portland, OR.

Motivation and Coordination Games: Experiencing Organizational Dynamics

*Nicole Marie Bouchez**

I. Introduction

The motivation and coordination games covered here are used in the Managerial Economics class that is taught at UC Santa Cruz. Both games provide students with a hands on way to experience the differences between problems of motivation and coordination, a distinction which many under-graduates do not immediately understand.

Both games are conducted in class and they have a short follow-up assignment that is announced after the game is finished. This assignment is meant to help the students understand what they have been doing and why the two games are different.

In the coordination game, the students have a common interest (the equilibria are Pareto ranked, and one is efficient). The problem is aligning expectations (and actions). Generally, the students initially settle on an inefficient equilibrium. Direct communication between students allows students to achieve efficiency and move to the Pareto efficient equilibrium without the need for binding commitments.

In contrast, in the motivation game, the players have a personal interest diametrically opposed to the common interest (a sort of multilateral prisoner's dilemma). By playing the game, students come to

realize how difficult it can be to achieve cooperation when the benefits to defection are great. Even in the classroom, it seems impossible to get the Pareto optimal equilibrium without some kind of binding agreement.

II. Motivation and Coordination in Economics

Following Milgrom and Roberts' text, *Economics, Organization, and Management*, the firm's problems fall into two distinct categories: motivation and coordination. Problems such as getting all of the parts of a firm to work together, and economy wide resource allocation, are illustrations of the coordination problems faced by the firm. Some of these problems, like resource allocation, are easily solved by using price mechanisms. In other situations, however, prices are inappropriate or just do not work. How does a firm set up and make work a just-in-time manufacturing system? Relative prices may work but they may not be the most appropriate way to coordinate all of the elements that need to work together to get such a system to work. In all of these problems, there is an equilibrium that is best for all the actors involved, but how does the firm get there? Are there not ways for firms to get better outcomes?

Motivation problems are slightly different. These deal with the problems of making people or firms do what they otherwise would not want to. This issue is critically important to issues involving contracts. It also illustrates why it is so difficult to get others to do what is in the group's best interest and how group and personal interests can be diametrically opposed.

Firms constantly face motivation problems from both inside and outside. How does one ensure that employees consistently act in the best interest of the company and not in a self interested fashion? How, in inter-firm agreements, do the firms work for the best interest of the partnership? The key to solving motivation problems is to align the interests of the individual (or other company) with the interest of the firm.

A hands-on experience with some of these problems seems to help students understand the concepts as well as appreciate the difficulty, in some situations, of reaching the optimum.

III. The Coordination Game

The coordination game is very simple in its structure. The students are playing for points (ideally linked to a prize or in our case, bonus points) and receive an instruction/reporting sheet. Two to four class monitors are needed. All the other students in the class participate. The students are split into groups A, B, … of between 5 and 15 players each.[1] Each period, the students are asked to choose a number between 1 and 10 (inclusive) based on the following earnings rule that is on their instruction sheets (see Appendix A): let L_G be the smallest number chosen in team G, let $x_i \geq L_G$ be the choice of individual i in that team. Student i earns L_G less his deviation $d_i = x_i - L_G$ from the team's choice. So, $\pi_i = L_G - d_i$ $(= 2L_G - x_i)$ are i's earnings that period.

The students make their choice and record it on their reporting sheets. The monitors then go around and announce the values of L_G for all of the teams and the students calculate their earnings that period (and record the L_Gs for each group).

We use two different treatment variables: communication and group size. The initial periods can have no communication between students. In subsequent periods, communication is allowed. They generally achieve the optimal outcome without incentive schemes so long as there is communication allowed. Varying group size by combining and splitting up groups also adds some additional dynamics to the exercise and keeps the students' interest up by changing the people with whom they must interact. It is however crucial to make sure that each change in treatment be noted on the students' record sheets.

The efficient equilibrium is to have all members of the group choosing $x_i = 10$ (see Table 1). Contrary to what will happen in the other game, there is no incentive here to defect. A student who

[1] *The examples given in this paper are for a class of approximately 50 students. A few minor adjustments may have to be made for classes that are substantially larger or smaller.*

Table 1. Coordination Game Payoffs
The individual player's earnings are dependent on the smallest number chosen in team G (L_G) as well as the choice of x_i.

	$L_G = 1$	$L_G = 2$	$L_G = 3$	$L_G = 4$	$L_G = 5$	$L_G = 6$	$L_G = 7$	$L_G = 8$	$L_G = 9$	$L_G = 10$
$x_i = 1$	1									
$x_i = 2$	0	2								
$x_i = 3$	-1	1	3							
$x_i = 4$	-2	0	2	4						
$x_i = 5$	-3	-1	1	3	5					
$x_i = 6$	-4	-2	0	2	4	6				
$x_i = 7$	-5	-3	-1	1	3	5	7			
$x_i = 8$	-6	-4	-2	0	2	4	6	8		
$x_i = 9$	-7	-5	-3	-1	1	3	5	7	9	
$x_i = 10$	-8	-6	-4	-2	0	2	4	6	8	10

chooses to defect would get earnings of 9 instead of the 10 they could get by not defecting (it is interesting to note that the other members of the group lose even more from the defection--they now get earnings of 8 points instead of the 10).

IV. The Motivation Game

The motivation game appears very similar to the coordination game. The class setup is the same and the instructions are similar. This is done so that the students focus on the structure of the game rather than on the differences in notation. The primary difference is in the earnings rules that are given. The group and individual benefits are now diametrically opposed, not complementary.

Each period, each student is asked to choose either 0 or 1 based on payoff rules that are provided on their instruction sheets (see Appendix B). Letting $M_G = \Sigma x_i$ be the total number chosen in group G, player i earns M_G less her effort cost $5x_i$, so player i's individual earnings are $\pi_i = M_G - 5x_i$. The students make their choice and write it on their reporting sheet. The student monitors go around checking the sheets and announce the values of M_G for each group. The students fill in the values for M_G and calculate their earnings on their reporting sheets.

Once again, the first four periods are done with no communication between students. In periods four through eight the students are allowed to communicate. In the final periods the students are allowed to agree on contingent transfer (or incentive) schemes. Group size and composition are also changed periodically.

As can be seen from Tables 2 and 3, the players have an interest diametrically opposed to the group interest. Assuming a group of seven students, table 2 shows how a myopic individual player perceives the game. The myopic player will have a tendency to play $x_i = 0$. In contrast, Table 3 shows the group average earnings for different M_Gs. Here the average earnings clearly increase as M_G increases so there is a definite benefit to everyone in the group choosing $x_i = 1$ over $x_i = 0$.

Table 2. The Individual's Motivation Game Payoffs
How the individual player perceives the game (given a group of 7)

M_G	$\pi_I \mid x_I = 0$	$\pi_i \mid x_i = 1$
0	0	n/a
1	1	-4
2	2	-3
3	3	-2
4	4	-1
5	5	0
6	6	1
7	n/a	2

Table 3 also illustrates the advantages defection from the optimal policy can have for a player. If all other players are going to play $x_i = 1$, the last player has the option of playing $x_i = 1$ earning 2, or $x_i = 0$ earning 6. The player's interests are diametrically opposed to the group's interest.

Table 3. Motivation Game Payoffs: Motivation game payoffs with a group of 7 students					
# of $x_i = 1$	# of $x_i = 0$	π_i for $x_i = 1$	π_i for $x_i = 0$	Total group earnings	Average Earnings
0	7	n/a	0	0	0
1	6	-4	1	2	0.2857
2	5	-3	2	4	0.5714
3	4	-2	3	6	0.8571
4	3	-1	4	8	1.1428
5	2	0	5	10	1.4286
6	1	1	6	12	1.7143
7	0	2	n/a	14	2

In class, the students are usually incapable of reaching the Pareto optimal outcome without binding agreements. It is interesting to let the students decide on their own what kind of agreement they think will work (although they do occasionally need a few suggestions on how binding agreements can be set up). The instructor is often used to enforce the binding agreement but this is only allowed when their group's agreement is unanimous.

V. Post Game Exercises

After the games have been conducted in the classroom, the students are required to turn in follow-up exercises in the next class. This usually requires graphing the results, computing the mean, the standard deviation, the deviations from the Pareto optimal outcome, etc., across the different treatments. These reports are usually separate assignments since the two games are usually conducted on different days. The results of the game and the students' write-ups are then discussed in class (or in section). This is a time for the students to compare their experiences and results, get questions answered, and discuss the differences between the two games.

Because the students will be basing all of their analysis on the data they recorded on their record sheets, it is crucial that they fill these out completely. It is also important to have the follow-up analysis announced after the students have completed the exercise so that it does not influence their actions.

VI. Variations and Other Applications

Both of these games can be varied in several different ways. In either game the earnings could be changed from individual earnings to average group earnings. This would substantially change the actions of the individuals in the motivation game and not have a substantial effect on the coordination game. Another possible variation is making slight changes in the earnings rules. Changing the effort cost in the motivation game will affect the gains to defection and should change the ease of reaching the Pareto optimal outcome. Making the earning rule in the coordination game be dependent on two times the deviation from the team's choice is another possibility. The variants are endless and could lead to interesting post game exercises for the students.

There are also other possible uses of these games. Although incorporated in a series of games, these games could just as easily be used as stand alone games in other classes such as environmental, introductory, or intermediate economics courses. The motivation game is particularly suited to explaining the difficulties in organizing a cartel (although the game does not model the social costs of the cartel).

References

Milgrom, Paul and John Roberts, Economics, Organization, and Management, Englewood Cliffs, New Jersey: Prentice Hall, 1992.

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Appendix A: Coordination Game Instructions and Reporting Sheet

Economics 101 Name: _____
UCSC Term, 199X

Coordination Game Instructions

Purpose: To experience a basic coordination problem and how it may be overcome.

Rules: Two to four student volunteers to monitor. The others form teams. Each period each person chooses a number 1-10 so as to maximize earnings.

Earnings: Let L_G be the smallest number chosen in team G, and let $x_i \geq L_G$ be the choice of individual i in that team. Then, i earns L_G less his deviation $d_i = x_i - L_G$ from the team's choice, i.e., $\pi_i = L_G - d_i$ (= $2\ L_G - x_i$) are i's earnings that period.

Each period, every player records his or her own choice, x_i, each team's choice L_A, L_B, …, and his or her deviation d_i and earnings each period on the record sheet.

Players receive .05 of the total earnings as bonus points. Monitors receive the class average bonus points.

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Name: _____
Term, 199X

Record Sheet: Coordination Game

	Choices					Your outcome	
Period	Your x_i	L_A	L_B	L_C	L_D	$d_i = x_i - L_G$	$\pi_i = L_G - d_i$
0	7	4	.	.	.	3	1
1							
2							
…							

Total earnings _____

Appendix B: Motivation Game Instructions and Reporting Sheet

Economics 101 Name: _____
UCSC Term, 199X

Motivation Game Instructions

Purpose: To understand how group efficiency can be affected by motivational problems.

Rules: Two to four student volunteers to monitor. The others form teams. Each period each person i chooses a number $x_i = 0$ or 1 so as to maximize earnings.

Earnings: Let $M_G = \Sigma x_i$ be the total number chosen in team G. Then player i earns M_G less her effort cost $5x_i$, so $\pi_i = M_G - 5x_i$ are her earnings that period.

Each period, every player records his or her own choice x_i, each team's choice M_A, M_B, … and his or her earnings each period on the record sheet.

Players receive .05 of the total earnings as bonus points. Monitors receive the class average bonus points.

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Name: _____
Term, 199X

Record Sheet: Motivation Game

	Choices					Your outcome
Period	Your x_i	M_A	M_B	M_C	M_D	$\pi_i = M_G - 5x_i$
0	1	6	.	.	.	1
1						
2						
…						

Total Earnings _____

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