USING CONTEXT IN CLASSROOM EXPERIMENTS:

A PUBLIC GOODS EXAMPLE

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Abstract

The public good experiment has been used as both a teaching and research tool. In almost all instances it has been designed without reference to a specific public good or real-world application. This is done so participants’ feelings or experiences involving the public good do not affect their behavior. In a teaching environment, however, the addition of context can further student understanding of the public good experiment and its applications to real-world issues. This paper shows how two farm marketing problems can be illustrated through the use of the public good experiment by adding context. The experiment also incorporates the idea of a communication period with students encouraged to find a solution to free riding as a lesson in the difficulties inherent with collusive agreements.
The addition of context can increase substantially the pedagogical benefits of the public good experiment by expanding the lesson and discussion afterwards. Further, adding interaction that may lead to a deviation from anonymity can also increase the scope of benefits to the students. Unfortunately, the public good experiment, as is common in most economic experiments used in teaching, is typically used without context to a specific problem and preserves participant anonymity in the decision making process (Holt and Laury 1997; Leuthold 1987, 1993; Marwell and Ames 1981; Nelson and Beil, Jr. 1994; Williams and Walker 1993). This paper presents two examples of farm marketing problems that fit well into the public good framework and demonstrates the advantages to deviating from the usual approach.

While the details of the public good problem can be found in any good introductory economics textbook, a reminder is useful to understanding it better in the context of farm marketing problems. A public good is one for which consumption is non-rival, meaning consumption by one does not preclude consumption by others, and non-excludable, meaning it would be impossible or extremely costly to prevent others from enjoying the good. The difficulty with such goods is that they encourage what is known as free riding. People know they can get the benefits without contributing towards the public good, and therefore the socially optimum amount of the good is difficult to provide.

Farmers face problems that easily match the requirements of the public good framework. They must deal with marketing problems unlike those at other levels in the food system due to several nearly perfectly competitive conditions. In particular, the public good aspect stems from their large number and the homogeneous nature of the products they produce. This makes it difficult for any to stand apart and benefit from marketing activities without others also benefiting from their efforts. For instance, an apple farmer engaging in advertising could increase demand for apples, but all apple farmers would benefit from the
increase. Similarly, the farmer could choose to limit supply in hopes of driving up prices, but again, all would share in the results. In both of these instances, the non-excludability aspect of the public good problem is readily apparent. While the socially optimal outcome in this context would have the entire group of farmers of some commodity cooperating, this public good aspect makes that goal difficult.

To allow opportunities to organize to overcome the public good difficulties, a communication period is added to the experiment. The idea of a communication period has been used in several forms as a variation to the traditional design (Hoaas and Drouillard 1993; Hoaas and Madigan 1996; Holt and Laury 1997; Nelson and Beil, Jr. 1994; Netusil 2000). However, as suggested by Nelson and Beil, Jr. (1994), the typical design has been to keep the voting or decision-making process anonymous after any communication periods. In the experiment presented, student solutions to free riding were allowed to include some degree of monitoring, removing the anonymity constraint. In this setup, the extent to which participants will free ride will be affected by the degree to which their decisions are monitored. This allows for the illustration of both the difficulties and possible methods to form binding collusive agreements.

The paper thus has two goals. First, to show the ease and effectiveness with which farm marketing problems can be presented through a public good experiment. This will hopefully inspire others to design more context-focused experiments as part of their teaching. Second, to show that allowing for communication, including possible participant monitoring of decisions, extends the traditional public good experiment to incorporate the topic of collusion and its associated problems.
EXPERIMENT FRAMEWORK

The experiment has been designed for and conducted both in an introductory microeconomics course (prior to explaining public goods) and in an upper level food marketing course. Enrollment in the courses typically ranged from the high teens to mid twenties, making it easy enough to conduct the experiment by hand, with the instructor using a computer to enter student responses and calculate results. The experiment had been conducted with a class size of thirty students, however due to time constraints, it would be difficult to use this experiment in classes larger than thirty students.

The experiment design consisted of four periods to be conducted as part of a one hour and fifteen minute class, allowing time before to explain the instructions and time after to present and discuss the results. The actual running of the experiment took approximately twenty minutes. The number of periods could be extended, but at an obvious price of class time. Four periods is the minimum that can work in this design.

One continuing issue in classroom experiments has been deciding on the incentive or reward structure to use (Holt 1999; Stodder 1998). Some options have been to give extra credit, grades, or cash payments, but this experiment has been conducted without any reward structure. While the aforementioned methods may be useful for other experiments, no such incentive has proven necessary here for results to come out as anticipated. The primary benefit in not having a reward structure is that it speeds the processing of student decisions in a manual setting, as the order of entry into a spreadsheet, or other calculation method, does not matter.

RUNNING THE EXPERIMENT

At the beginning of class, introduce the idea that farmers will be faced with several marketing problems and will find themselves in a difficult situation in the food marketing system. Most of the problems stem from the nature of their products. To help students
appreciate this, first ask them about their preferences for different brands of some food product at the retail level. This will generate many opinions. Next, ask them if they care which farms the ingredients initially came from. Students will not have considered this and will find the question puzzling. Simply posing the question is enough to get across the notion of most farm products being viewed as homogeneous, but does not fully explain the marketing problems of farmers.

Next ask students what farmers could do to have more market power. Students will typically respond that there is a need for farmers to act together, perhaps to try and bargain as a unit with processors or to exert control over supply. Another option suggested to help farmers might be to increase demand, with advertising the obvious solution. Once the students agree that acting together is the best strategy for the farmers, the final question is to ask them how easy that is to do. That question can be left unanswered with the start of the experiment.

Continue by handing out the instructions, profit calculation and decision sheets, which are all included in the Appendix. These include instructions for both the supply control and the generic advertising campaign contexts, and the general steps for running the experiment are identical. Note that both stress the context while neither explicitly mentions the public good problem. Go over instructions carefully after giving the students enough time to read them over.

After answering any questions, have them make their decisions for the first period, fold their papers and pass them forward. Enter the numbers into your spreadsheet and report back to the students the level of cooperation (for example, the percentage of acres withheld from production) and the extra income each person receives as a result. The extra income each person receives is determined by doubling the total acres withheld or funds contributed and distributing it equally regardless of the amount of individual contributions. Optionally, it
could also be reported the high profit and low profit for each period.

When the experiment is half over, after two periods in the suggested setting, stop the group. At this point, the class is encouraged to discuss what has been happening so far. Some students will be anxious to talk, with some chastising their classmates for not cooperating. The term free riding may come up, or perhaps an allegation that some are “cheating.” The free riders may be surprised that anyone is acting in the interest of the group as a whole, and express this opinion. Once this initial discussion has settled down, it is time to bring the students back to focus on the problem. Remind them they are all farmers facing the same marketing problem and need to decide how to deal with the issue at hand.

As part of the discussion, students will usually determine the socially optimal strategy whereby the group as a whole would be better off if all of them cooperated. The problem that is encountered in the discussion is how to get 100% agreement and assurance that the strategy will be followed. During the discussion, leave it open for them to see if they can convince each other to do so, or if they can create a method to get everyone to cooperate (for example, one person completes the decision sheets for everyone; switching seats and completing the decision sheet for someone else; one person assigned to monitor and report what others are entering on their decision sheets). The only limit placed here was that physical threats were not allowed. The instructor should stay out of the discussion as much as possible and allow the class to be creative. Discussion may last approximately five minutes but will vary with the class dynamics.

When the class has reached some type of consensus, including potentially no agreement, have them complete and submit their decisions for the third period. Depending on the agreement and results of the third period, some verbal response from the students may be inevitable. However, discussion again after the third period is optional. It has typically been performed without another chance to organize, but depending on the individual class
dynamics, another attempt may be useful to learning. Finally, collect and process decisions for the fourth period.

**EXPECTED RESULTS**

This experiment has been run a number of times over the past five years, and results have been highly consistent. It can be expected that students will withhold acres or contribute advertising funds between 40 and 60 percent of their extra acres or budget funds in the first period. This result dates back to Marwell and Ames (1981) and has been quite robust. In general, this total will decrease in the second period, although not substantially. In some instances, the percentages will increase in the second period but not by a substantial amount.

The third period outcome will depend on the results from the class discussion. For an extreme, on the first running of this experiment, two students were adamant about not trusting others to cooperate and no agreement was reached. Normally, there will be an agreement for all students to cooperate, with some expressing various degrees of confidence that it will succeed. The class may also settle on a method that guarantees full cooperation. The most common way to guarantee compliance was to have different students fill out each other’s decision sheets. The second most common method was to have an appointed monitor watch others fill out their sheets. As no threats are allowed, however, failure to cooperate while being watched can only mean being reported to the rest of the class, still allowing deviation from the agreement.

If the class agrees on a method that guarantees compliance then the remaining period results are set. In the absence of such an agreement, cooperation will increase, but typically will not reach 100%. The amount of cooperation can vary substantially depending on the size, dynamics, and composition of the class. It will not be uncommon to have cooperation in the 90 percent range, while around 60 to 70 percent is also possible. In either event, students
will be disappointed, and this will affect the results in the last period. Contributions in the final period will be the lowest, perhaps by a large margin.

**POST-EXPERIMENT DISCUSSION**

As noted by Hoaas and Drouillard (1993), the classroom discussion afterwards is crucial to achieving the full pedagogical benefit of the experiment. The best way to start the post-experiment discussion is by showing the results graphically. As an example, Figure 1 shows the results from two of the most recent sessions of the experiment, both in the supply control context. Both class results, for the most part, follow the typical pattern, although for Class 1, period three withholding of acreage was lower than expected. This was the result of class concerns over the sincerity of a vocal classmate. For Class 2, although the period three withholding was higher than Class 1, it reflects a lack of method to guarantee full withholding even though the class agreed to fully withhold.

In the event that no guaranteed method of cooperation is attained, the primary point of interest is the period three results. Students in upper level courses might not be surprised in the lack of full cooperation since they may have remembered the public goods and free riding problems. The important aspect here is to bring the context of the farmers’ problems back into focus. Compare the difficulty of getting a relatively small group of classmates, not faced with any financial incentives, to cooperate with that of a perhaps large and diverse group of farmers. Also point out that in the experiment all farmers of the particular commodity were sitting together whereas in reality farmers are located in many states as well as in other countries.

At this point in the discussion, it is useful to ask students if they can give a real-world example of a group who attempts to restrict output and thus influence price in the market. In most cases, students will respond with OPEC. Although OPEC is quite often in the news for setting output levels, the group is not without its problems. With the experience of the
experiment, ask students what problems OPEC faces when attempting to set output levels for its members. By identifying why it is so difficult to achieve cooperation, students are in fact identifying the elements needed for successful cooperation.

The two main elements of successful collusive agreements are 1) the ability to detect cheating and 2) the ability to enforce the agreement. In the event that students all agreed to contribute 100% but no monitoring mechanism was in place, it would be very difficult for those in the group to detect who among them cheated if in fact the group did not achieve full cooperation. Depending on the method of monitoring it would be possible to detect cheaters. However, even in the event that the group detected any cheaters, does the group have any ability to punish those who cheated and enforce the terms of the agreement? These two elements together are thus important to be able to achieve a successful collusive agreement otherwise members of the group will always face the incentive to cheat on the agreement.

This is also a good point to see if the context would make a difference to the students. Ask if their contributions would have been different, and how, if they had been instructed that they were members of OPEC instead of a group of farmers. Would they be more or less willing to fully cooperate as a member of OPEC rather than as an individual farmer? Do they feel differently about one group cooperating than the other? These questions will expand their views of both groups and reveal similarities they would not have noticed. This can extend to comparisons with any other examples the class proposes.

Another major lesson can be seen in the drastic decrease in cooperation in withholding acres in the final period. It can usually be assumed that the class would not have reached levels that low so quickly if it had not been for the break and the discussion on organizing at the midway point. This enforces how quickly and drastically a non-binding agreement can deteriorate. It can show how even a single free riding farmer could lead to a rapid unraveling of any voluntary cooperation program.
This situation is of particular interest in the context of funding generic advertising. If current mandatory check-off programs were to be removed, it is likely that a voluntary system would be put in its place, with farmers having discussions and making agreements similar to those the class held at the experiment’s midpoint. Some farmers will not even wish to make any agreements, a situation again probably mirrored by the students. Continuing a voluntary system after a guaranteed system, and the inevitable withholding of funds by some, may have a similar psychological effect as the response to period three results. In this sense, the experiment clearly shows how farm marketing problems could become more serious. In this context, see if the lesson has altered any student’s views on mandatory programs.

Continuing with the discussion of the experiment, results can also be displayed as in Table 1. This gives additional information on individual actions while remaining anonymous. Examining the high and low profits by period reveal that at least one person fully participated and at least one person did not participate at all each time in both of the two classes. This is a typical result and an opportunity for further discussion on differences in cooperation levels. Remember, of course, there is no way to know if it is consistently the same people.

To end the discussion, return to the question of how easy it would be for farmers to act together to help overcome some of their marketing problems. The difficulties will now be clear to the students. Review the special characteristics of farm markets that leave them in this situation. If the terms had somehow not come up, be sure to relate to the public good problem and free riding, and perhaps provide other examples where similar problems occur.

**SAMPLE RESULTS WITH INCORRECT INCENTIVES**

As previously noted, this experiment has primarily been conducted without incentives. An important point to remember when running an experiment with incentives is to design them to match the behavior you are trying to generate. To illustrate this point, the
experiment was run with incorrect incentives. Prior to the start of the experiment it was announced that the three students with the highest profits would receive an extra credit coupon worth three points applied to his/her final exam score. At the start of the following class period, in addition to these three coupons, a fourth unannounced, coupon worth the same number of points, was awarded to the most altruistic student, lowest profit. The actions in the experiment revealed that in fact students were not playing the game as intended.

   Based on this incentive structure, the optimum behavior for the students in the case of farm production was to plant all of their remaining 50 acres. The student would be maximizing his/her individual profit each period. The student’s profit each period therefore would be $50 for the acres planted plus the share of the group account. There would be no incentive for an individual student to withhold acres in order to maximize the group’s profits.

   During the communication period half way through the experiment, students identified the strategy of withholding all of his/her acres to maximize the group’s profits but the students were playing to win the extra credit coupons. Students who were following the above strategy in the first periods were not willing to change strategy and potentially lose the opportunity to obtain the coupon. The students realized the possibility of free-riding and no additional compromise or guarantee could be reached.

   Figure 2 shows the results from the session conducted using 6 periods, as there were 75 minutes available to run the experiment. Compared to Figure 1 it can be seen that in the periods prior to the communication opportunity, the percentage of acres withheld was substantially lower, 13.5%, 14% and 9% in periods 1 through 3 respectively. This indicated that students were maximizing individual profit from the very first period in order to obtain the extra credit coupon. After the communication period, there was an increase in percentage of acres withheld (15.5%, 20.8%, and 20.8% in periods 4 through 6 respectively) as some students withheld more acres after realizing they had no chance to win the extra credit
coupons. Again comparing these results to Figure 1, even without a guaranteed method of cooperation, the percentage of acres is substantially lower.

In order to establish incentives therefore that generate the behavior desired the following is proposed. Prior to the start of the experiment announce that one experiment dollar profit earned is equal to 1/100 extra credit point. This conversion scale was determined as follows for an experiment with four periods: if each student withheld all 50 acres for all periods, then each student’s total profit would be $400 ($100 earnings per period). Using the conversion of 1/100 extra credit point for each dollar profit, the student would earn a maximum of 4 extra credit points. A similar conversion could be used if real dollar incentives were used instead, whereby students could earn a maximum of $4.

CONCLUSION

In using experiments, care has often been taken to remove context to prevent subjects’ feelings towards a specific issue from influencing their behavior. Following such considerations in the classroom may reduce the scope of lessons and discussion possible afterwards and hinder the use of experiments in classes, especially beyond the introductory level. The pair of farm marketing problem examples given here were just two possibilities for covering specific lessons with context added to a public good experiment. Numerous other lessons are possible. It is hoped that in the future many other uses will be designed for the public good experiment as well as others. This should not only increase the usage of experiments as important teaching tools in the classroom, but also increase the pedagogical benefits of those experiments.

Lastly, the use of a communication period half way through the experiment allowed students an opportunity to discuss the previous period results, optimal strategy, and ways to achieve this result. Generating solutions to the free riding problem may include monitoring which could guarantee 100% cooperation in the following rounds. This possibility further
extended the traditional public good experiment and provided opportunities for additional lessons on the topic of collusion.
APPENDIX: EXPERIMENT INSTRUCTIONS AND HANDOUTS

Supply Control Version Instructions

In today’s experiment we will examine the potential for farmers to exercise control over commodity prices. Everybody is in the same group of farmers, planting the identical commodity. There will be four periods representing planting seasons, and at the start of each period, each of you has already planted 100 acres and have 50 acres left that you need to decide what to do with. For each acre of your remaining 50 you plant, you will earn $1. However, you know that if acreage is withheld, supply will be lower and the price of the commodity will increase. For every acre withheld from production, the price will increase enough so that there is $2 added to the entire group’s income. In other words, the value of a withheld acre is double a planted acre.

Since the commodity is identical for everyone, any extra income from withheld acres is divided equally among every member of the group, regardless of whether or not they withheld any acreage. So, no matter how many acres you withhold, 18, 50, or none, you will still get an equal share. The money you earn each period is equal to $1 for each of your remaining 50 acres you planted plus your share of the income increase from withheld acres.
**Generic Advertising Version Instructions**

In today’s experiment we will examine the potential for farmers to fund generic advertising programs. Everybody is in the same group of farmers, planting the identical commodity. There will be four periods representing years, and at the start of each period, each of you has already allocated 100 dollars of your budget to cover the operations of the farm and have 50 dollars left that you need to decide what to do with. For each dollar of your remaining 50 you save, you will earn the dollar. However, you know that if a generic advertising campaign is funded, demand will be higher and the price of the commodity will increase. For every dollar spent on generic advertising, the price will increase enough so that there is $2 added to the entire group’s income. In other words, the value of a dollar spent on advertising is double a saved dollar.

Since the commodity is identical for everyone, any extra income from generic advertising is divided equally among every member of the group, regardless of whether or not they spent any money towards the campaign. So, no matter how many dollars you saved, 18, 50, or none, you will still get an equal share. The money you earn each period is equal to $1 for each of your remaining 50 dollars you save plus your share of the income increase from the generic advertising campaign.
### Profit Calculation Sheet

<table>
<thead>
<tr>
<th>Period</th>
<th>Planted</th>
<th>from Acres</th>
<th>from Group</th>
<th>Profits</th>
<th>Total</th>
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<tr>
<td>1</td>
<td>______</td>
<td>______</td>
<td>______</td>
<td>______</td>
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</tr>
<tr>
<td>2</td>
<td>______</td>
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<td>______</td>
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<tr>
<td>4</td>
<td>______</td>
<td>______</td>
<td>______</td>
<td>______</td>
<td>______</td>
</tr>
</tbody>
</table>

**Total**

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### Student Decision Sheet Example

**Period #1**

I have decided to plant ______ of my 50 remaining acres.
NOTES

1. We learned this idea from William Schulze, whose help we gratefully acknowledge.

2. In personal experiences conducting the public goods experiment involving approximately one thousand students there has only been one instance of a group reaching 100% cooperation after a discussion without some method of guarantee. Again, though, different groups have been shown to behave differently in public good experiments.

3. As another example, while not yet tested in the classroom, a public good experiment has been designed for a technology course to explain why patents are necessary for innovation. In each period, they may either keep money as profits or invest it in research and development. Without any protection system, all benefits of research go to all the firms in the industry.
REFERENCES


Figure 1. Percent of acreage withheld per period for two typical experiment sessions.
Figure 2. Percent of acreage withheld per period for session with incorrect incentives
Table 1. Acreage withholding and student profits for two typical experiment sessions

<table>
<thead>
<tr>
<th></th>
<th>Period 1</th>
<th>Period 2</th>
<th>Period 3</th>
<th>Period 4</th>
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</thead>
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<tr>
<td>Percent of acreage withheld (Share)</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class 1</td>
<td>58.57</td>
<td>45.52</td>
<td>69.81</td>
<td>22.67</td>
</tr>
<tr>
<td>Class 2</td>
<td>50.53</td>
<td>29.33</td>
<td>79.33</td>
<td>26.67</td>
</tr>
<tr>
<td>Income from withheld acres</td>
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<td>$58.57</td>
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