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Experiment for Positive Externalities: Is Coase Theorem Applicable to the Positive Externalities?

by

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1. Introduction

There are many arguments in economic and legal research about Coase theorem. In 1960, Coase took an example of negative externalities and argued that the efficiency is achieved regardless of the liability rule. He took the example of straying cattle which destroy crops growing on neighboring land. In his example, a farmer and a cattle-raiser are operating on neighboring properties. He further supposes that, without any fencing between the properties, an increase in the size of the cattle-raiser's herd increases the total damage of the farmer's crop. He concluded that the ultimate result is independent of the legal position (whether the cattle-raiser is liable or not for damage), if the pricing system is assumed to work without costs.

The experimental literature supports Coase's argument. Hoffman and Spitzer (1982) conducted experiments with bargaining and side payments. Their experimental design simulates the negative externalities in pollution problem. There have been few experiments in positive externalities. This paper deals with bargaining with positive externalities. The experiments in this paper try to simulate the R&D activities among several companies. The results of R&D activities of one firm can easily be replicated by others at lower costs. In this paper's experimental design, each firm may spend its resources on R&D activities, but the results of successful R&D activities benefit all firms, regardless of whether a particular firm spends its resources on that activity. This is an example of positive externalities. My major interests are whether players in the experiments bargain for their benefits and achieve the joint payoff maximum. I deal with two kinds of experiments under positive externalities: 1) Coasian Bargaining with certainty, 2) Coasian bargaining with uncertainty.

(controller)" than with the second instruction with the expression "is designated to be controller.

Harrison and Mckee (1985) also changed the nature of property rights and proved that there is indeed an externality problem. They observed that joint payoff maximum is not pervasive in their setting and concluded that the existence of controller and side payments is crucial to achieve joint payoff maximum.

Shogren (1992) examined Coasian bargaining under uncertain payoff streams. Subjects bargained over both *ex ante* lottery and the *ex post* reward. Shogren used the traditional "controller" scheme, which is different from the positive externality scheme in this paper, and showed that 87% of all agreements were Pareto-efficient. However, only 7.3% were mutually advantageous and 85 percent of all agreements split the reward equally.

Isaac and Reynolds (1988) demonstrated that the R&D activities (i.e., the mean number of draws in their setting) is larger without positive externalities (with "full appropriabilities") than with positive externalities (with "partial appropriabilities"). Their scheme, however, does not include the negotiations and side payments.

3. Experimental Design

In Coase theorem literature, most papers deal with negative externalities and few papers deal with the positive externalities. This paper will attempt to reveal the behaviors specific to positive externalities in Coasian bargaining.

A major difference in Coasian bargaining under negative externalities and under positive externalities is the existence of the "controller." In Hoffman and Spitzer (1982),

ours is the informational setting: in Shogren, subjects have only limited information: in our experiment, subjects have full information.

Under uncertain payoffs, binomial lotteries are introduced for R&D activities. In our experiments, if R&D activities are successful, all subjects benefit from R&D activities.

Next, we will discuss some conditions that we will need to induce the appropriate bargaining under uncertainty.

In the following discussion, "Spending-Spending" indicates a situation in which both players spend their resources on R&D activities, while "Spending-No spending" indicates a situation in which player A spends her resources but player B does not. "No spending-Spending" indicates a situation in which player B spends her resources but player A does not. "No spending-No spending" indicates that neither player spends their resources on R&D activities.

One condition to inducing negotiations among subjects is that subjects are better off spending their resources on R&D activities. Otherwise, they are better off without spending their resources in R&D activities and they do not have externalities.

Another issue for the parameter setting is that expected payoff for "Spending-Spending" should be less than the expected payoff for both "Spending-No spending" and "No spending-Spending." Otherwise, subjects do not have incentives to negotiate for better payoffs. They simply achieve better payoffs in "Spending-Spending" without negotiations.

Thus, to induce negotiation for R&D activities, we need the following conditions for symmetrical probabilities:

Specifically, the probability of success for player A is 80% and the probability of success for player B is 10%.

4. Instructions

a. Certainty setting

First, I will verify that the Pareto-optimal outcomes are achieved and that the mutually advantageous situation is achieved in this setting. Agreement forms similar to Hoffman and Spitzer (1982) are used in the following experiments.

Instruction for Two Person Experiments

Following the general explanation similar to Hoffman and Spitzer (1982), subjects are shown the following instruction. The experimenter read the instruction orally after a few minutes.

You will be asked to make one choice. The cash value to you of the outcome in the table below is given. (See Table 1 in Appendix 1.) You have two points at the beginning of the experiment. You have an option to spend 1 for to get 2 points. But if you spend 1 for your self, the other player also gets 2 points. The other player has the same option to spend 1 and get 2 points. In the example shown below, you might be person B. If you spend 1 and person A does not spend 1, you will get additional 1 and person A gets additional 2. Your payoff sheets list not only the value of each number to you, but also the value of each number to other participant. Each of you will make your own decision. After both of you make decisions and inform the monitor, who will stop the experiment and pay both participants. You and other participant may attempt to influence each other to reach

Following the general explanation similar to Hoffman and Spitzer (1982), subjects are shown the following instruction.

You will be asked to make one choice. The cash value of the ending points is given to you. You have two points at the beginning of the experiment. You have an option to spend 1 for to get 2 points. But if you spend 1 for your self, the other two players also get 2 points. If anyone of one or two or three persons spend 1, every person gets 2 points. If no one spends a point, no one gets anything. You know not only your payoff but also other player's payoff for each outcome.

Are there any questions? We ask you to answer the questions on the attached sheet to make sure you understand the instructions.

Question

1. Suppose you are player A. If you spend 1, how many additional points do the other players get?
2. Suppose you are player A. If player B spends 1, how many additional points you and player C get?
3. Suppose you are player A. If both player B and player C spend 1, how many points do you get?
4. If all three players spend 1, how many points does each player get?

Objective of the experiment is to simulate coordination on R&D activities among three firms in the same industry.

participants. You and other participant may attempt to influence each other to reach mutually beneficial decisions. You and other participant may offer to pay part or all of his of her earnings to each other.

Are there any questions? We ask you to answer the questions on the attached sheet to make sure you understand the instructions.

Questions

1. Suppose you are player A. If you do not spend 3 to draw and player B spends 3 to draw a lottery, what is the expected point for you?

2. Suppose you are player A. If both you and player B spend 3 to draw lotteries, what is the expected point for you?

3. Suppose you are player A. If you spend 3 to draw a lottery and player B does not spend 3 to draw a lottery, what is the expected point for you?

4. If both of you do not spend 3, what is your expected point?

The objective of the experiment is to simulate the coordination on R&D activities under different probabilities of success between two firms.

H3: Even under uncertain payoffs with positive externalities, the parties will choose the joint payoff maximum.

H4: Under uncertain payoffs with positive externalities, players split the reward equally in their agreement.

Shogren (1991) showed that nearly 87% of all agreements were Pareto efficient. However, only 7.3% were mutually advantageous and nearly 85% of all agreements split the reward equally. I will test the similar hypothesis under positive externalities.

information in a joint controller setting. Once again, the difference is made by the existence of controller(s). In the positive externalities setting, no one has bargaining power to enforce the individually better payoff.

In the positive externalities setting, the existence of a controller is not crucial to achieving the joint payoff maximum. Is the unilateral property right (i.e., the existence of controller) really necessary to achieve joint payoff maximum in the Coasian bargaining under negative externalities?

To answer this question, we review the results of the experiments in Harrison and Mckee (1985). To test the hypothesis (H6) that the establishment of unilateral property rights increases the number of joint payoff maximum, Harrison and Mckee compared the results under two different conditions: no property rights (NPR) and unilateral property rights (UPR). Under the NPR condition, side payments are prohibited and there is no controller. Under the UPR condition, sidepayments are allowed and there is a controller.

Harrison and Mckee concluded that H6 was strongly supported by the experiment when they compared the results under UPR and results under NPR. But it is a confusing argument. They have another condition called joint property rights (JPR) in their experiment. Under JPR, there is no controller but two players jointly choose the number and divide the total payoffs.

Harrison and Mckee should compare the results under UPR and JPR conditions to test the hypothesis (H6), because both conditions allow the transfer of the property but differ in the existence of controllers. In fact, they admit that there is no significant difference between the efficiency properties (i.e., the number of joint payoff maximum) of JPR and UPR conditions. They should conclude that there is not significant effect to

7. Concluding remarks and extensions

The experiments of positive externalities support Coase's theoretical proposition. Under the full information setting, most of agreements are Pareto-optimal for both certain payoffs and uncertain payoffs. Subjects achieve the joint payoff maximum in our experiment. These results indicate that the unilateral property rights (i.e., the existence of controller) are not crucial to the efficiency in the bargaining under positive externalities.

The absence of controllers in the positive externalities setting gives equal bargaining power to subjects. As a result, no one has the bargaining power to achieve individual payoff maximum.

Our further analysis of the results in Harrison and Mckee (1985) implies that the unilateral property rights are not crucial even for the bargaining under negative externalities.

We may consider the following extensions of this paper.

1. What would be the results of the experiment if social surplus (i.e., the difference between the maximum payoff and the next best alternative) is increased? Do subjects still split their payoffs?
2. Under uncertain payoffs, what would happen if each player has asymmetrical payoff between under successful R&D activities and failed ones? (In our experiment, the differences of payoffs between two players are the same in the successful R&D and failed one. It facilitates the negotiation between two party.)
3. What if side payments are not allowed in my experiment?

Appendix 1

Table.1

		A	
		No spending	Spend 1
B	No spending	(2,2)	(4,3)
	Spend 1	(3,4)	(3,3)

Table. 2

			B		
			No spending	Spend 3	
				Success	Failure
A	No Spending		(3,3)	(8,5)	(3,0)
	Spend 3	Success	(5,8)	(5,5)	(5,5)
		Failure	(0,3)	(5,5)	(0,0)