

A Simple Investment Game Experiment for the Classroom*

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Abstract

We present a simple way of carrying out the Investment Game, introduced by Berg, Dickhaut and McCabe (1995), inside the classroom for instructional purposes. This game is a handy way of illustrating the principle of backward induction in sequential move games and as well as demonstrating how behavior often deviates from the game theoretic prediction. We modify the original design to allow each subject to play both as a Sender as well as a Receiver.

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1. Introduction

The Investment Game, first proposed by Berg, Dickhaut and McCabe (1995), is an excellent tool for illustrating (1) how the principle of backward induction works in sequential move games and (2) how behavior often differs from that predicted by backward induction. The Investment Game proceeds like this. Subjects are paired up, with one person called the Sender (alternatively Proposer or Allocator) and the other person called the Receiver (alternatively Respondent or Recipient). Each Sender is given \$10. Each Sender is told that she is free to keep the entire \$10 or she can split it with an anonymous Receiver (who is in another room). However any amount that the Sender offers the Receiver will be tripled by the experimenter and given to the latter. The Receiver will then decide whether to keep the entire amount offered to her or to send some back to the anonymous Sender who made the offer in the first place. This latter amount is not tripled. The game ends at that point. To take an example, suppose the Sender decides to keep \$5 out of the initial \$10 and offers \$5 to the anonymous Receiver. Then the experimenter triples the \$5 offered and gives the Receiver \$15. The Receiver can then decide to keep the entire \$15 or send part or all of it back to the Sender.

The solution to this game using backward induction goes like this. Consider the Receiver's decision. Since the game ends after this point, the Receiver has no incentive to send any money back to the Sender. Knowing this the Sender should not send any money to the Receiver in the first place since she should not expect to get anything back. The principle of backward induction dictates that the Sender should keep the entire \$10. This way the Sender gets \$10 and the Receiver gets \$0. However there is an alternative way of looking at this. Suppose the Sender decides to "trust" the Receiver and sends her the

entire \$10. The Receiver then will receive \$30. If the Receiver “reciprocates” the Sender’s “trust” then there are numerous possible splits of this \$30 (say \$15 each) which makes both the Sender and the Receiver better off than if the Sender had sent nothing. However if the Receiver does not “reciprocate” the Sender’s “trust” then the Sender is worse off since she loses all or part of the \$10 that she could have kept.¹

This game then provides a handy way of discussing backward induction as well as demonstrating behavior that deviates from the game theoretic prediction.

2. Experimental Procedure

I used this experiment in my class on Behavioral Economics. Students play the game for extra-credit points rather than money. This however posed a problem at the very outset. When carrying out experiments with extra-credit points, it is important to avoid any appearances of “unfairness”. See Stodder (1998). But in this experiment the Sender is in a more advantageous position. So we modify the original experiment to allow every subject to play as both a Sender and a Receiver.

Each subject is given a copy of the instructions (see Appendix). The instructions are also read aloud. Each student gets an initial endowment of 50 extra-credit points that she could keep or split with an anonymous partner who would be in another room. There were 14 students who were assigned ID numbers, #1 through #14.² They are told that each of them would make both a Sender decision as well as a Receiver decision. They know that they would always be paired with someone who would be in the other room. So while they knew who the people in the other room were, no one (except the Experimenter) knew who he or she was paired with.³ They were also told that they would not be interacting with the same person in the two roles. For instance, subject #1

(as Sender) offers a split to subject #8 (as Receiver), while subject #1 (as Receiver) receives a split from subject #14 (as Sender), while subject #8 (as Sender) offers a split to subject #2 (as Receiver) and so on. The following scheme illustrates this point.

<u>Room A</u>	<u>Room B</u>	<u>Room B</u>	<u>Room A</u>
<u>Sender</u>	<u>Receiver</u>	<u>Sender</u>	<u>Receiver</u>
1	8	8	2
2	9	9	3
3	10	10	4
4	11	11	5
5	12	12	6
6	13	13	7
7	14	14	1

Subjects 1 through 7 were asked to stay in the same room (Room A) while 8 through 14 went into the next (empty) classroom (Room B). Each subject, at this point, was asked to fill out Boxes B and C on the record sheet. Box A already had 50 points written in it. Each subject, as Sender, decided how much she wished to keep and how much she wished to offer to the anonymous Receiver. Let us look at subject #1. Suppose Subject #1 decided to keep 25 points and offer 25 points to the Receiver she is paired with (which happens to be subject #8). At this stage the Record Sheet looks like the following.

A	Starting Amount	50
B	Amount you wish to KEEP	25
C	Amount you wish to SEND (A – B)	25

Then this page of the Record Sheet is carried to the other room and given to subject #8. Except, for subject #8, box D is filled in and reads as 75 points. Subject #8 then is asked to decide how much she wants to keep and fill up Boxes E and F accordingly. Suppose subject #8 decides to keep 50 points (out of the 75 offered) and send back 25. Boxes D-F then look like as follows:

D	Amount you have been sent (3 times the amount in Box C)	75
E	Amount you wish to KEEP	50
F	Amount you wish to SEND BACK (D – E)	25

Subject #8 is also asked (since this sheet will go back to subject #1, the Sender) to copy the information from boxes D-F onto boxes G-I on Page 2 of the instructions. This way subject #8 will have a record of what happened to her in the role of the Receiver. At this point subject #1 has earned 50 points – 25 points that she kept as Sender and another 25 points that are sent back by the Receiver (subject #8). But subject #1 is the Receiver in the (subject #14, subject #1) pair. So as Receiver subject #1 receives a split from subject #14. Let us say that sheet looks like this: (filled in by subject #14)

A	Starting Amount	50
B	Amount you wish to KEEP	30
C	Amount you wish to SEND (A – B)	20

So subject #14, the Sender, has offered 20 points (which gets tripled to 60) to subject #1, the Receiver. Say subject #1 keeps 30 (Box E) and returns 30 (Box F). Boxes D-F then look as follows:

D	Amount you have been sent (3 times the amount in Box C)	60
E	Amount you wish to KEEP	30
F	Amount you wish to SEND BACK (D – E)	30

Then subject #1 notes down the same information on Boxes G-I which appear as follows:

G	Amount you have been Offered	60
H	Amount you wish to KEEP	30
I	Amount you wish to SEND back (D – E)	30

Subject #1's total earnings in the experiment are 80 points. 25 points she kept back as Sender (Box B), 25 points she got back from the Receiver, subject #8 (Box F) and finally the 30 points she kept as the Receiver (Box H) out of the split offered by subject #14. Boxes A through F on Page 1 of the Record Sheet show what happened to subject #1 as the Sender while boxes G through I shows what happened when subject #1 is the Receiver.

3. Results of the Experiment

Looking at the decisions made by the Senders we find that out of the initial endowment of 50 points, on average, the Sender keeps 31 points, i.e. 62%, and sends 19 points (38%) to the Receivers. Figure 1 shows the distribution of the amounts (in points) sent by the Senders to the Receivers.

In order to look at Receiver decisions we need to look at percentages since different Receivers receive different amounts. On average Receivers get 57 points (3 times 19) and out of those 57 points they keep 40 points (70%) and send back 17 points

(30%). Figure 2 shows the distribution of the amounts (expressed as a percentage of the amounts received) sent back by the Receivers. Note that no Receiver sent back more than 50% of the amount that she received.

Since each subject plays both as a Sender and a Receiver, so each subject, on average, makes 88 points. 31 points kept back as Sender, 17 points sent back by the anonymous Receiver she is paired with. And finally 40 points that she keeps back as Receiver out of the 57 points sent by the Sender she is paired with. Each subject then does better than if they had kept back all of the initial 50 points as Sender since that would give each a maximum of 50 points while this way each subject gets 88 points.

Let us compare this behavior with Berg, Dickhaut and McCabe (1995). In their experiment the initial endowment is \$10 out of which Senders keep \$4.82 (48%) and send \$5.16 (52%). On average Receivers Get \$15.48 and keep \$10.71 (70%) and send back \$4.77 (30%). So the Senders in our experiment are much more parsimonious keeping back 62% of the initial endowment compared to 48% in Berg et al.⁴ But the behavior of the Receivers in both experiments is remarkably similar.

There is no correlation between the amounts that the receivers receive and the amounts they send back. So it is not the case that those Receivers who get more send more back

Finally out of 14 Senders, only 3 (21%) sent all of their initial endowment as opposed to 5 out of 32 (15.6%) in Berg et al.

4. Concluding Remarks

In this paper I have presented a simple way of carrying out the Investment Game of Berg, Dickhaut and McCabe (1995) for instructional purposes. I do not intend to present

these findings as research. My aim is to provide other instructors with a simple way of conducting the Investment Game in the classroom since this is a good game to illustrate the principles of backward induction as well as deviations from that principle. The experiment described above has the added advantage that the instructor does not run the risk of appearing to be “unfair” since the experiment allows for each subject to play as both a Sender and a Receiver. With 14 students it takes me at most 10 minutes to read the instructions and then at most another 10 minutes to conduct the experiment. If the instructor has the pairing scheme made up then the design can be easily extended to classes that have many more students. Except one must make sure that there is another empty classroom available close by and preferably right next door. Also I carry out the experiment at the end of the class period so that I can collate the data and report the results the next class period.

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Endnotes:

1. I have put the words "trust" and "reciprocity" within quotes. The behavior of the subjects in this game, which deviates quite sharply from game theoretic predictions, is usually explained by appealing to the above concepts. But the real motivation behind such behavior is still open to debate and the subject of ongoing research by many. See Cox (2000) and Chaudhuri, Sopher and Strand (2000).
2. We actually had 15 students in the class while the experiment requires an even number of subjects. So after explaining the instructions we announced that we needed one student to sit out this particular experiment. In return we offered a fixed amount of extra-credit points. We started the bidding at 50 points fully expecting to have to go higher than that for a student to accept our offer to opt out. But a student immediately raised her hand. She was asked very specifically and more than once, if she was sure she wanted to opt out for 50 points, i.e. she would be awarded 50 points but would not take part in the experiment and forego whatever she could have earned there. She replied emphatically each time that she understood the offer and was willing to exclude herself for 50 points. We then proceeded with the remaining 14 students.

3. The original Berg et al (1995) experiment followed a complex double-blind procedure where even the experimenter was unaware of which subject made which decision. However introducing double-blind procedures in this classroom experiment will make things quite complicated and increase the duration of the experiment. Also, it is debatable whether a double-blind procedure is absolutely essential. Bolton, Katok and Zwick (1998) comment “We find no basis for the anonymity hypothesis...” referring to double-blind procedures. (The anonymity hypothesis posits that the fact that the experimenter can see subject choices, leads subjects to behave differently than if the experimenter could not). Roth (1995, pp. 301) comments “...there is no evidence to the effect that observation by the experimenter inhibits player 1 in ultimatum games, nor that it is the cause of extreme demands in dictator and impunity games.”
4. This parsimonious behavior may reflect the fact that the students had just gone through my lecture on sequential games and backward induction the previous week and the material was still fresh in their mind. As a result their behavior is more in accordance with the game theoretic prediction than that of the average experimental subject who are recruited from widely divergent backgrounds as was the case in Berg et al’s experiment.

Appendix

Instructions:

There are two rounds to this experiment.

In the first round every player is a SENDER. To start with each of you have 50 points. You are free to take the entire 50 points. Or if you wish you could split the 50 points with an anonymous RECEIVER that you are paired with. You will not know the identity of

this player that you are paired with. The anonymous RECEIVER that you are paired with is someone in another room.

Any amount of points that you offer to the anonymous RECEIVER, however, will be **tripled** by the experimenter and given to the RECEIVER. That player then can take all the points offered to him or he can decide to send some back to you, the SENDER. Any amount sent back by the Receiver, however, will not be tripled.

Please take a look at the RECORD SHEET on Page 2 now to understand how you will send and receive money. In Round 1 you are the SENDER. When asked to do so, please fill out the Boxes B and C on the Record Sheet on Page 2 only. Box A should have the number 50 written in it already.

In the second round everyone is a RECEIVER. You will RECEIVE a split from an anonymous SENDER. You will be told how an anonymous SENDER offered to split 50 points. This person that you are paired with be in the other room and his identity will not be revealed. Now you have to decide if (1) you wish to take the entire amount sent to you or (2) whether to send anything back to the anonymous SENDER who proposed the split to you. The experimenter will fill in the amount you have been offered by the anonymous Sender. This will be done by filling in box D on the Record Sheet. This box will show how much you have been offered as the Receiver. When asked to do so, please fill out Boxes E and F on the Record Sheet on Page 2. **After you fill in boxes E and F, please copy the information from Boxes D-F on Page 2 onto Boxes G-I on Page 3 for record keeping purposes.** This makes it easier for you to calculate your earnings for this part of the experiment.

NB: You will not be paired with the same person in both rounds. You will be paired with one person the first time around and then with a different person the second time around. To clarify ideas let us say that you are subject #1. Then you may be SENDING a split of \$5 to subject #2 while RECEIVING a split from subject #5. None of you know who you are paired with at any point. Only the experimenter knows that information.

RECORD SHEET

SUBJECT ID # _____

ROUND #1: YOU ARE THE SENDER NOW. PLEASE FILL OUT THE TOP PART

A	Starting Amount	
B	Amount you wish to KEEP	
C	Amount you wish to SEND (A – B)	

SENDER: You will get the bottom part back after the RECEIVER you are paired with has made his decision

SENDER DO NOT WRITE BELOW

RECEIVER – FILL IN THE BOXES BELOW WHEN ASKED TO DO SO

RECEIVER: Please make a note of the amount you have been offered, the amount you wish to keep and the amount you wish to send back on the next page in Boxes G, H and I. This makes record keeping easier

D	Amount you have been sent (3 times amount in Box C)	
E	Amount you wish to KEEP	
F	Amount you wish to SEND BACK (D – E)	

RECORD SHEET

SUBJECT ID # _____

ROUND #2: YOU ARE THE RECEIVER NOW:

Copy the information in Boxes D, E and F about the offer made to you, how much you wish to keep and how much you wish to send back below for record keeping purposes

G	Amount you have been sent (3 times C)	
H	Amount you wish to KEEP	
I	Amount you wish to SEND BACK (D – E)	

THIS PART IS FOR THE EXPERIMENTER'S USE – DO NOT WRITE BELOW!

Amount kept as SENDER in Round 1 (Enter the amount from Box B on previous page)	
Amount sent back by receiver in Round 2 (Enter the amount from Box F on previous page)	
Amount kept as RECEIVER in Round 2 (Enter the amount from Box H above)	
TOTAL (Boxes B + F + H)	

Figure 1

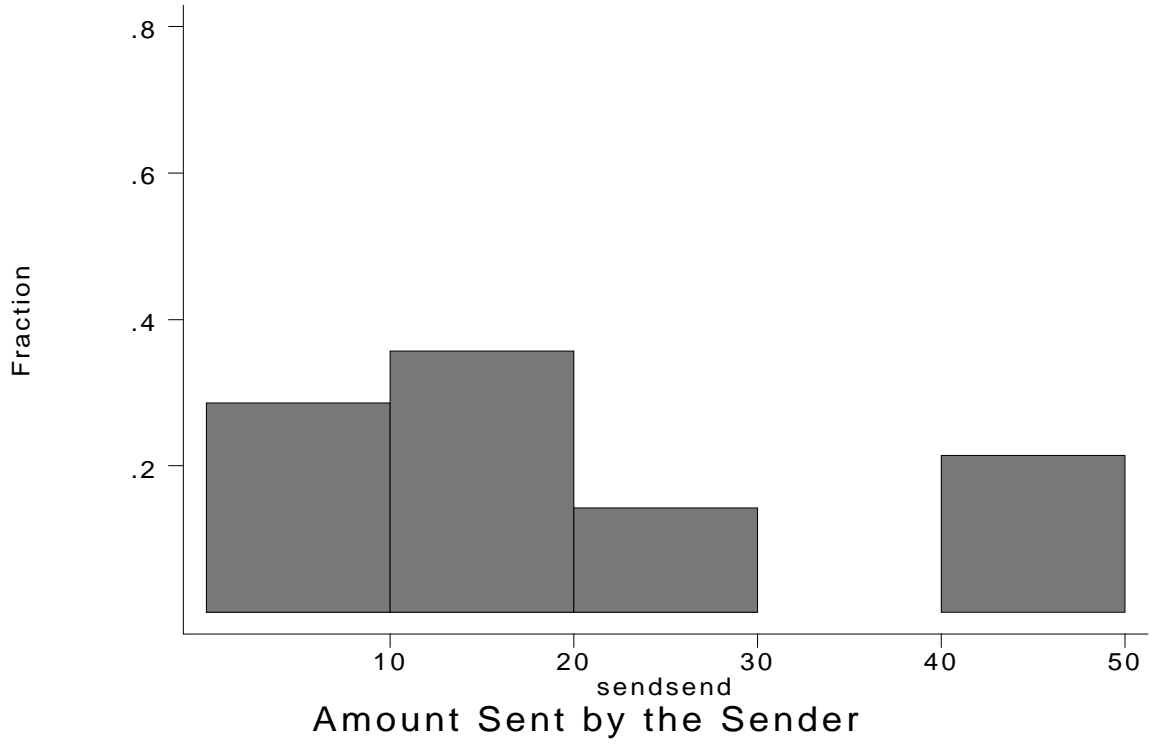


Figure 2

