Classroom

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A Simple Investment Game Experiment for the Classroom

*Ananish Chaudhuri**

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. In a slight deviation from the original design we allow each subject to play both as a Sender as well as a Receiver.

Introduction

The Investment Game, first proposed by Berg, Dickhaut and McCabe (1995), provides an excellent way of 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 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 in the first place. 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 documenting behavior that deviates from the game theoretic prediction.

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 was 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

[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 research by many. See Cox (2000) for one.

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 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.

Room A Sender	**Room B Receiver**	**Room B Sender**	**Room A Receiver**
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

[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 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 complicate things 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. 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."

Subject #8 is also told (since this sheet will go back to subject #1, the Sender) to copy the information from 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.

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 sent by the Senders to the Receivers.

In order to look at Receiver decisions we need to look at percentages since Receivers receive different amounts. On average Receivers get 57 points (3 times 19) and out of those they keep 40 points (70%) of the amount they receive and send back 17 points (30%). Figure 2 shows the distribution of the amounts sent back by the Receivers. Note that no Receiver sent back more than 50% of the amount that she received.

Figure 1

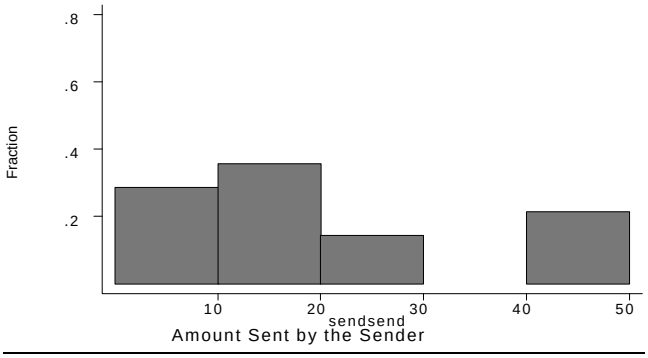
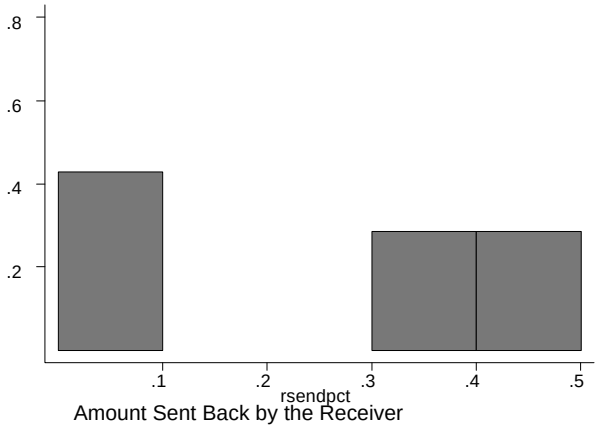


Figure 2



Since each subject plays both as a Sender and a Receiver, 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 in 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 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.

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.

[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.

References:

Berg, Joyce, John Dickhaut and Kevin McCabe (1995), "Trust, Reciprocity and Social History", *Games and Economic Behavior*, 10, pp. 122-42.

Bolton, Gary, Elena Katok and Rami Zwick (1998), "Dictator Game Giving: Rules of Fairness versus Acts of Kindness", *International Journal of Game Theory*, 27, pp. 269-99.

Cox, James (2000), "Trust and Reciprocity: Implications of Game Triads and Social Contexts", Mimeo, University of Arizona.

Roth, Alvin (1995),"Bargaining Experiments", Ch. 4 in John Kagel and Alvin Roth (eds), "Handbook of Experimental Economics", Princeton University Press, Princeton, NJ.

Stodder, James (1998), "Experimental Moralities: Ethics in Classroom Experiments", *Journal of Economic Education*, Spring 1998, pp. 127-138.

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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)	

Representative Templates and Methodology for Stodder's Comparative Advantage Experiments

*Paul M. Mason**

Introduction

A few years ago I read "A Simple Experiment of Comparative Advantage" by Jim Stodder, in Volume 3, Number 1 (Spring, 1994) at this site. Since I actively search out and also design experiments that I can use in my classes, Stodder's brief discourse motivated me to develop similar experiments for my principles of microeconomics classes. The experiments discussed here operationalize Stodder's experiment in both linear and non-linear forms, with emphasis on identifying how both countries can improve their positions through trade.

The Methodology

This experiment is designed to introduce students to the ramifications of comparative advantage theory after the completion of a discussion of the basics of production possibility analysis. Generally, a thorough discussion of both linear and concave production possibility curves is necessary to prepare the students to undertake this task. The students are notified that they will be conducting an experiment from which effective partners can generate extra credit for each or one of them (typically one point on their final exam). However, they must both protect their own self-interest as well as maximizing joint benefit.

At the beginning of the class period in which the experiment takes place, I split the class into two lines starting from opposite sides of the room. They then approach the front to form pairs, one from each line, to become either the Mexican trade representative or the trade representative of the United States – their choice. The purpose of this procedure is to pair them with someone they are unlikely to know, which assists them in performing their country representative role better, and also introduces them to a classmate. I tell them that they may use the textbook, that they may want to look elsewhere in the book than the chapter we covered last, and that I will circulate to answer questions while they negotiate. Before setting them loose I discuss the implications of trade versus autarky.

After the pair of students decide who will represent each country, they must construct the production possibility curves for each country and discuss the most desirable pre-trade combination of the two goods (trucks and computers). Thereafter, they are told to discuss trading ratios that would be fair to both countries and yet make both countries able to access more of both goods. Encouraging the students to write out the production possibility tables as well as drawing the graphs helps them decide how to proceed.

You will notice in Handout 1 that the production possibilities relationships are designed strategically such that the internal exchange values of trucks for computers in the United States is 1C = 1T while for Mexico it is 1C = 3T. Once the pairs discover this trade-off, they naturally gravitate to assuming a 1C = 2T mutually beneficial trading ratio.

Thereafter, following the template in Handout 1 they need to determine how many of each to produce in each country to maximize the total available and to determine how many to trade to their partner (counterpart). Those that are astute enough to determine the trading terms generally proceed quickly to the realization that specialization by Mexico in trucks maximizes total production, but the U.S. production can combine any combination of computers and trucks that satisfied the most desired outcome. As the theory implies, Handout 1 dictates. However, routinely, only about 10 – 15% of the trading pairs arrive at one of the right answers. I generally collect the forms from all those pairs who think that they have any chance of having arrived at a right answer, and grade them right away since the correct answers are so obvious. In some pairs only one member gets extra credit while the other does not when they arrive at the proper specialization but with the rewarded

representative negotiating more favorable terms. However, most often the fair terms of trade result, and both or neither get credit.

Either at the end of the class period in which Handout 1 is employed, or at the beginning of the following class, I go over the results. I also post representative results on my website that can be downloaded and kept. I emphasize why Mexico should specialize, why it is not necessary for the U.S. to also do so, why trade is beneficial, and that the results are at least partially the result of the linear production possibility properties.

Thereafter, I form new pairs of trading partners (separating both those who achieved one of the correct solutions to Handout 1, and those who could not), and distribute Handout 2. Following the theory, complete specialization by either party is not necessary in this example, but movement towards specialization by both is most desirable. The students soon recognize that the trading terms are not nearly as easy to determine as in the previous experiment, and that where you start and finish determines the degree to which trade is advantageous. Those that succeeded the first time generally do again, dragging their new partner to prosperity – but not always.

The conclusion of this second experiment, which provides the same compensation, is also followed up by a discussion of the results, and another posting on my website. I emphasize that the more realistic non-linear production possibility curves make the trade negotiating process more complicated, and establishing equity in the trading process more difficult, but that trade employing comparative advantage can improve the well being of the citizens of trading partners under almost all circumstances.

Conclusions

Experiments in the principles of economics classroom both liven up the presentation and invoke considerably more interest from students who generally are in the class only because the course is required. Majors in upper division classes may not need such stimuli, but even they enjoy the diversion from lecture - discussion classes if understanding of the material is enhanced. While Stodder laid the groundwork, I hope that these templates will allow more instructors in principles of economics to adopt these experiments and expand their use. Comparative advantage is one of the most important and fundamental topics in economics, and obviously one of the most ignored in real world practices, otherwise trade would be considerably freer. Enlightening a new generation of students to this concept can only enhance the likelihood that trade advantages arise in the future.

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HANDOUT 1: Linear Production Possibility Curves

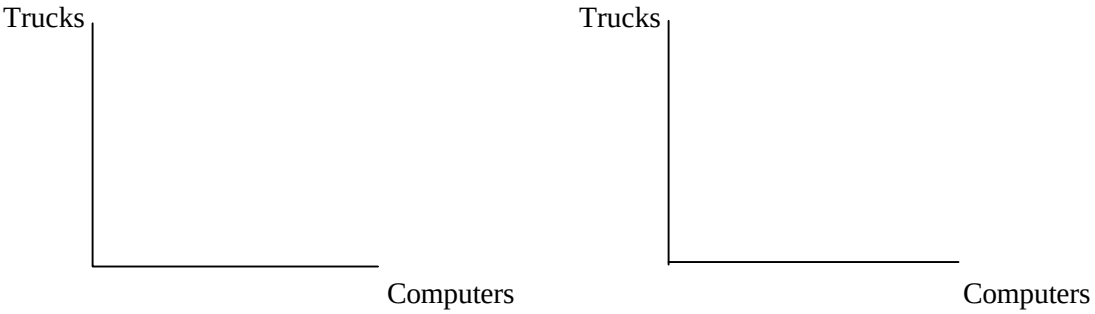
Comparative Advantage Experiment

One of you is the U.S. Trade Representative while the other is the Trade Representative for Mexico in a world that only has these two countries. You are responsible to your nation's citizens relative to optimizing their access to two goods -- trucks and computers.

_____ Is the U.S. trade representative in our world (put your name)

_____ Is the Mexican trade representative in our world (put your name)

The United States has a linear production possibilities frontier that implies maximum production of trucks and computers of 10 each. Mexico also has a linear production possibilities curve allowing for maximum production of trucks of 9 and computers of 3. Draw the corresponding curves in the graphs below.



1) Fill in your personal preferences for the combination of the two goods under autarky (no trade).
(your preferences <u>must</u> imply integer numbers of trucks and computers)

	# of trucks _____		# of trucks _____
U. S.	# of computers _____	Mexico	# of computers _____

2) Our terms of trade are _____ computers for _____ trucks

3) List the numbers of trucks and computers that should be produced by each country with trade.

	# of trucks _____		# of trucks _____
U. S.	# of computers _____	Mexico	# of computers _____

4) Fill in your personal preferences for the combination of the two goods that will be available for consumption after trade.
(your preferences <u>need not</u> imply integer numbers of trucks and computers)

	# of trucks _____		# of trucks _____
U. S.	# of computers _____	Mexico	# of computers _____

HANDOUT 2: Non-Linear Production Possibility Curves

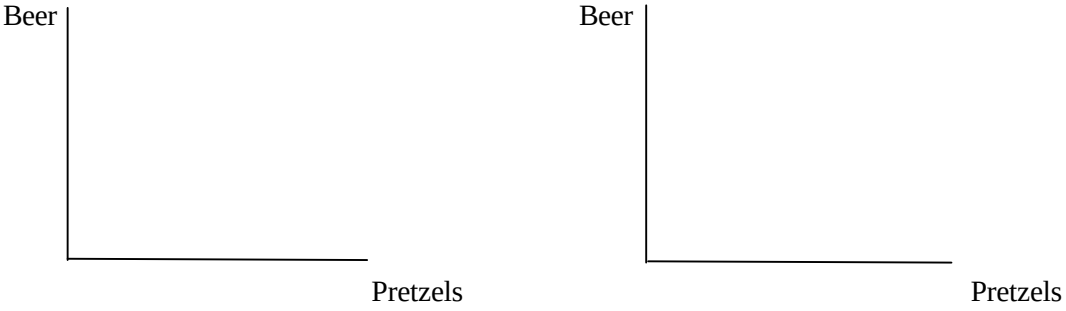
Comparative Advantage Experiment II

One of you is the U.S. Trade Representative while the other is the Trade Representative for Mexico in a world that only has these two countries. You are responsible to your nation's citizens relative to optimizing their access to two goods -- beer and pretzels.

_____ Is the U.S. trade representative in our world (put your name)

_____ Is the Mexican trade representative in our world (put your name)

The United States has a production possibilities frontier that implies production of beer of either 15, 14, 12, 9, 5, or 0, in combination of the production of pretzels of 0, 1, 2, 3, 4, or 5. Mexico has a production possibilities curve allowing for production of pretzels of 10, 9, 7, 4, or 0, corresponding to production of beer of 0,1, 2, 3, or 4. Draw the corresponding curves in the graphs below.



1) How many of each product should each country produce to maximize joint production assuming that they will trade to acquire internal preferences for the goods?

	# of beer ___or____		# of beer ___or____
U. S.	# of pretzels ___or____	Mexico	# of pretzels ___or____

2) Our terms of trade are _____ beer for _____ pretzels

3) Fill in your personal preferences for the combination of the two goods that will be available for consumption after trade.

(your preferences <u>need not</u> imply integer numbers of trucks and computers)

	# of beer _____		# of beer _____
U. S.	# of pretzels _____	Mexico	# of pretzels _____

A Production and Cost Experiment for Use in the Principles of Microeconomics

*Paul M. Mason**

Abstract

This paper presents a new, hands-on production and cost experiment that instructors can use in principles of microeconomics to introduce the fundamental concepts of revenues, production, and costs. The experiment provides an opportunity for the students to become directly involved in a production process (with incentives to maximize profits), and then facilitates the derivation of the production function and all of the standard short-run cost relationships based on data that the class generated. Students assimilate the theory more rapidly and comprehensively this way, allowing the instructor to cover these issues more effectively in preparation for their application in the market models. However, careful construction can also provide empirical exposure to quality control, innovations in production, specialization of labor, just-in-time delivery, etc. Several microeconomics experiments have been presented by others to explain supply and demand, collusion, scarcity, and monopoly behavior. This paper introduces a comprehensive new experiment to identify cost curves and production concepts similar to others available on this site and elsewhere, but more extensive in its coverage and flexibility.

Introduction

Experimental techniques can improve both attention and performance in almost all classes and particularly principles of economics classes. In addition, such innovative, interesting techniques can enhance the recruitment of economics majors both to sustain our discipline, and to increase the analytical skills of college students.

This paper seeks to add to the discipline's list of experimental techniques by delineating a production and cost experiment that has proved extremely successful in my classes.[1] As an interesting aside, I first developed and used the experiment without knowledge of similar procedures developed by Neral (1993) and Bergstrom and Miller (1997 & 2000). Naturally, the reader will have to form his/her own opinion, but I believe that my experiment is superior to those mentioned for several reasons. This exercise involves more inputs and produces more complex outputs. Consequently, student effort is more substantial in planning strategies regarding the production rounds, in completing the production tasks, and calculating the outcomes of the experiment. In addition, the greater complexity is more likely to produce the expected production and cost relationships (i.e., cost curves with the right shapes, production functions exhibiting diminishing returns). The group structure allows for management decision making, analysis of the most efficient labor and capital resources, corporate espionage, and a more competitive atmosphere. It is also valuable that the experiment can be used to lead into long run costs, and perfect competition.

The students who participated in the experiment discussed here, as well as during the other eight semesters the experiment has been employed clearly enjoyed the endeavor and learned the material quite effectively. The remainder of this paper outlines the experiment and its results, with the intent of providing sufficient detail and support materials so that other economics professors at a variety of levels can replicate it in their classrooms. Attached as an appendix to this paper are an instruction sheet for professors and a preliminary handout for students that can be provided either at the start of the experiment class period, or at the end of the previous class.

[1] For purposes of simplicity I only discuss the outcome of the experiment for one of my classes in the Spring of 1998. Each application of the experiment is somewhat different, but this particular class provided interesting and consistent results.

Popsicle Sticks, Inc.

The primary goal of this experiment is to introduce students to the production function and the various total, average, and marginal cost relationships that are normally derived after discussing consumer behavior, but before the presentation of market models. As all authors dating back to Chamberlin (1948) imply, the lecture material regarding the topic should follow the experiment, so that the students see that the expected outcomes occur even without any prior knowledge of what theory implies. As an outgrowth of the results of the experiment, the theory flows more effectively both by interrelating production and cost concepts, and by defining those terms.

Specifically, the experiment entails the creation of manufacturing units (given that 45 students who attended the day the experiment was conducted, five firms were created) to produce squares using popsicle sticks and double-sided sticky tabs.[2] Each four-stick square represents a unit of output that can be sold in the marketplace for $2. The use of a constant price, and specifying that all units can be sold at that market price, is a precursor of perfect competition—the next topic in the standard progression of the course.

The students are instructed that each member of the group that generates the largest profits from the endeavor will receive two extra points on their final exam grade as compensation.[3] This was meant to be an effective way to motivate the students to maximize their efficiency, to act competitively, and to maximize profits, which is exactly what happened.

The experiment was designed to contain 5 construction rounds with a discussion period of 15 minutes prior to the first round and approximately five minutes prior to each subsequent round. Initially only one member of each group actually produced the squares. Then, two, three, four and finally all of the group members could participate in the production process, although increasing numbers of production personnel were not required. Naturally, all members of the group participate in each round of discussion. Each round was three minutes long. As a result, the production portion of the experiment fits into a 50 minute class period.

The materials involved in the square construction were the sticks, the tabs, scissors (to cut the tabs), the workers, and desks on which to do the work. Consequently, there were 3 types of variable costs (workers, tabs, and sticks) and two fixed costs (the scissors and the desks).

The primary justification for this specific production process was simple**:** it was inexpensive to conduct. A box of 1000 popsicle sticks cost $1.99. The tabs **cost** $0.37 per package of 50, and the students were told that they could cut the tabs to dimensions of their choosing. However, the finished products had to remain square and together while being transported across the room and acceptable squares were prohibited from exposing any of the tab, otherwise they could not be sold. The entire experiment used less than five full packages of tabs, so the entire experiment cost $5.10 plus tax, in materials.

[2] Tabs, rather than glue, are recommended so that the squares remain together. Glue will not set sufficiently rapidly to allow the experiment to proceed expeditiously.

[3] Some may object to using extra credit to motivate the students to perform in the experiment. However, previous experience convinced me that without the incentive to compete against the other group or groups, the students did not execute their tasks with sufficient fervor to generate the desired outcomes. Besides, competition between firms is how markets operate, and the experiment provides a precursor of this reality. An instructor concerned about the impact of the extra credit on grades can simply replace this inducement with some small prize such as candy or food.

The students were provided with costs for each of the materials (including their labor) required for production. The specific input prices were $0.50 per pair of scissors, $1.00 per desk used, $0.10 per stick, $0.05 per corner for tabs used, and $0.40 per worker, per round for labor. These prices remained constant throughout the rounds.

To mimic quality control, five inspectors were designated to approve or disapprove the output, like Bergstrom and Miller. After the transportation of the squares, and while the next round was being discussed, the inspectors evaluated the output for quality. The inspectors were thorough (since they too had extra credit at stake) and actively rejected inferior squares.[4] The inspectors were seated next to one another so that each could see how the other inspectors were operating. This controlled the fervor of their activity. If a unit was rejected by the inspector (unsalable defective output), the firm incurred production costs without realizing any sales revenue, and profits suffered. The inspectors also served as recording secretaries. During the experiment's five rounds, only the first six columns of Table 1 were recorded. The remaining columns were reserved for the discussion during the next class period. At the beginning of the next class period, each student was provided with a hard copy of Table 1 on which to record the outcomes.

As indicated above, the longest discussion period was allowed prior to the first round since the best strategies were unfamiliar. Immediately, the students were forced to plan under considerable uncertainty. They had to choose the "best worker," decide upon the order of activity, discuss strategies for carry-overs to future rounds, and make decisions regarding how to maximize output in the time period given.

The first round results were as expected. All of the groups produced either no units or one unit. Having to switch functions—from cutting, to peeling, to pasting, to quality control, to carrying—reduced efficiency and slowed production, particularly since everything was new. Each group therefore incurred fixed costs of $1.50 for scissors and desks, but variable costs that varied from $0.40 to $1.00 worth of sticks, tabs and labor cost.

In the second round, two workers were permitted, with everything else as in round one. Thereafter, the number of workers per round was determined by the groups. Production innovations occurred, mostly associated with specialization in tasks (presumably taking advantage of the relative strengths of the group members). Each group, apparently independently, recognized the advantage of transporting production at the very end as the remaining time was counted down. A beautiful example of just-in-time delivery was therefore developed. In addition, some groups stockpiled cut tabs, since inventory costs were zero and partial production could be carried over to future rounds.[5] Others used just-in-time inventory management. Most groups eventually recognized that labor was expensive relative to the single pair of scissors, so not all group members actually produced in any group. The other rounds proceeded as expected.

In the post-experiment discussion during the next class period, key points from the experiment were outlined. First, I emphasized that this was a short-run experiment, and that some costs were fixed and some were variable. Students easily

[4] The five inspectors' names were put in a hat and one name was drawn to receive extra credit of two points. In this way they had no incentive to favor or disfavor the group they were evaluating. The five inspectors chosen were picked because they arrived late to class!

[5] Some readers of earlier versions of this paper object to the allowance of inventory carry-overs. If you are among them, do not allow carry-overs. I have found that allowing them enhances the strategic development and even improves the conformance with expected results.

TABLE 1
Experiment Template

Round	# Produced	Cost of Desks	Cost of Scissors	Cost of Sticks	Cost of Tabs	Cost of Labor	Total Fixed Costs	Total Variable Costs	TC	TR	AFC	AVC	ATC	MC	ð
1															
2															
3															
4															
5															

identified each. Second, the data for the individual groups allowed for identification of the shape of the production function. Specifically, the results illustrated the diminishing marginal productivity of labor after a period of increasing returns, and production phases and appropriate operating locations on production functions could therefore be discussed. Table 2 presents the results for one of the groups, the one I showed in class, but not the profit-maximizing group. Rather than prepare the entire figure for this group, we collectively filled in beyond the first six columns. As the class filled in each column (beginning with total fixed costs, total variable costs and total costs), the associated shapes were discussed. The non-linearities in variable and total costs were emphasized, as was the constancy of total fixed costs.

Next, the class collectively completed Table 3, which presents the results of the five rounds of the experiment for each group in aggregate (which I did in preparation for class), and all of the associated cost concepts for the aggregated data were then entered collectively. Thereafter, we considered the average and marginal cost concepts and graphs, with emphasis on how the average concepts relate to the total ones both within the experiment, and on the graphs. The discussion concluded the same way that it always did without the experiment, emphasizing the universal nature of short-run cost attributes across production processes, and indicating that we would assume that all of the firms in the market model section of the course would exhibit these cost characteristics. I was careful to conceal the revenue results until the end to keep the class in suspense regarding the winning group. The class learned that producing defective output is costly, that slow production hurts revenues, that specialization is advantageous, that worker skills differ, etc., but mostly they learned the production and cost concepts in a way that they are more likely to remember.

Conclusions

The goal of any experimental classroom technique in economics should be to involve the students directly in deriving postulated relationships. Preferably, this task should be

TABLE 2
Experiment Template

Round	# Produced	Cost of Desks	Cost of Scissors	Cost of Sticks	Cost of Tabs	Cost of Labor	Total Fixed Costs	Total Variable Costs	TC	TR	AFC	AVC	ATC	MC	ð
1	0	$1.00	$.50	$.00	$.00	$.40	$1.70	$.40	$2.10	$.00	---	---	---		$-2.10
2	1	$1.00	$.50	$.40	$.20	$.80	$1.50	$1.40	$2.90	$2.00	$1.50	$1.40	$2.90	$.80	$-0.90
3	5	$1.00	$.50	$2.00	$1.00	$1.20	$1.50	$4.20	$5.70	$8.00	$.30	$.84	$1.14	$.70	$2.30
4	9	$1.00	$.50	$3.60	$1.80	$1.60	$1.50	$7.00	$8.50	$12.00	$.17	$.78	$.95	$.70	$3.50
5	12	$1.00	$.50	$4.80	$2.40	$2.40	$1.50	$9.60	$11.10	$22.00	$.125	$.80	$0.93	$.87	$10.90

TABLE 3
Experiment Template
Aggregate Results

Round	# Produced	Cost of Desks	Cost of Scissors	Cost of Sticks	Cost of Tabs	Cost of Labor	Total Fixed Costs	Total Variable Costs	TC	TR	AFC	AVC	ATC	MC	ð
1	17	$5.00	$2.50	$6.80	$3.40	$3.60	$7.50	$13.80	$21.30	$34.00	$.44	$.81	$1.25		$12.70
2	21	$5.00	$2.50	$8.40	$4.20	$4.00	$7.50	$16.60	$24.10	$38.00	$.35	$.79	$1.14		$13.90
3	18	$5.00	$2.50	$7.20	$3.60	$2.80	$7.50	$13.60	$21.10	$26.00	$.41	$.75	$1.16		$4.90
4	27	$5.00	$2.50	$10.80	$5.40	$6.40	$7.50	$23.60	$31.10	$44.00	$.28	$.87	$1.15		$12.90
5	20	$5.00	$2.50	$8.00	$4.00	$4.00	$7.50	$16.00	$23.50	$40.00	$.38	$.80	$1.18		$16.50

completed before the students have been introduced to the theory so that it is clear that the results were not biased by *a priori* expectations or knowledge of the process. The Popsicle Stick, Inc. experiment accomplishes this task and also facilitates the discussion of the shapes of production and cost curves, and how the total and average cost concepts are related. In addition, the students are more interested in the outcomes and the interrelationships of the cost concepts since they are introduced to them through a production effort that they have participated in directly.

I can almost hear your concern that this must have taken much more time than a traditional lecture on the costs of production. However, the experiment took only two, 50 minute class periods to complete, including the post-experiment discussion.[1] Historically, without the experiment, three or more 50 minute class periods were necessary to discuss short-run costs of production, so that some efficiency gain must be attributable to the experiment. I fervently believe that because the students were personally involved in developing the relationships, they more quickly assimilated the implications of these cost concepts, requiring less reinforcement than historically has been necessary.

Ultimately, because the students were given the opportunity to engage in interactive learning, they became more involved, and were more impressed by the applicability of these basic microeconomic concepts. I recommend that professors try this experiment, as well as Holt's 1996 experiment and several others that have been outlined elsewhere (e.g., Wells (1991), Davis and Holt (1993), and Williams and Walker (1993)).

Economists face a daunting task. The students in college classes are increasingly less analytical. Further, students are more accustomed to interactive activities as the result of video games, interactive television, and computer software. Classroom presentations need to correct the former, and adapt to the latter. This experiment, and classroom experiments in general, can be effective tools for preparing students to be more productive workers. Such techniques may even motivate more students to recognize the extensive benefits to economics education. Experimental techniques require extra planning, and may limit the coverage of certain material. However, the rewards of having more motivated students, and more analytical ones, should encourage any instructor.

[1] Having time between the experiment and the discussion actually improves the process, since the instructor has time to prepare support materials regarding the results to better emphasize the outcomes. For example, a graphing program can be used to plot the output and cost relationships and to create transparency overlays to exhibit the cost curves without need for blackboard drawing. To add simultaneity to the process, the data can be entered into a computer program between classes and the curves drawn right in front of the student's eyes using computer projection technology.

References

Bergstrom, T.C. and Miller, J.H. 1997. *Experiments with Economic Principles*. New York: McGraw Hill.

Bergstrom, T.C. and Miller, J.H. 2000. *Experiments with Economic Principles, Microeconomics,2nd Edition*. New York: McGraw Hill.

Chamberlin, E. H. 1948. An Experimental Imperfect Market. *Journal of Political Economy*. LVI, No. 2. (April): 95-108.

Holt, C. A. and Davis, D. D. 1993. *Experimental Economics*. (Princeton, N.J.: Princeton University Press).

Holt, C. A. 1996. Classroom Games: Trading in a Pit Market. *Journal of Economic Perspectives*. 10, No. 1. (Winter): 193-203.

Joseph, M. L. 1965. Role Playing in Teaching Economics. *American Economic Review*. LV, No. 2. (May): 556-65.

Neral, J. 1993. Widget Production in the Classroom. *Classroom Expernomics* 2 (1): 7-8.

Smith, V. L. 1962. An Experimental Study of Competitive Market Behavior. *Journal of Political Economy*. LXX, No. 2. (April): 111-37.

Wells, D. A. 1991. Laboratory Experiments for Undergraduate Instruction in Economics. *Journal of Economic Education*. 22 (Summer): 293-300.

Williams, A.W. and J.M. Walker. 1993. Computerized Laboratory Exercises for Microeconomics Education: Three Applications Motivated by the Methodology of Experimental Economics. *Journal of Economic Education* (Fall): 291-315.

Appendix

Popsicle Sticks, Inc.: Procedures for the Professor

This experiment is designed to precede any discussion of production functions or costs of production. You should distribute the "Instructions to the Students" that appear below during the class period before you perform the experiment. That way the students can begin to think about the production process and efficiency in performing their tasks. However, the blank copy designated as Table 1 from the paper should not be distributed until after the experiment has been completed.

Materials for use in the experiment should be available in a craft store at nominal cost. The standard box of popsicle sticks should last many semesters, and double-sided tabs come in many shapes and types of packages. To reduce your costs, choose tabs that have peel off fronts and backs, but that are near the size of the width of the popsicle sticks. They are cheaper per square inch.

The number of groups employed will depend on the size of your class, but the progression discussed above assumes groups of nine (plus one inspector per group). Groups much bigger than this will become cumbersome, and smaller groups prohibit the progression outlined. However, group size can be quite flexible. Odd numbers of students could be assigned as additional inspectors, or you could separate the inspector function from the recording of results, giving the "reward" to the latter students regardless of which group maximizes its profits (for the more risk-averse students). You can also employ a timekeeper or monitors to guarantee fair practice by the groups (no cheating). Naturally, having more than five groups requires adjustments in the tables provided, and will mandate additional construction materials.

Less is more in terms of your involvement in this process. The instructions below outline what the students need to know, so your function during the experiment is to keep track of the time in the class period and to look for issues to address in the follow-up analysis.

Allot at least ten minutes prior to the first round, and up to five minutes between rounds. It will be of assistance to the students if you count down the time as it approaches the three minute limit during the construction periods. If you follow this schedule, you will be able to complete the experiment in a 50 minute class, and in a 75 minute class you can also begin to complete Table 1 beyond what the inspectors record between rounds.

Between the experiment class and the evaluation class, thoroughly review the results for conformity with microeconomic theory. You may want to graph the production and cost curves so that they can be displayed for the class, and if the capability exists, enter the results into a plot program so that the graphical presentation can be spontaneous. If your students react like mine, they will be anxious to return to class to find out who won, and also to discover how effectively the experiment delineated the microeconomic theory you were trying to teach.

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Popsicle Sticks, Inc.: Instructions to the Students

There will be five rounds of production in this experiment where each group will be producing popsicle stick squares. The squares will need to be assembled and transported to inspectors who will provide quality control. If an inspector rules that the square is defective, no revenue will be earned from that unit (although the costs will clearly be incurred).

Production Specifications:

1. The squares must be attached at all four corners with sticky tabs and be relatively square. The tabs **must not stick out** beyond the width of the popsicle sticks.

2. They must be in this condition upon arrival at the inspector's station.

3. Tabs must be cut with the scissors, not torn.

Costs of Resources:

1. Desks cost $1.00 and each group must use one and only one desk.
2. Scissors cost $0.50 per pair, and only one pair may be used.
3. The popsicle sticks cost $0.10 per stick.
4. The tabs cost $0.05 per corner regardless of the size of the tab used (however, see #1 above).
5. Labor is paid wages of $0.40 per worker, per round.

Number of Workers Per Round:

In the first round only one worker may be involved in production. In the second round two workers may participate. In the third through fifth rounds four, six, and eight workers (or the entire group -- whichever is appropriate) respectively, may participate. It is up to you to determine how to use these resources. YOU NEED NOT USE THE MAXIMUM NUMBER OF WORKERS PER ROUND.

Who Wins:

The group that generates the largest profit or smallest loss (TR - TC) wins the experiment and reaps the reward. Assume that each acceptable square can be sold for $2.00, and the market will purchase all of the squares produced by all of the groups at that price.

Revisiting Teaching Moral Hazard: Additional Class-Room Experimental Results

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Abstract

The authors previously presented results of their attempt to make moral hazard more real to beginning economics students by inducing their own demonstration of it through their behavior regarding exams. Though earlier results provided no basis to support a hypothesis of moral hazard in the exam behavior experiment, the procedure's pedagogical usefulness was noted. This paper presents the results of the authors' attempt to correct their perceived experimental design flaws and induce moral hazard with a new sample of beginning economics students. These results are analyzed, and conclusions are described in this paper.

Introduction

This paper presents an account of our further attempts to develop a moral hazard pedagogy by experiment. Drawing on an example in Arnold's principles text, (Arnold 2000, p. 721), for pedagogical purposes we seek to induce moral hazard on the part of principles of microeconomics students with respect to study effort. We do so by unexpectedly altering the grading procedures during the course, providing a guaranteed minimum grade. In essence, we unexpectedly offer students "grade insurance" at zero price.

Our initial and follow-up findings are contrary to hypothesis. We present both sets of findings and discussion that we believe may lead to results closer to expectations, and therefore improved pedagogy in the future.

Moral Hazard and Other Asymmetric Information Problems

Classroom discussion of moral hazard usually takes place within a larger discussion of the economic effects of asymmetric or incomplete information. Asymmetric information, along with non-internalized externalities and the existence of public or collective goods, is conceived of as a primary cause of market failure. Market failure exists when a particular good or service is not produced in the optimal quantity, which is the predicted perfectly competitive equilibrium quantity. To the extent that market failure occurs, society fails to reach Pareto optimality. Asymmetric information leads to market failure primarily by causing supply of or demand for a good, service, or resource to deviate from the (hypothetical) perfectly competitive supply or demand. Such information-driven deviations lead to over- or under-production.

Awareness of the existence of asymmetric information may lead to non-optimality in other ways as well. As a result of asymmetric information, parties with superior information may strategically select to participate in or abstain from a given market. This is adverse selection, as famously analyzed in George Akerlof's "lemons model" (Akerlof 1970). Additionally, moral hazard will exist when the party with superior information alters his behavior in such a way that benefits himself while imposing costs on those with inferior information (Pauly, 1974). The most common examples of moral hazard involve insurance (Pauly, 1974). The insured has far better information regarding her behavior than the insurers. After she has contracted for insurance, she can use that informational superiority to alter her behavior in a way that benefits her exclusively and "socializes" the cost among those with inferior information. For example, after purchasing health coverage, the insured may begin eating a diet higher in fat and sodium; or, after purchasing collision coverage, the insured may begin to drive faster and more carelessly.

Pedagogy of Asymmetric Information

Asymmetric information and moral hazard have become standard features of a wide variety of principles texts, including Arnold (2000), Case and Fair (1996), Gregory and Ruffin (1994), Gwartney, Stroup, and Sobel (2000), Heyne (1997), McConnell and Brue (1996), and O'Sullivan and Sheffrin (2000). The inclusion of market failure as

a substantive component of the body of economics principles creates interest in the pedagogy of moral hazard: how can instructors teach the concept in a meaningful way?

Concurrent with this trend are the trends toward experiential learning and toward general acceptance of direct economics experimentation as a method. We seek to combine these trends to develop an effective experiential, experimental pedagogy for moral hazard. Both authors teach in the business administration department of a public university with a strong teaching emphasis. Our principles of microeconomics students are overwhelmingly traditional students in business administration majors: accounting, finance, management, and marketing. Often disdaining purely theoretical modes of presentation, our students prefer results they can concretely demonstrate to themselves, and often prefer "hands-on" activities as opposed to "chalk and talk." Insofar as possible, we seek to accommodate these preferences by involving the students in an experiment regarding their study behavior for quizzes that would demonstrate the moral hazard concept.

The Experiment

Our initial experiment involved two sections of principles of microeconomics for the fall 1999 semester. Our follow-up experiment involved both sections of principles of microeconomics for the fall 2000 semester. Both syllabi listed chapter or "topics" quizzes that were weighted as four percent (fall 1999) or five percent (fall 2000) of the total course grade each, among other credit items. Identical quizzes were given in each section, in approximate succession, giving students from the separate sections limited opportunities to interact. Two of these quizzes formed the basis for our moral hazard experiment. In 1999, our first quiz covered elasticity concepts. We graded the elasticity quiz on a straight ten-point scale ("B" awarded for eighty to eighty-nine percent correct responses). The second quiz covered asymmetric information. Days prior to administering the second quiz, both instructors announced that all students would earn a minimum passing grade (low C), regardless of their actual percentage outcome on the quiz. For reasons discussed below, we altered the experiment somewhat for 2000. The first quiz covered elasticity and was graded on the ten-point scale. The second quiz covered the logic of consumer choice and carried a guaranteed minimum grade.

By guaranteeing a minimum grade, we created the situation for moral hazard, rather analogously to offering "grade point insurance" at zero price. Due to the announcement about grading with a "floor", students possessed superior information regarding their study efforts. With reduced risk of lowering their grade point average, based on the informational asymmetry, and without risk of counter-action by the instructors, students could consume more leisure and exert less effort in studying. This behavior represented "cost" to the instructor/insurers. It was expected that this would empirically result in different mean scores between the two quizzes. By hypothesis, the raw mean score for both sections would be lower on the second quiz, as students exhibit moral hazard. Though students were not informed of the experiment while it was on going, later they were apprised of the results, as a capstone to asymmetric information instruction. This fulfilled the pedagogical benefit.

Our institution and department share common and stable demographics. For both years, the institution's students were predominantly female, but the department's students exhibited more gender balance. In all cases, the heavy majority of students were native Georgian, Caucasian, traditional students. Our principles of microeconomics students tended to be sophomores with some juniors, and business administration majors.

Regarding experimental design, these sections presented the possibility of cross-sectional comparisons, in addition to or instead of time-series comparisons. We believe there is more control utilizing a strict time series approach, which compares an instructor's students only to themselves, instead of comparing students across professors. There exists an apparent trade-off of bias in experimental design. If we organized the experiment as a cross-sectional comparison, we feared creating "cross-professor bias," the difficulty arising from

comparing students who learned material under one professor with students who learned the same material under another. However, by utilizing a time series approach that compared students only with themselves, we included a variety of biases, which are discussed in the conclusion.

The Results

For 1999, the summary statistics for each quiz are presented by section in Tables 1 and 2. We tested the two sections to determine whether the sample variances between quizzes were similar (Tables 3 and 4). In both instances, we were unable to reject the hypothesis of similar variances, thus determining the next appropriate statistical test. Accordingly, our t-test results comparing the sample means across the two quizzes for section A are presented in Table 5.

Similar results for section B are presented in Table 6. We found no evidence to support a hypothesis of moral hazard. Our evidence is contrary to hypothesis. In section A, we found no statistically significant differences between the first and second quiz means. In section B, we found statistically significant differences between means; however, the second quiz mean was significantly greater than the first quiz mean.

Despite corrective efforts, our 2000 results are similarly counter-hypothetical. Summary statistics and sample variance tests for 2000 are presented in Tables 7 through 10. Our t-test results for 2000 are presented in Tables 11 and 12. In neither section were the mean scores significantly different between quizzes, again not supporting a moral hazard hypothesis.

Table 1: Section A Quiz Summary Statistics-1999

Section A	Score Q1	Percent	Score Q2	Percent
Mean:	8.763158	58.42	9.00	60.00
Median:	9	60.00	9.00	60.00
Variance:	7.591038	337.3795	7.214286	320.6349
Std. Dev.:	2.755184	18.36789	2.685942	17.90628

Table 2: Section B Quiz Summary Statistics-1999

Section B	Score Q1	Percent	Score Q2	Percent
Mean:	9.604167	64.03	10.94	72.91
Median:	9.5	63.33	11.00	73.33
Variance:	6.925089	307.7817	6.104533	271.3126
Std. Dev.:	2.631556	17.54371	2.470735	16.47157

Table 3: Section A Test for Similar Variance-1999
Section A analysis:
F-Test Two-Sample for Variances

	Quiz 1	*Quiz 2*
Mean	8.763158	9
Variance	7.591038	7.214286
Observations	38	29
Df	37	28

Table 4: Section B Test for Similar Variance-1999
Section B Analysis:
F-Test Two-Sample for Variances

	Quiz1	*Quiz 2*
Mean	9.604166667	10.93617
Variance	6.925088652	6.104533
Observations	48	47
Df	47	46
F	1.134417462	
P(F<=f) one-tail	0.334912819	
F Critical one-tail	1.629318902	

Table 5: Section A Test for Similar Mean Quiz Scores-1999

Section A analysis:

t-Test: Two-Sample Assuming Equal Variances

	Quiz 1	*Quiz 2*
Mean	8.76315789	9
Variance	7.59103841	7.21428571
Observations	38	29
Pooled Variance	7.42874494	
Hypothesized Mean Difference	0	
Df	65	
t Stat	-0.3524152	
P(T<=t) one-tail	0.36283353	
t Critical one-tail	1.66863629	
P(T<=t) two-tail	0.72566707	
t Critical two-tail	1.99713668	

Table 6: Section B Test for Similar Mean Quiz Scores-1999

Section B analysis:

t-Test: Two-Sample Assuming Equal Variances

	Quiz 1	*Quiz 2*
Mean	9.60416667	10.9361702
Variance	6.92508865	6.10453284
Observations	48	47
Pooled Variance	6.51922234	
Hypothesized Mean Difference	0	
Df	93	
t Stat	-2.5422323	
P(T<=t) one-tail	0.00633378	
t Critical one-tail	1.66140353	
P(T<=t) two-tail	0.01266757	
t Critical two-tail	1.98579983	

Table 7: Section A Quiz Summary Statistics-2000

Section A	Score Q1	Percent	Score Q2	Percent
Mean:	9.642857	64.21429	10.84615	72.23076923
Median:	10	67	11	73
Variance:	5.93956	268.489	4.474359	199.525641
Std. Dev.:	2.437121	16.38563	2.115268	14.12535455

Table 8: Section B Quiz Summary Statistics-2000

Section B	Score Q1	Percent	Score Q2	Percent
Mean:	9.27027	62.32432	10.05405	67
Median:	10	67	10	67
Variance:	10.48048	452.0586	6.552553	292.9444
Std. Dev.:	3.237357	21.26167	2.559795	17.11562

Table 9: Section A Test for Similar Variance-2000

Section A Analysis:

F-Test Two-Sample for Variances

	Quiz1	*Quiz2*
Mean	9.642857	10.84615
Variance	5.93956	4.474359
Observations	14	13
Df	13	12
F	1.327466	
P(F<=f) one-tail	0.315217	
F Critical one-tail	2.66018	

Table 10: Section B Test for Similar Variance-2000

Section B analysis:

F-Test Two-Sample for Variances

	Quiz 1	*Quiz 2*
Mean	9.27027	10.05405
Variance	10.48048	6.552553
Observations	37	37
Df	36	36
F	1.59945	
P(F<=f) one-tail	0.081821	
F Critical one-tail	1.742972	

Table 11: Section A Quiz Summary Statistics-2000

Section A Analysis:

t-Test: Two-Sample
Assuming Equal Variances

	Quiz 1	*Quiz 2*
Mean	9.642857	10.84615
Variance	5.93956	4.474359
Observations	14	13
Pooled Variance	5.236264	
Hypothesized Mean Difference	0	
df	25	
t Stat	-1.365261	
P(T<=t) one-tail	0.092166	
t Critical one-tail	1.70814	
P(T<=t) two-tail	0.184331	
t Critical two-tail	2.059537	

Table 12: Section B Quiz Summary Statistics-2000

Section B Analysis:

t-Test: Two-Sample
Assuming Equal Variances

	Score Q1	*Score Q2*
Mean	9.27027	10.05405
Variance	10.48048	6.552553
Observations	37	37
Pooled Variance	8.516517	
Hypothesized Mean Difference	0	
df	72	
t Stat	-1.155184	
P(T<=t) one-tail	0.125917	
t Critical one-tail	1.666294	
P(T<=t) two-tail	0.251834	
t Critical two-tail	1.993462	

Conclusions

Strictly speaking, we should conclude the evidence fails to support a moral hazard hypothesis. This would render the search for effective moral hazard pedagogy problematic. However, we believe continuing issues of experimental design and implementation and peculiarities in students' rates of time preference, rather than an inherent problem in the theory of moral hazard, likely explain our results. Therefore, though our results continue to be discouraging, we see the path to continued, hopefully effective, change.

Regarding our original experimental design, the following concerns came to light. It became obvious that students perceived a disparity in the difficulty of the material covered on the respective quizzes. Mastery of the elasticity material requires a greater degree of technical or mechanical competence. This more difficult material was tested first and tended to bias the initial section mean downward. Furthermore, despite instructors' efforts to conceal the experiment from students, many realized what we were attempting, thereby contaminating behavior. The quizzes were designed as chapter quizzes and were administered soon after the material was presented. Therefore a student received instruction regarding moral hazard and was promptly told that they would receive a minimum grade on the next chapter quiz. When the negative empirical results were presented in class, students' prior knowledge was one of the first objections raised. Lastly, we realized we needed to script our statements to students regarding the grading and quiz content. Post-experimental discussion with students revealed that the different sections had very different ideas about how the grade floor would work in practice, as well as different ideas regarding quiz content.

Accordingly, we amended our experimental procedure. Instead of testing students on asymmetric information, we substituted the "more difficult" material of consumer's choice for the second quiz. We chose elasticity and consumer's choice for their perceived difficulty and conceptual distinctiveness. We administered the second quiz before our initial instruction in moral hazard, and carefully scripted our statements regarding quiz coverage and the operation of the grade floor. Despite these amendments, we generated our second set of counter-hypothetical results.

Two issues of design and implementation may be over-riding the underlying moral hazard we seek to elicit. The first issue is simple math phobia. Though the mathematics of elasticity is uncomplicated, the concept is one of the most math-intensive taught in Principles classes. To the extent that students fear and loath mathematics, they may be less effective learners and quiz-takers. We may be able to mitigate this effect and highlight the possible moral hazard by offering our "grade insurance" on the elasticity quiz.

The second issue is the possibility that a form of "grade illusion" may exist, driven by students' remarkably high rates of time preference. Rather than recognizing that five percent of his grade is unchanged regardless of when it is earned, a student perceives five percent of his course grade as less important when he has fifty percent of the grade outstanding than when he has only fifteen percent outstanding. This may motivate students to study less diligently for the first quiz, swamping moral hazard. We are not implying students are irrational. Because of students' high rates of time preference, study effort this week seems much more costly than projected equal study effort three weeks away. Consequently, students "blow off" the early going, then "buckle down" as the term concludes. We may be able to control for this effect by introducing cross-sectional analysis; that is, by having professors teach the chapters in opposite order from each other. Thus, we would expect the section taught elasticity first to demonstrate larger variation between quiz means than the section taught elasticity second.

We began with one of the rarest commodities in academics: an idea that might be interesting, useful *and* fun, both for us as educators and economists, and for our students. We still believe in the pedagogical value of the experiment despite the counter-hypothetical results. Despite the "failed" outcome of these experiments, we are convinced that our students benefited by their participation. They were excited to be involved in "economics research," and gained useful analytical experience in discussing why the experiment failed. Thus, even though the experimental evidence was contrary to hypothesis, we achieved our pedagogical objective: improved student mastery of the moral hazard concept.

References

Akerlof, George A. 1970. "The Market for 'Lemons': Quality Uncertainty and the Market Mechanism." *Quarterly Journal of Economics* 84: 488-500.

Arnold, Roger A. 2000. *Economics, 5th ed*. Cincinnati: South-Western College Publishing.

Case, Karl E. and Ray C. Fair. 1996. *Principles of Economics, 4th ed*. Upper Saddle River: Prentice Hall.

Gregory, Paul R. and Roy J. Ruffin. 1994. *Economics*. New York: Harper Collins College Publishers.

Gwartney, James D., Richard L. Stroup and Russell S. Sobel. 2000. *Economics: Private and Public Choice, 9th ed*. Ft. Worth: Dryden Press.

Heyne, Paul A. 1997. *The Economic Way of Thinking, 8th ed*. Upper Saddle River: Prentice Hall.

McConnell, Campbell R. and Stanley L. Brue. 1996. *Macroeconomics, 13th ed*. New York: McGraw Hill.

O'Sullivan, Arthur and Steven M. Sheffrin. 2000. *Economics Principles and Tools, 2nd ed*. Upper Saddle River: Prentice Hall.

Pauly, Mark V. 1974. "Overinsurance and Public Provision of Insurance: The Roles of Moral Hazard and Adverse Selection." *Quarterly Journal of Economics* 88: 44-62.

**North Georgia College and State University*

A Search-Theoretic Classroom Experiment with Money[1]

*Denise Hazlett**

This classroom experiment promotes discussion of the social origins and characteristics of money. Students take the roles of traders who face a double coincidence of wants problem. As they recognize the benefits of overcoming trading frictions, students spontaneously begin using a consumption good as a medium of exchange. The setting comes from Duffy and Och's (1999) experimental version of the Kiyotaki-Wright (1989) search model of money. In the Kiyotaki-Wright (KW) environment, agents specialize in production, but consume a good other than their own product. Specialization combined with decentralized trading introduces the double coincidence of wants problem. In fact, no one could trade if each person held out for his consumption good. For trade to occur, at least some people must be willing to accept a good which they do not intend to consume, but which they hope to trade later for their consumption good. In other words, some people must be willing to accept a medium of exchange. When there exists an item generally accepted as a medium of exchange, then that item is money. Thus the KW setting captures money in its essential role as a medium of exchange. Here, using a medium of exchange reduces the cost of searching for a trading partner who has what you want and wants what you have.

The instructor does not tell students which item they should use as money, or even that they should use money at all. In fact, nothing in the instructions or the title of the experiment ("A Trading Experiment") even mentions money. Instead, students discover for themselves the usefulness of a medium of exchange. Thus the experiment works well for demonstrating what social conditions give rise to money, namely specialization and decentralization. Furthermore, the experiment demonstrates what characteristics of a commodity make it a good candidate for becoming money. Here, the commodity with the lowest storage cost naturally emerges as a generally accepted medium of exchange.

I have used this experiment twice, both times in my upper-level monetary theory course. The first time, with a class of 22 students, we spent the full period (50 minutes) on the experiment, including going over the instructions, running eight trading periods, and briefly discussing our results. The second time, with 16 students, it took 30 minutes to go over the instructions, run eight rounds and have a brief discussion. Eight rounds seemed adequate in both cases. The experiment fit well into our introductory discussion of what circumstances give rise to a role for money, and which items are likely to emerge as money. See the next section for the instructions and record-keeping sheet

Instructions for the Trading Experiment

1. You are about to participate in an experiment which will last several periods. Participants are divided into three types, called Type 1, Type 2 and Type 3. There are also three types of goods in the experiment, called Good 1, Good 2 and Good 3. Type 1 people consume only Good 1. Whenever a Type 1 person consumes Good 1, he or she automatically produces Good 2. Similarly, Type 2 people consume Good 2 and produce Good 3. Also, Type 3 people consume Good 3 and produce Good 1. Your ID tag indicates which type of person you are. There are roughly equal numbers of Types 1, 2 and 3.

2. Because you do not produce the good that you wish to consume, you will have to trade with someone else to get your good. Each period you will be randomly matched with someone else in the experiment. You and the person you are matched with will each be holding one unit of a good. You may trade the good you are holding for the good that person is holding, provided both of you are willing to trade. All trades are one for one, so you may not trade any fractions of a good. There are three possible outcomes of a meeting:

[1] Support for this work was provided by the National Science Foundation's Course, Curriculum and Laboratory Improvement Program under grant DUE-9950688.

(i) You trade for the good you consume. Then you automatically consume your good, and automatically produce the good your type produces. You store your production good until the next period.

(ii) You trade so that you receive some good which is not your consumption good. Then you store that good until the next period.

(iii) You do not trade. Then you store the good you are currently holding until the next period.

3. At the beginning of the next period, you will again be randomly matched with another participant, and you will decide whether you want to trade with that person.

4. Your objective is to get as many points as possible over the course of the experiment. Points represent the satisfaction you get from consuming your good minus the costs of storing goods. Every time you consume your good, you earn twenty points. Every time you store a good between periods, you pay a storage cost in points. The cost of storing goods between periods is: one point for storing Good 1, four points for storing Good 2, and nine points for storing Good 3.

5. Each player begins the experiment with 40 points, plus one unit of the good which he or she produces.

6. Let's consider how you earn points. Suppose that you just received in trade your consumption good. Then, you earn the net payoff given in the table below.

Type of Person	Points for consuming	Storage cost of good produced	Net points earned
1	20	Storing Good 2 costs 4	16
2	20	Storing Good 3 costs 9	11
3	20	Storing Good 1 costs 1	19

7. Recall that every period you must pay a storage cost for the good which you hold, whether you consumed that period or not. Please keep track of your points on your record-keeping sheet.

Record-Keeping Sheet for the Trading Experiment

Your Type: _____ Your name: _____

Period	Good you start with	Type of person matched with	Good that person is holding	Did you trade?	Storage cost at end of period	Did you consume? If yes, mark 20 pts	Total points
1							
2							
3							
4							
. :							
25							

Details on Matching Traders

The process of matching traders each period requires a bit of time. Using the following matching technique, I ran the experiment and a brief discussion with 16 students in 30 minutes: I put into a hat 16 slips of paper, two of which had the letter A written on them, two with B, two with C, and so forth through the letter H. Each period I had every student draw a slip. The two who drew A's were matched with each other. They met to trade in a section of the room labeled A. Similarly, the two people drawing B slips had a designated meeting place. As soon as a trader drew a letter, she went to the designated trading area for that letter, and waited for her partner to show up. Each student wore a badge that identified his or her assigned type. As soon as a pair of trading partners met, they told each other what good they were each holding. Then, they decided whether to trade. The actual decisions about whether or not to trade took very little time, compared to the process of matching traders. I suspect that a class larger than about 30 would need to use a computerized random-matching program in place of the hat technique.

Theoretical Predictions

For the utility function and storage cost given in the instructions, theory predicts a unique pure strategy Nash equilibrium. In this equilibrium, called the fundamental equilibrium, everyone's best response is always to trade for a good which is less costly to store. Thus, Good 1, as the cheapest to store, becomes a generally accepted medium of exchange. The experiment therefore demonstrates how money arises endogenously in an economy with specialization and decentralization. Furthermore, the experiment shows in a straight-forward manner the desirability of low storage costs for the medium of exchange.

However, a different storage costs and utility functions could yield a different unique pure strategy equilibrium, called the speculative equilibrium. Specifically, given a low enough cost of storing Good 3, Type 1's always trade for Good 3. They hope to use it in trade with a Type 3 person who has produced and stored Good 1. In this equilibrium, Types 2 and 3 always trade for a lower storage cost good. So, Types 2 and 3 use a fundamental strategy, whereas Type 1's use a speculative strategy.

Results

Running this experiment using the parameters described in the instructions, I found that within three periods everyone had settled on using fundamental strategies. Everyone was always willing to trade the good they were holding for a lower storage cost good. In the subsequent discussion, students reported that Good 1 spontaneously became a universally accepted medium of exchange because of its low storage cost. After the initial periods, no one was willing to accept a good for which they would have to pay a higher storage cost than that of the good they currently held. (Of course, if the good offered was their consumption good, students accepted it regardless of the storage cost. They would be consuming it immediately and paying a storage cost only on the good they subsequently produced.) Type 2 people therefore found it impossible to unload the costly-to-store Good 3's which they produced, unless they met a Type 3 person. Type 2's without the good luck to be matched with a Type 3 ended up with very small or even slightly negative profits after several periods of storing good 3. In comparison, a lucky Type 1 or 2 had 60 or 70 points by the end of the eight trading periods.

I also ran a version of this experiment using parameters that generate a speculative equilibrium. Here, the storage costs on Good 3 were low enough that Type 1's would accept Good 3 in hopes of getting matched with a Type 3 holding Good 1. The resulting speculative strategies generated a more complicated follow-up discussion. As theory predicts, the Type 1's were always willing to trade for good 3. After the initial periods, everyone else held out for a lower storage cost good, provided they couldn't get their own consumption good. So, students did note in the discussion that Good 1 served as a universally accepted medium of exchange. However, they wrestled with the role of Good 3,

because Type 1's were also willing to accept it as a medium of exchange. In some ways this discussion was productive. It allowed us to emphasize that by definition, money is a *generally accepted* medium of exchange, not merely a medium exchange accepted by a particular subgroup of society. However, I do not recommend using this version. The more complicated nature of the equilibrium seemed to make it harder for students to form an overall impression of what other traders were doing. For instance, in the follow-up discussion, many of them reported thinking that people other than Type 1's were playing speculative strategies, when they actually were not.

In fact, in computerized research experiments using versions of this set-up, Duffy and Ochs (1999) found that subjects had a pronounced tendency to play fundamental strategies. Subjects would play the fundamental strategies even given the speculative equilibrium parameters and under informational treatments meant to promote speculative play.

Questions for Discussion

The following questions could serve to start a follow-up discussion, or as the core for a laboratory report. Note that to answer Question 2, students must have access to information about all the trades in the experiment.

1. What trades were you willing to make and why? Did you have a particular trading strategy, and if so, what was it? Was your strategy effective at maximizing your total points?

2. Did any item serve as a generally accepted medium of exchange in the experiment? If so, what item was it, why were people willing to accept it, and how was the pattern of trades affected by the existence of a medium of exchange? What were the advantages having a generally accepted medium of exchange in this economy? If not, why was there no generally accepted medium of exchange?

3. What would the effect on trading strategies have been if the storage costs of all the goods had been equal?

4. Can you think of any markets where some item other than currency serves as a generally accepted medium of exchange? If so, what are the advantages and disadvantages of using this item instead of currency?

Request for Beta-Testers

This experiment is one of six designed for macroeconomics courses as part of a National Science Foundation curriculum development grant. Feedback from instructors willing to beta-test it would be most welcome. Please contact Denise Hazlett at hazlett@whitman.edu for more details.

Conclusion

This experiment demonstrates how specialization and decentralization endogenously give rise to money. Furthermore, the experiment promotes discussion of the characteristics of an item which make it a good candidate for becoming money. Here, the commodity with the lowest storage cost spontaneously emerges as a generally accepted medium of exchange.

References

Duffy, John and Jack Ochs. "Emergence of Money as a Medium of Exchange: An Experimental Study," American Economic Review, 1999, vol. 89, number 4, pp. 847-77.

Kiyotaki, Nobuhiro and Wright, Randall. "On Money as a Medium of Exchange." Journal of Political Economy, August 1989, vol. 97, number 4, pp. 927-54.

**Whitman College*

International Trade and Money: A Simple Classroom Demonstration

Robert G. Houston Jr. and Gail M. Hoyt***

Introduction

Demonstration can be a powerful strategy to incorporate active learning into the classroom (Nattiv, 1994). Along with verbal explanation, an instructor can *show* how a process occurs. The activity presented in this paper is designed to demonstrate both gains from trade and the importance of fiat money as a medium of exchange. While this is certainly not the first activity to demonstrate either concept, it does offer the instructor the opportunity to prepare one demonstration for the presentation of multiple topics.[1] This demonstration can be used in both a principles of macroeconomics or microeconomics classroom.[2] It also can be tailored in several ways to reduce the amount of time required or to emphasize a particular topic. Student learning is enhanced as students typically find this activity humorous, adding to their excitement and interest in the topic.

Setup

This experiment is typically conducted in a microeconomic principles course to introduce the topic of gains from international trade or in a macroeconomic principles course to introduce the idea of fiat money as a medium of exchange. Approximately twenty to thirty minutes are required to perform the entire experiment for a class size of thirty, but the instructor can easily tailor the demonstration to accommodate more restrictive time or content constraints. A sample of students may be used to save time or certain rounds of trade may be eliminated depending on the topics the instructor plans to emphasize. Only a few minutes outside of class are required to create a variety of tickets (see Figure 1) and a record sheet (see Figure 2). Some tickets should include events with a high level of appeal (popular music groups, popular sporting event, etc.), others should appeal to specific students (i.e. cultural events) and some should have very little appeal to anyone (i.e. unpopular TV shows or music groups).

At the start of the experiment, split the class into two subgroups representing two different countries. Send students from each country to a different part of the classroom (usually with a physical barrier, like a row of desks, between the two countries). Gender is an easy criteria for separating the class into two countries. You might call the country of males the People's Republic of Guys (PRG), and the country of females Womanzania (W). Once the class is divided into subgroups, distribute tickets to the class. The tickets should also be divided into two groups before coming to class, those that may generally appeal more to males and those that may appeal more to females. Giving females the tickets that may generally appeal more to males and visa versa will enhance the demonstration results.

An important part of conducting this particular activity is creating a realistic setting for students. Before going any further students are provided with a description of the world they find themselves in. One possible scenario is the following:

"Each of you have recently started your first job. All of you have been hired in the entertainment industry and are using your particular talents. You have been hired as accountants, promoters, camerapersons, managers, and writers to help produce different entertainment products. As part of your compensation package you have received a ticket to the event you are helping to produce."

[1] See Colander and Ortmann (1995) for another demonstration of gains from trade or Fried and Levy (1992) for a demonstration of the importance of fiat money as a medium of exchange.

[2] It can also be used in a 100 level introduction to economics. The demonstration can be referred to later in the semester without having to redo the demonstration.

Figure 1: Sample Tickets

Admit One: Dave Matthew's Band
Admit One: World Series Game 7 (Cubs vs. Red Sox)
Admit One: The Lion King on Broadway
Admit One: KY Thoroughblades Opening Night
Admit One: Garth Brooks Concert
Admit One: Shania Twain Concert
Admit One: John Michael Montgomery Concert
Admit One: Reba McEntire Concert
Admit One: 4th of July with the Boston Pops
Admit One: KY Derby (Millionaires Row)
Admit One: NWO Wrestling
Admit One: WCW Wrestling
Admit One: Aerosmith Concert
Admit One: Smashing Pumpkins Concert
Admit One: Live Taping of *Friends*
Admit One: Live Taping of the *Drew Carey Show*
Admit One: Live Taping of *This Old House*
Admit One: Live Taping of *Barney*
Admit One: Muppets on Ice
Admit One: Campbell Soup World Champions on Ice
Admit One: UK Final Four
Admit One: Super Bowl
Admit One: Rosie O'Donnell Show
Admit One: David Letterman Show
Admit One: Conan O'Brien Show
Admit One: Jay Leno Show
Admit One: Regis and Kathie Lee Show
Admit One: Daytona 500
Admit One: Indianapolis 500
Admit One: Rose Bowl
Admit One: Premier of the next Tom Cruise Movie
Admit One: Premier of the next Jim Carey Movie
Admit One: Phantom of the Opera on Broadway
Admit One: Celine Dion Concert
Admit One: Van Gogh Exhibition at the Metropolitan Museum of Art
Admit One: Tony Bennett Concert
Admit One: John Wayne Film Festival at the Kentucky Theater

A story along these lines is important to help students understand they are not being given anything, in fact they have "earned" the ticket they received because they helped produce it. This scenario of production is relatively more realistic than just saying that students have been arbitrarily endowed with their tickets.

The Trading Game

Round 1: Once tickets have been distributed to the two subgroups, ask students the following question:

"What is the most you would be willing and able to pay if you had to purchase this ticket from a scalper on the street? Keep in mind that you just started your job so the only money you have available is what you have in the bank right now."

At this time each individual student is asked what ticket they have and the amount they would be willing and able to pay to purchase the ticket. Students cannot give negative values, so the lowest value they are allowed to give for the ticket is zero. The instructor should record these monetary ticket valuations on a record sheet, (see Figure 2). Displaying these figures on an overhead projector, (see Figure 3 for example), allows students to see the recorded values. Assign one student with a calculator to total the ticket values. Calculating the total values yourself will increase the time it takes to conduct the demonstration and reduce your ability to guide discussion.

Round 2: Tell students they may trade with anyone **in their own country.** Allot a few minutes for students to trade. You will need to monitor trading activity to determine the actual time needed for a sufficient number of trades to occur. When trading is complete, students are again asked what they would be willing and able to pay for the ticket they now possess. Students who possess the same ticket they had in round one are required to report the same dollar value. Again the value is totaled and students can see that each nation has gained from trade by not

Figure 2: Overhead Worksheet

Entertainment Produced	**Round 1**	**Round 2**	**Round 3**

Womanzania	**Initial Womanzania**	**Trade with Womanzania Only**	**Final Value**	**Final Holder**
Masters				
Tom Cruise				
Dave Letterman				
This Old House				
Conan O'Brian				
Muppets on Ice				
Rosie O'Donnell				
John Wayne Festival				
WCW Wrestling				
Drew Carrie Show				
NOW Wrestling				
	Round 1 Womanzania Total:	**Round 2 Womanzania Total:**	**Round 3 Womanzania Total:**	
		Gains: $	***Gains: $***	

People's Republic of Guys	**Initial PRG**	**Trade with PRG Only**	**Final Value**	**Final Holder**
Daytona 500				
Garth Brooks				
4rth with the Pops				
Tony Bennett				
Lion King on Broadway				
UK Final Four Tickets				
Barney on Ice				
Celine Dion				
John Michael Montgomery				
Regis and Kathie Lee				
Live Friends Taping				
World Champs on Ice				
Derby Millionaires Row				
Smashing Pumpkins				
	Round 1 PRG Total:	**Round 2 PRG Total:**	***Round 3 PRG Total:***	
		Gains: $	**Gains: $**	

	Round 1 to Round 2	Round 2 to Round 3
Total Gains From Trade:		

Figure 3: Sample Worksheet

Entertainment Produced	**Round 1**	**Round 2**	**Round 3**

Womanzania	**Womanzania**	**Trade with Womanzania Only**	**Final Value**	**Final Holder**
Masters	20	40	400	PRG
Tom Cruise	300	300	***300***	***W***
Dave Letterman	40	25	40	PRG
This Old House	5	5	25	PRG
Conan O'Brian	20	20	***20***	***W***
Muppets on Ice	5	5	***5***	***W***
Rosie O'Donnell	5	30	***30***	***W***
John Wayne Festival	15	15	30	PRG
WCW Wrestling	0	25	25	PRG
Drew Carrie Show	15	15	35	PRG
NOW Wrestling	0	0	15	PRG
	Round 1 Womanzania Total:425	**Round 2 Womanzania Total:480**	***Round 3 Womanzania Total:$1015***	
		Gains: $55	***Gains: $535***	

People's Republic of Guys	**Initial Guys**	**Trade with Guys Only**	**Final Value**	**Final Holder**
Daytona 500	25	25	***50***	***W***
Garth Brooks	20	20	20	PRG
4rth with the Pops	3	5	***50***	***W***
Tony Bennett	0	0	0	PRG
Lion King on Broadway	30	20	20	PRG
UK Final Four Tickets	300	300	300	PRG
Barney on Ice	5	5	***5***	***W***
Celine Dion	0	60	60	PRG
John Michael Montgomery	20	20	20	PRG
Regis and Kathie Lee	40	40	***20***	***W***
Live Friends Taping	20	20	***20***	***W***
World Champs on Ice	0	10	***15***	***W***
Derby Millionaires Row	50	5	***500***	***W***
Smashing Pumpkins	3	40	40	PRG
	Round 1 PRG Total:516	**Round 2 PRG Total:570**	***Round 3 PRG Total:$1030***	
		Gains: $54	**Gains: $460**	

	Round 1 to Round 2	Round 2 to Round 3
Total Gains From Trade:	**$109**	**$995**

requiring individuals to consume only what he or she has produced.

Round 3: Students are given another opportunity to trade. This time the government (i.e. instructor) does not prevent international trade and rather encourages free and open trade if an individual so chooses (i.e. citizens in Womanzania can freely trade with citizens of PRG and visa versa). At this time the instructor should also remove any physical barrier (i.e. desks) that may separate the two countries. After a given amount of time students are asked to indicate the value of the ticket they now hold and those values are again recorded. After summing the new ticket values in each country, students can see that both nations have made significant gains from international trade. Emphasize that we have not increased the number of tickets or the quality of tickets produced in the world. We have only made it easier to put tickets into the hands of people who value them more highly.

It is inevitable that some students will be stuck with a ticket they do not value highly because of the inability to satisfy mutual coincidence of wants. This situation provides an opportunity to explain the historical existence of the barter system and related problems.

Round Four: Select a few tickets that you suspect are undervalued in the market. Big time sporting events are often undervalued in the barter stages of the demonstration. Allow students to make monetary bids on a few of these tickets. This is a good time to include students who were not able to participate if only a sample of students was used. A few such bids will demonstrate the constraints that mutual coincidence of wants places on trade. Students are ripe at this point for a discussion of fiat money and the function of money as a medium of exchange. Students can see that fiat money lowers the "price" of trade and as a result the "quantity of trades demanded" would increase.

Extensions and Conclusions

The value of this experiment is twofold. It can be used in macroeconomics or microeconomics courses. Also, it can be tailored to take as much or as little time as you choose. The impact it has on student learning has not been empirically estimated. However, anecdotal evidence collected from student evaluations and comments would suggest it is an effective tool for emphasizing the importance of free and open markets. Students also seem to better understand that money is only a means and not an end.

References

Fried, Harold O., and Daniel Levy. 1992. "Beans as a Medium of Exchange." *Classroom Expernomics* 1(1): 3-4.

Nattiv, Amalya. 1994. *111 Active Learning Strategies: Applications for Higher Learning*. Eastern New Mexico University: Centers for Teaching Excellence.

Ortmann, Andreas, and David C. Colander. 1995. *Experiments in Teaching and in Understanding Economics.* Richard D. Irwin Inc.

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A Classroom Game for Developing Market Demand and Demand Elasticities: The Snicker Effect

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Abstract

This simple experiment of market demand has students create their own individual demand curves based on principles of consumer choice and then has them combine to create a market demand curve. The experiment further introduces students to the various types of elasticity associated with the demand curve; price elasticity of demand, income elasticity, and cross-price elasticity. Students are asked to hypothetically "buy" from a "store" in the classroom where product price and income change throughout the different stages of the experiment. The students are grouped and develop market demand curves for various products from which elasticities are then calculated. Including a 5 minute introduction, and a 5-10 minute concluding discussion, this experiment fits into a 50 minute class period. The author has used it in her introductory microeconomics course, with class sizes ranging from 20 to 70.

Introduction

Classroom experiments give students the opportunity to grapple with everyday events in a controlled environment. The unique hands-on experience gives way to a dynamic classroom and the potential for tremendous learning based on concrete experience. Experiments stimulate students to a height that is not matched by textbook readings or lectures (Yandell, 1999a). A great deal of research has recently been concluded to determine some of the enjoyment and learning outcomes associated with experiments, particularly in the microeconomic classroom. Although the research is not definitive, experiments are generally found to be enjoyed by students more, and lead to either increased or neutral test scores as compared to the standard lecture format (Beil and Delemeester, 1999; Mullin and Sohan, 1999; Yandell, 1999b).

In their survey of 113 non-computerized classroom games for college economics Brauer and Delemeester, (2001) point out that the overwhelming number of existing experiments have been written for the principles of microeconomics course. However, they note a lack of games which use the principles of consumer choice to construct a market demand curve and only one game which includes elasticity of demand and/or supply. Brauer and Delemeester further argue that, "As fundamental as demand is to microeconomics that seems an odd omission indeed," (Brauer and Delemeester, p. 6). This experiment of market demand hopes to make some headway toward filling this void that was pointed out in the survey described above.

In this game the student is introduced to market demand and the related elasticities in a setting which is quite familiar—a grocery store. These concepts are therefore realized at a rudimentary level which leads to a fundamental understanding of these microeconomic concepts.

Description of the Experiment

The market demand experiment provides a basic introduction to market demand and the related elasticities, demonstrating price elasticity of demand, cross-price elasticity, and income elasticity. Students take the roles of hypothetical buyers of various products held for sale in a "store" in the front of the classroom. Students all have the same income and face the same prices. Outside influences cause one of the product's prices to change in the second stage of the experiment; in the third stage, the income level changes while the prices revert back to their original levels. When the students get in groups to create "market" demand curves, they internalize (and often simply realize for the first time) the idea of "market" demand as the summation of individual willingness to buy at various prices. Further, students use the newly developed "market" demand curves to experience first-hand the relative responsiveness of quantity

demanded to changes in price and income (i.e., elasticities).

At the start of class, each student is provided a copy of the "Market Demand Experiment Instructions" (see Appendix A). The instructor begins the first stage of the experiment by explaining that each student has an income of $5 and an option of buying any of the products (or any combination of the products) in the store. The students are then told that they must spend *all* of their income. The "store" (possibly a table in the front of the class) has four products (any products will work, although products that vary in desirability and that relate somehow to each other help to facilitate the experiment) and the prices are listed clearly. For example, the four products might be a 20 ounce bottle of Coke ($1), a package of Twinkies ($1), a King Size Snickers candy bar ($1) and a carton of milk ($1). The prices do not necessarily have to be the same, but keeping things simple is important. It is also fairly important to find products that are priced somewhat close in actuality to the price that you are charging (from my experience, students will simply not buy products that they perceive to be a "bad deal"). The instructor then asks the students to log their purchases on the log sheet provided for the experiment. (For the instructions and information sheet, see the next section of the paper, and also Appendix A.)

Market Demand Experiment Instructions
Situation 1

You are a consumer of goods for sale in our classroom "store". You have a total income of $5 to spend on goods. You may buy any number of the products that you desire (as long as you spend only $5) and you certainly don't have to purchase all of the products, but you must spend all of your income. The prices of the products for sale are listed below.

Write down the number of each product you decide to buy next to the product price in the "Individual Quantities" column (the "Market Quantities" column will be dealt with later).

	Individual Quantities	**Market Quantities**
Can of Coke =$1	_____	_____
Snickers Bar =$1	_____	_____
Twinkee =$1	_____	_____
Carton of Milk =$1	_____	_____

In the second stage of this experiment, an outside force changes the price of one of the products (e.g., there is a decrease in the total number of Snickers bars available in the U.S., causing supply to shift to the left and price to increase). In actuality, the instructor simply changes the price of one of the products and asks the students to provide the same information as above. For example, the price of the Coke, the package of Twinkies, and the carton of milk all remain $1, but the price of the Snickers candy bar has doubled to $2. The students are asked to log their purchases on the log sheet associated with this change in the price of one of the products (i.e., the Snickers bar).

It is necessary to state before the second stage begins that the students are wiping their slates clean (or starting over as if they hadn't previously made any of the purchases in stage 1). I often simply state that situation 2 is a "new day" to simplify matters. Students must consider purchases made in situation 2 completely independent of situation 1 due to the relationships between the products. For example, a student may wish to buy 3 Cokes and 2 Snickers bars in situation 1. If a "new day" is *not* made clear before beginning situation 2, that same student may buy 3 packages of Twinkies and 2 cartons of milk in situation 2 because she already has plenty of Snickers bars and Cokes in her possession, thus causing the student to move along her demand curve rather than creating one demand curve with various prices and quantities. The example above further emphasizes the necessity of this experiment being conducted as a hypothetical one; because there would be no way in which to "wipe a student's slate clean" if she were buying real products (partial instructions are once again listed below).

Market Demand Experiment Instructions
Situation 2- "A New Day"

Due to a peanut production catastrophe the price of Snickers Bars increases to $2, and all of the other product prices remain unchanged. Once again write down the number of each product you decide to buy next to the product price (below) allowing only for the change in the price of Snickers Bars, your income is still $5.

	Individual Quantities	**Market Quantities**
Can of Coke =$1	_____	_____
Snickers Bar =$2	_____	_____
Twinkee =$1	_____	_____
Carton of Milk =$1	_____	_____

In the third stage, the instructor starts again with all of the original prices (i.e., changes the price of the Snickers bar back to $1), and asks the students once again to wipe their slates clean. The instructor then explains that a university donor has offered more scholarship support to students, thus leading to increased income for all students. All students in the class now have $8 to spend on the products from the "store". The students log their purchases (remembering to spend all of their income) on the log sheet.

Market Demand Experiment Instructions
Situation 3 - "Another New Day"

The peanut production catastrophe gets all straightened out (i.e., the price of Snickers Bars decreases to its original market price of $1). Further, a university donor has offered more scholarship support to students, leading to increased income for all students. Once again, log your purchases next to the product price (below) remembering to spend all of your income ($8).

	Individual Quantities	**Market Quantities**
Can of Coke =$1	_____	_____
Snickers Bar =$1	_____	_____
Twinkee =$1	_____	_____
Carton of Milk =$1	_____	_____

The students then form groups of 5 or 6 (groups may be larger if necessary, larger groups simply necessitate more time to organize). Each group develops a market demand curve for the product that changed price during the second stage (i.e., the Snickers bar). Students simply sum the total purchases of that product at each price and then plot the two points. This turns out to be a significant learning experience for a large number of students. Deriving the market demand curve and actualizing ownership helps students to internalize the concept of market demand, often for the first time. Once the market demand curve is graphed according to the instruction sheet, a price elasticity of demand is then calculated.

Although students do not have much of an understanding as to what they are doing when they originally calculate elasticity of demand, these initial calculations lead to a lively dialogue and thoughtful discussion at the end of the experiment. We are able to discuss when the quantity of a product might be considered "elastic" or "responsive" to given changes in price. Invariably someone comes up with the idea that when the numerator (percentage change in quantity demanded) is greater than the denominator (percentage change in price) then certainly the product should be considered "elastic" or "responsive".

After price elasticity of demand is calculated, the various groups of students are then asked to contemplate income elasticity. Each group is asked to examine once again the market for Snickers bars. They examine the responsiveness of the quantity of Snickers bars to the given change in income. An income elasticity is calculated and the students are asked to formulate ideas about the relationship between this product and income (i.e., normal good or inferior good). Although it is extremely difficult in this type of experiment to develop a product which is an inferior good, in the discussion following the experiment it is straightforward to include a discussion of the way in which an inferior good would have behaved (i.e., the curve would have shifted to the left rather than to the right).

Finally, each group of students examines how the change in one product's price affects the quantity demanded of another product (cross-price elasticity). The group is asked to examine the responsiveness of each of the other three product's quantity to the given change in the price of the Snickers bar. A cross-price elasticity is calculated and the students formulate ideas about how the other three products are related to Snickers bars (i.e., complementary goods, substitute goods, or non-related goods).

Students seem to have the most difficulty with this part of the experiment. Students who do not read the instructions carefully will often attempt to make the two points that they find into one demand curve rather than two separate points on two separate demand curves. This problem can be alleviated if the instructor can walk around the classroom and read through the instructions *with* the groups who are having difficulty. The instructor may also remind students of their earlier practice with complements and substitutes and the shifting demand curves. When a group of students has a product with a cross-price elasticity equal to zero, it is often quite enlightening as well. Students come to a realization that not all goods are related, and those goods that are not related would have cross-price elasticities of zero.

Once the groups are finished with the above scenarios, the class as a whole should come together and talk briefly about some of the findings. This may bring to light variations in elasticities and various group findings as to whether these products are normal or inferior goods, and complements or substitutes. It may also be interesting to discuss the distinction between expectations (in terms of which types of goods might generally be thought of as complements or substitutes for example) and the actual signs of the elasticities computed by the groups.

Concluding Remarks

I usually perform this experiment after we have had the traditional two day introduction and discussion of demand and supply, and before any true elasticity "lecture". Having said this however, I have found that a brief introduction or a simple general description of elasticity in terms of responsiveness, at the beginning of the experiment is helpful to students so that they can see where the game is headed. Students also should be "reminded" of how to calculate a percentage change before the experiment begins. I have an "Economics and Math" review the first day of class during the semester, so that we don't have to take time throughout the semester to "brush up" on our math skills. Including a 5 minute introduction, and a 5-10 minute concluding discussion, this experiment can be completed in a 50 minute class period.

I have found that reading and working through the first page of the instructions *with* the class as a whole works best. Once the students split up into groups they clearly work most efficiently with minimal instructor interference. However, it is definitely important to emphasize the necessity of reading all of the instructions in a step-by-step manner.

As a final note, I would like to point out that the focus of this experiment is on the *concepts* of market demand and the associated elasticities. The elasticity calculations are purposefully simple and therefore not as accurate as they otherwise might be. The goal of this experiment is to have students walk away with a fundamental understanding of market demand and the elasticities of demand, it is not meant to teach them all of the various ways to calculate an elasticity. My experience with this experiment is that more students come away with a broader comprehension of market demand, price elasticity of demand, income elasticity, and cross-price elasticity after having experienced the experiment, than when I simply introduced the topics and had the students compute various calculations in order to "cement" the ideas.

References

Beil, Richard and Greg Delemeester. "The Double Oral Auction: Is it an Effective Teaching Tool?" Proceedings. *Economics and the Classroom Conference*, Idaho State University and Prentice-Hall Publishing Co., March 1999, pp. 12-32.

Brauer, Jurgen and Greg Delemeester. "Games Economists Play: A Survey of Noncomputerized Classroom-Games for College Economics." Journal of Economic Surveys Vol. 15, No. 2. 2001, pp. 221-236.

Mullin, David and Gerald Sohan. "Benefit Assessment of Classroom Experimental Economics." Working Paper, United States Air Force Academy, April 1999.

Yandell, Dirk. *Using Economic Experiments in the Classroom*. Upper Saddle River, New Jersey: Prentice Hall, 1999a.

Yandell, Dirk. "Effects of Integration and Classroom Experiments on Student Learning and Satisfaction." Proceedings. *Economics and the Classroom Conference*, Idaho State University and Prentice-Hall Publishing Co., March 1999b, pp. 4-11.

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Appendix A: Market Demand Experiment Instructions

Situation 1

You are a consumer of goods for sale in our classroom "store". You have a total income of $5 to spend on goods. You may buy any number of the products that you desire (as long as you spend only $5) and you certainly don't have to purchase all of the products, but you must spend all of your income. The prices of the products for sale are listed below.

Write down the number of each product you decide to buy next to the product price in the "Individual Quantities" column (the "Market Quantities" column will be dealt with later).

		Individual Quantities	**Market Quantities**
Can of Coke	= $1	_____	_____
Snickers Bar	= $1	_____	_____
Twinkee	= $1	_____	_____
Carton of Milk	= $1	_____	_____

Situation 2- "A New Day"

Due to a peanut production catastrophe the price of Snickers Bars increases to $2, and all of the other product prices remain unchanged. Once again write down the number of each product you decide to buy next to the product price (below) allowing only for the change in the price of Snickers Bars, your income is still $5.

		Individual Quantities	**Market Quantities**
Can of Coke	= $1	_____	_____
Snickers Bar	= $2	_____	_____
Twinkee	= $1	_____	_____
Carton of Milk	= $1	_____	_____

Situation 3 - "Another New Day"

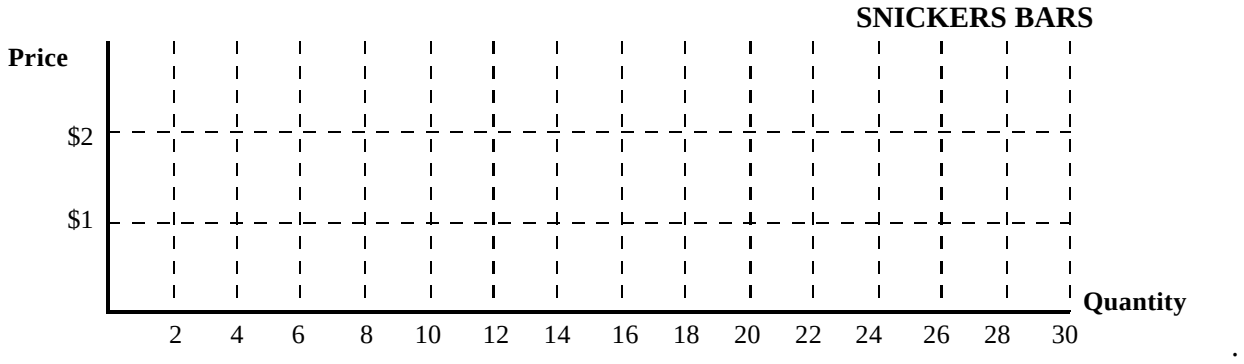
The peanut production catastrophe gets all straightened out (i.e., the price of Snickers Bars decreases to its original market price of $1). Further, a university donor has offered more scholarship support to students, leading to increased income for all. Once again, log your purchases next to the product price (below) remembering to spend all of your income ($8).

		Individual Quantities	**Market Quantities**
Can of Coke	= $1	_____	_____
Snickers Bar	= $1	_____	_____
Twinkee	= $1	_____	_____
Carton of Milk	= $1	_____	_____

As an Economist, you (yes you!) are interested in how these various factors impact the **Market Demand** for these products. Therefore, you need to develop a market demand curve. Get in a group of 5 - 8 people, and determine the "Market Quantities" for **situation 1** and **situation 2** only (simply sum the quantities demanded for each product at each price level over all individuals) and log the values in the spaces provided above. We will deal with situation 3 later.

You now have the ability to develop a demand curve for Snickers bars (remember that a market demand curve is simply the summation of individual demands at various prices).

Draw the demand curve below.



We also now have information regarding the *responsiveness* of quantity to a given change in price. This is known as "elasticity" or more specifically "price elasticity of demand" which can be computed by dividing the percentage change in quantity demanded by the percentage change in price:

$$E_d = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price}}$$

Note: A simple way to compute the percentage change in a variable is to divide the change in the value of the variable by the initial value.

Compute the price elasticity of demand for Snickers Bars.

You know that income also impacts the demand for a product. Go back and fill in the "Market Quantities" column in situation 3. Examine specifically how the market quantities of Snickers Bars changed when income increased. Graph this new point (comparing situations 1 and 3). An increase in income leads to a shift in demand (in our case since we have only one point on our new demand curve, we'll assume that it is a parallel shift). Draw the new demand curve below. We also have information regarding the *responsiveness* of quantity to a given change in income. This is known as "income elasticity" which can be computed by dividing the percentage change in quantity demanded by the percentage change in income.

$$E_I = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in income}}$$

Compute the income elasticity for Snickers Bars.

You know that when the price of one good changes, that change often affects the demand for another good (e.g., a price change in Pepsi affects the demand for Coke). Go back and look at the "Market Quantities" columns in **situation 1** and **situation 2** again. Examine specifically how the market **quantities** of the other goods changed when the **price** of Snickers Bars changed, ceteris paribus. Remember, when the price of one good changes, it causes a shift in the demand for a related good. Therefore, the two different

market quantities that you have for each product (in situation 1 and 2) are points on two *different* demand curves. You do not have any information regarding the slopes of the demand curve, you simply need to draw them with some kind of a negative slope.

This specifically gives us information regarding the *responsiveness* of quantity of one product to a given price change in a related product. This is known as "cross-price elasticity of demand" which can be computed by dividing the percentage change in quantity demanded of one good (X, or in our case one of the other products) by the percentage change in the price of a related good (Y, or in our case Snickers Bars).

$$E_{xy} = \frac{\text{Percentage change in quantity demanded of X}}{\text{Percentage change in price of Y}}$$

Compute the cross-price elasticity of demand for the other goods, and draw the appropriate curves on the graphs below.