A Classroom Experiment Illustrating the Law of Demand*

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Abstract

This paper describes a classroom experiment in which participants are engaged in making trading decisions. Students are provided an endowment of gum and are asked to make trading decisions for chocolate. As the opportunity cost of acquiring a piece of chocolate rises, fewer students are willing to make trades. This interactive classroom exercise provides students with a mental image of a fundamental economic concept - the law of demand.

1   Introduction

A fundamental economic concept presented in an introductory economics class is the law of demand - the quantity demanded of a good falls when the price of the good rises. Put more simply, people buy less when the price rises. Graphically this is represented as a downward sloping demand curve with price and quantity on the axes. Students are frequently bewildered by graphs, not understanding why economists draw downward sloping demand curves and upward sloping supply curves. The objective of this classroom exercise is to have students discover the demand curve themselves, and hence provide them with some intuition as to why economist's draw demand curves with negative slopes. This activity also may be used to initiate a discussion of two principles of individual decision making - (1) people face trade-offs and (2) the cost of something is what you give up to get it.[1]

The purpose of this paper is to describe an easy to implement and entertaining classroom activity that provides students with a mental image of a fundamental economic concept - the law of demand. The next section describes the experimental procedures and preparation needed to conduct this classroom activity. This is followed by the class discussion section which provides some suggestions to the instructor for explaining the observed trading data and what the student should learn from this exercise. The fourth section presents results from an assessment quiz which measures the effectiveness of the classroom experiment on student learning for both undergraduates and elementary school students. The assessment results indicate that this classroom activity is an effective way to teach the law of demand and opportunity costs concepts. The final section provides some additional resources for instructors interested in learning more about classroom experiments.

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[1] For a detailed discussion of tradeoffs and opportunity costs see Mankiw (2008).

2 Procedures

This exercise involves every student in the class. It has been conducted in classes ranging in size from 19 to 64 students. A limited amount of preparation must be done prior to the start of class. Each student in the class receives a small bag containing an endowment of five pieces of individually wrapped bubble gum along with five small pieces of paper. After each student has received a single bag provide two instructions: "Do not eat the gum" and "The contents of the bag are yours to keep. You may trade the gum if you wish. You do not have to trade."

Next, show the class a large bag of various snack-size chocolate candy (e.g., Snickers, Milky Way, 3 Musketeers, M&M's etc.). In case every student opts to make a trade, the instructor needs to have at least as many pieces of chocolate as there are students in the class. Students are instructed that there will be five rounds of hypothetical trades where the student can trade gum for chocolate, followed by a sixth round of actual trading. At the conclusion of trading, data from the hypothetical trades are presented and discussed with the class.

To start the activity, announce the following hypothetical trade proposal: "Would you be willing to trade a piece of gum for a piece of chocolate - an even swap?" Any student who is willing to make this hypothetical trade writes "yes" on a piece of paper or "no" if they do not want to trade. Students are restricted to making a single trade. Many students will be eager to agree to this trade since they have a large inventory of gum (five pieces) and no chocolate. In larger classes the instructor may need to recruit a student volunteer to assist in collecting and counting the number of "yes" votes. I opt to use paper ballots for compiling trading data rather than having students raise their hands for two reasons. First, I want students to make independent decisions while remaining anonymous and hence avoiding peer influences. Second, the paper ballot forces students to make a decision, "yes" or "no", compared to raising hands as

some students may opt to not raise their hand in either situation.[2]

While a volunteer is counting the number of "yes" votes, this is an excellent time to introduce the economic concept that people face trade-offs when making decisions. In our situation, the student must give up something that they like (gum) to get something else (chocolate). This concept is best summarized by the familiar adage: "there is no free-lunch". At the conclusion of the first round, the instructor records on the board the number of individuals who were willing to trade a piece of gum for a chocolate candy.

To start the second round, announce to the class the following trading proposal: "Would you be willing to trade two pieces of gum for a piece of chocolate?" Again, students record their decisions on a paper ballot with a "yes" or "no". While the votes are being tallied by a student volunteer, the instructor can introduce a second economic concept of opportunity costs or the cost of something is what you give up to get it. To illustrate this concept, ask the students to recall from round one, when they could trade a piece of gum for a piece of chocolate, "What was the opportunity cost of a piece of chocolate?" Most students will recognize that the answer is a piece of gum. Then ask "What is the opportunity cost of a piece of chocolate in the second round?" A majority of students will realize that the opportunity cost of chocolate has risen to two pieces of gum. At the conclusion of the second round of trading, the number of trades are again recorded on the board. Hopefully, students are rational decision makers and there are fewer trades made in the second round.

The third, fourth, and fifth round are conducted in similar fashion with the price of chocolate rising to three, four, and five pieces of gum, respectively. In each subsequent period there should be a declining (or possibly equivalent) number of trades. Again, it is worth pointing out that

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[2]Note, that an instructor could easily incorporate the clicker technology instead of using paper ballots to determine the number of trades each round.

students cannot get more of both chocolate and gum, hence this exercise illustrates the concept of trade-offs. I continue to ask at the conclusion of each trading period: "What is the opportunity cost of a piece of chocolate." In addition, once students have mastered the opportunity cost concept, I ask a related question: "What is the opportunity cost of a piece of gum?" Typically, only a few students will realize that the answer is the inverse and hence is expressed as a fraction.

The sixth and final round involves actual trading. The instructor rolls a six-sided die. The number that appears on the die indicates the trading rate of gum for chocolate (if a six appears, then roll again). For example, suppose that a "three" appears. Any student who is willing to trade three pieces of gum to obtain a piece of chocolate can do so with the instructor. After all students have made trades with the instructor, students are now permitted to eat the candy. This is an ideal time to begin a class discussion about the data collected.

3   Class Discussion

The instructor should dedicate at least fifteen minutes to discuss the results of the classroom experiment. I typically begin the discussion by asking a simple question, "What happens to the number of people willing to trade as the price of chocolate rises?" Most students are quick to respond that fewer people want to trade at higher prices. The important thing in the discussion is let the students figure out that people respond to higher prices by buying less. Tell the students that they have just discovered what economists term the "Law of Demand," and that this trading activity has shown that this class obeys the law of demand for chocolate.

Next, I plot the trading data collected on the board and connect the dots. I put price (pieces of gum per chocolate) on the y-axis and quantity (trades) on the x-axis. Figure 1 is representative of a typical trading sequence for five rounds.[3] In these data, nearly every student 24 of 26 was

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[3]These data are from a classroom of 4th graders at Wintergreen Intermediate School, Greenville, NC in Spring

willing to trade a single piece of gum for a piece of chocolate. After the price doubled to two pieces of gum for a chocolate only three fewer students were deterred by the higher price. Two more students were unwilling to make trades at a price of three pieces of gum for a chocolate. The largest response came when the price rose to four gums per chocolate as only 12 of the 26 students were willing to make this trade. The point of figure 1 is the downward sloping demand curve for chocolate, which illustrates the inverse relationship between price and quantity.

(Place Figure 1 about here)

I also compare the actual trading data from the classroom exercise with the textbook which shows a downward sloping linear demand curve. Teaching points that can be discussed here include mentioning that economic theory predicts a downward sloping demand curve. While few students were aware of the Law of Demand, prior to this exercise, their behavior and trading decisions are consistent with this economic theory. A second point worth noting includes the observation that actual demand curves for chocolate in these classroom exercises are rarely smooth (like it appears in the textbook). On the other hand, there are more similarities than differences between the textbook demand curve and the classroom's demand for chocolate as both have negative slopes and their overall shapes appear similar.

My experience indicates that students enjoy this exercise and it is effective in providing some intuition for downward sloping demand curves. This exercise works great for the initial class meeting for a microeconomics course or it can be used later in the semester to introduce demand. I have also conducted this classroom exercise for elementary school students. I have found that younger students also enjoy and can comprehend the fundamental economic concepts of the law

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2010. One advantage of this classroom activity is that it can be run in any class ranging from elementary school to undergraduate economics courses.

of demand and opportunity costs.

4   Assessment

To determine whether this demand exercise was effective in teaching the law of demand and the opportunity cost concepts, I administered an assessment quiz to both undergraduates and elementary school students (see Appendix for assessment questions). These assessment questions were given to East Carolina University principles of microeconomics students at the start and end of the semester to provide a benchmark for a before and after comparison of their understanding of the law of demand. For each of the four questions, a two-sample Wilcoxon rank-sum test rejects the hypothesis that the before and after undergraduate test scores have equivalent distributions.[4] Hence we conclude that undergraduates had a better understanding of the demand and opportunity cost concepts at the end of the course compared to the beginning.

The assessment quiz was given to elementary students two days after their exposure to the classroom experiment (we did not administer a "before" quiz). I found that elementary school students had a surprisingly good understanding of demand and opportunity costs two days after the classroom experiment. Four-fifths of fourth graders and nearly three-fourths of second grades knew the definition of the "Law of Demand" two days after this classroom exercise was conducted. We note that these correct response rates nearly match those of undergraduate economics students at East Carolina University (83% correct) on the initial class meeting. This result is remarkable for the second graders since some of these students were unable to read the questions, hence the teacher read the questions aloud.

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[4]It is worth noting that in addition to this classroom experiment, principles of microeconomics students also received traditional lectures on demand and opportunity costs. Therefore, we cannot distinguish which part of the higher test scores are attributed to the experiment and which part are due to the lecture.

The second assessment question asks students to identify the typical shape of a demand curve. At the end of the semester, seven of eight undergraduates correctly identified the downward sloping curve. Nearly three-fourths of fourth grades and four-fifths of second graders correctly identified the graphical representation of a typical demand curve. To put these elementary schools scores in perspective, we note that these elementary school students are more likely to correctly identify a typical demand curve on a graph then an introductory economics undergraduate on the first class of the semester. Almost every undergraduate (95%) understood the concept of opportunity cost of chocolate when a person is willing to trade two pieces of gum for another piece of chocolate. A majority of fourth graders (76%) and second graders (57%) also correctly determined the opportunity cost of a piece of chocolate candy.

The final assessment question asks students to determine the opportunity cost of a piece of gum, given a person is willing to trade two pieces of gum for a chocolate. The correct answer is a fraction (one-half). While seven-eights of the undergraduates answered the final question correctly, fractions posed problems for the elementary students as only about one-third of second and fourth graders provided the correct answer. In sum, it appears that both undergraduates and elementary school students can learn from this classroom demand activity.

5   Further Reading

I am not aware of any classroom experiments that illustrate the "Law of Demand". For instructors who seek a classroom experiment that includes both demand and supply functions, an excellent illustration of discovery of equilibrium prices and quantities is provided by Holt's (1996) pit market trading exercise. Previous research has found that classroom experiments are

effective tools for teaching economics (Dickie 2006; Emerson and Taylor, 2004; Holt 1999; Frank 1997) and in-class experiments increase students' interactions with others in the course (Emerson and Carter, 2011).

References

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Table 1: Assessment Results: Do students understand the "Law of Demand"?

Assessment Question	Undergraduates		4th graders	2nd graders
	Before	After		
Q1. Define the "Law of Demand"	82.9%	97.6%**	80.0%	72.9%
Q2. Identify demand curve on graph	56.1%	87.8%***	73.3%	79.2%
Q3. Opportunity cost of chocolate	78.0%	95.1%**	75.6%	57.0%
Q4. Opportunity cost of gum (fraction)	70.7%	87.8%*	35.6%	36.7%
Observations	41	41	45	64

Notes: A two-sample Wilcoxon rank-sum test rejects the hypothesis that the before and after test scores have equivalent distributions at the 1% (***), 5% (**), and 10% (*) level. See appendix for assessment questions. The assessment questions were administered on the first day (before) and final exam (after) for undergraduate students in principles of economics at East Carolina University, Spring 2010. Assessment questions were given to Wintergreen Primary and Intermediate students (Greenville, NC), two days after conducting the classroom activity in Spring 2010.
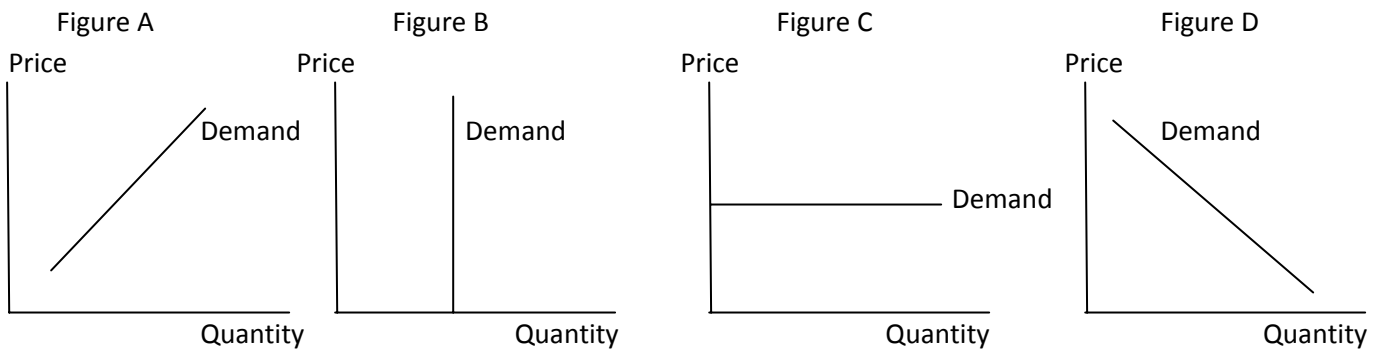
Figure 1: Data from a Classroom Demand Activity

(Wintergreen Intermediate, 4th grade - Spring 2010)
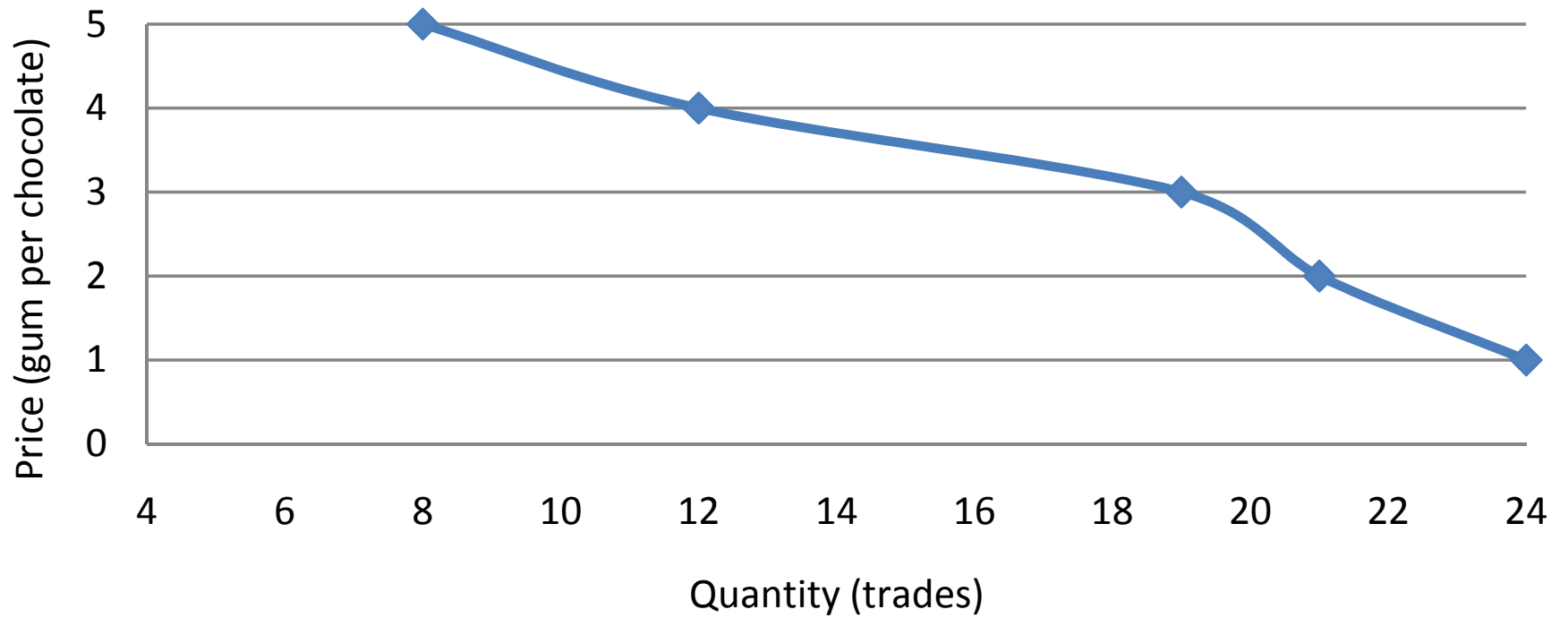
Appendix: Law of Demand Assessment Questions

1. What does the "Law of Demand" say:
    a. As the price increases, consumers buy more.
    b. As the price increases, consumers buy the same amount.
    c. As the price increases, consumers buy less.
    d. There is no relationship between price and how much consumers buy.

2. Which of the pictures below depicts a typical demand curve?
    a. Figure A
    b. Figure B
    c. Figure C
    d. Figure D

Figure A	Figure B	Figure C	Figure D
Price	Price	Price	Price
Demand	Demand	Demand	Demand
Quantity	Quantity	Quantity	Quantity

3. If a student is willing to trade 2 pieces of gum for 1 piece of chocolate, what is the opportunity cost of a piece of chocolate?

    a. 1 piece of gum

    b. 2 pieces of gum

    c. ½ of a piece of gum

    d. 3 pieces of gum

4. If a student is willing to trade 2 pieces of gum for 1 piece of chocolate, what is the opportunity cost of a piece of gum?

    a. 1 piece of chocolate

    b. 2 pieces of chocolate

    c. ½ of a piece of chocolate

    d. 3 pieces of chocolate