New Insights from In-Class Experiments: Using Excel to Post and Analyze Results On the Spot

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Classroom experiments have been used to achieve a variety of pedagogical objectives. They allow students to observe results of the interactions of their and their classmates' own decisions in a controlled environment. They gain insights into markets and other economic phenomena by observing and analyzing the results of these decisions. In discussing the double auction experiment, Hazlett (2005) says even students who have had a course in economics gain "a fresh perspective on the supply and demand tools they have seen before." Even I, an instructor who has taught supply and demand many times, gained new insights into the market clearing process and the gains from trade by conducting and analyzing this experiment with my class.

I first started using experiments in my Introduction to Economics class after the first TIP Workshop in May 2005. Student response has been enthusiastic from the beginning, and their feedback indicated that they were gaining more than just a break in the routine. As I played with ways of recording and analyzing the results, trying to maximize the value added from the experience, I discovered that even I was gaining insights into the workings of markets that I had never thought of before. This presentation is an attempt to share a simple technique for demonstrating the potential efficiency gains from markets, and a request for feedback from others on ways to improve its effectiveness.

Let me begin with some background on how I teach the course. I introduce economics with a concise restatement of the standard textbook definition: *Economics is the study of how we make the best of what we have*. Of course I discuss "allocating scarce resources," but my emphasis is on the pervasiveness of economics in our lives, and I remind students of this definition throughout the course. Every action we take, from the decision to get out of bed when the alarm goes off, is an economic choice, where we "make the best" of our opportunities by weighing the benefits and costs of the action. "What value will I get out of this? What will I have to give up?"

Early in the semester I conduct an auction in class, where students submit bids, in writing, for an inexpensive item (usually a food item appropriate for the time of day). (Thanks to Michael Salemi for this idea.) The auction forces them to think about the maximum amount they would be willing to pay, a reservation price. I then use the data to construct a demand curve. We also discuss the reservation price of suppliers, the opportunity cost to the supplier of each unit offered for sale. My purpose in this is to establish the "other" interpretation of demand and supply: textbooks emphasize that demand reveals the quantity buyers will buy at each price, but I want students to recognize that it also reveals the value somebody puts on each unit. When we do the double oral auction experiment I use this interpretation to show that as markets converge to equilibrium, the value that participants get out of exchange is maximized.

I devised a simple technique for displaying the results of trades using the classroom projector and entering the trades into Excel as they are reported. Simple descriptive results like the average price can then be immediately computed. By entering some data in advance it is also possible to quickly calculate and display gains from trade. Parker (1995) suggests that the follow-up analysis of the experiment include a discussion of the "efficiency of the experimental market as measured by the percentage of the potential gains from exchange that were achieved." This technique allows this discussion to take place after each round if desired.

Analyzing the results in this way enabled me to think of the market-clearing process in a new way, and to understand aspects of market equilibrium that had not occurred to me before. Of particular interest are these observations about the composition and distribution of gains from exchange:

1. For any specific pair of individuals who agree to trade, the total gain (consumer plus producer surplus) is the same regardless of the price. Of course, the price affects the distribution of gains.

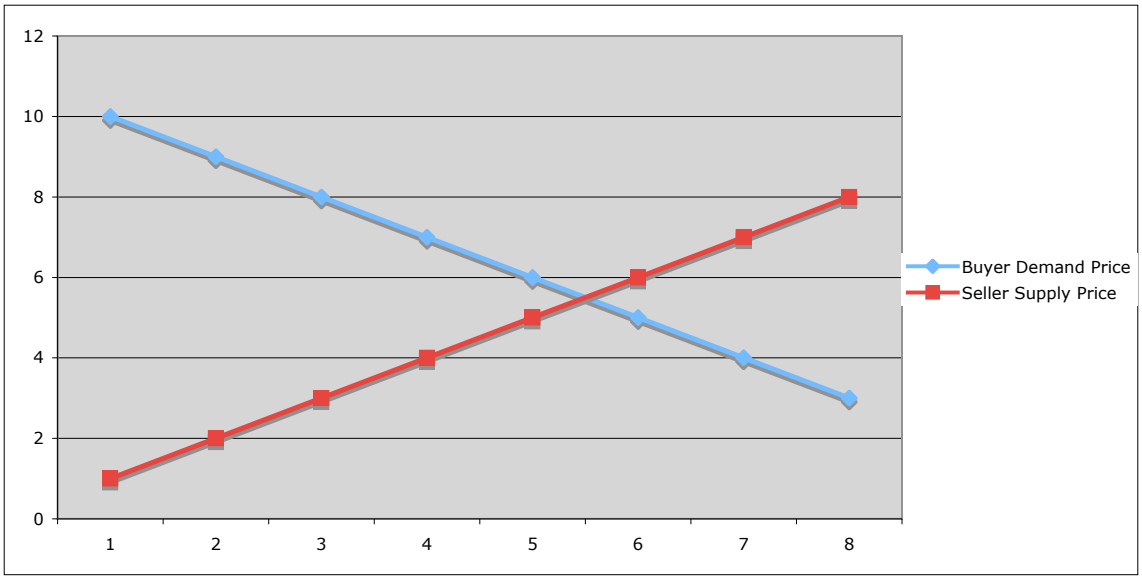
2. For any specific group of buyers and sellers who actually execute trades, the total gains are the same regardless of who trades with whom and at what price.

3. For any given group, total gains may increase if some individuals don't trade (low value buyers and high cost sellers). The fact that they found someone willing to trade may have benefited them. but decreased the net gains of the group as a whole.

4. Convergence to an equilibrium price eliminates the ability of low value buyers and high cost sellers to find trading partners, leading to the maximization of total net gain. Low cost sellers can do better than to sell to low value buyers. And high value buyers can get better deals than by buying from high cost sellers.

Discussing these points with my students seemed to lead to a deeper understanding of the equilibrium price and quantity in the market clearing process. It also provides an illustration of the role of opportunity cost in supply and demand.

An easy version of the DOA experiment that I have used recently uses playing cards. Buyers get black cards, sellers red; the number is the reservation price. My class had 16 students, so I used eight cards each from one red and one black suit. In order to skew the market slightly in favor of more trades I used slightly higher values for buyers (3 through 10) than for sellers (1 through 8). The supply and demand curves (which I don't show the students until later) look like this:



After explaining the process and distributing the cards, the students engage in a double oral auction and try to find trading partners. When two participants have completed a trade, they come to the front of the room and show me their cards and report the price. Entering the data in a spreadsheet is very quick, and is displayed on the projector screen, as shown for an early round below. I ask the students to confirm that I have entered the trade correctly.

Buyer Demand Price	Seller Supply Price	Trans. Price
6	4	5
8	5	7
9	3	5
10	9	9.5
7	2	6

I can then immediately show the mean price and the total gains from trade, as shown below. The columns are prepared in advance, but I usually step through the calculations so students can follow them , and so the process is more transparent.

Buyer Demand Price	Seller Supply Price	Trans. Price	Buyer Gain	Seller Gain	Total Gain
6	4	5	1	1	2
8	5	7	1	2	3
9	3	5	4	2	6
10	9	9.5	0.5	0.5	1
7	2	6	1	4	5
	Avg. Price	6.5		**Total Gain**	17

I then explain that search costs and imperfect information about the market may have prevented some mutually beneficial trades from happening, but that traders gain information in repeated rounds and the market converges on an equilibrium. However, not all trades are welfare improving, or beneficial to the whole group. As participants gain information and the market converges to an equilibrium price, high-value buyers and low-cost sellers find it easier to find trading partners, but low value buyers and high cost sellers find themselves shut out.

To show this I demonstrate that for any given pair of traders who agreed on a trade, the price affects the distribution of gain between them, but not the sum of the gains (which I later identify as consumer and producer surplus). I do this by changing one or two of the prices, and then by changing them all, first to the average price, then to some other prices.

Buyer Demand Price	Seller Supply Price	Trans. Price	Buyer Gain	Seller Gain	Total Gain
6	4	6.5	-0.5	2.5	2
8	5	6.5	1.5	1.5	3
9	3	6.5	2.5	3.5	6
10	9	6.5	3.5	-2.5	1
7	2	6.5	0.5	4.5	5
	Avg. Price	6.5		**Total Gain**	17

The last column stays the same, but the individual gains change, some to losses. Obviously, not everyone would participate at any given price. Similarly, for any given set of buyers and sellers who actually make a trade, the total gains are determined by the total values of the buyers and the total costs of the sellers, not by who trades with whom and at what price. I can show this by sorting the buyers in descending order (as in a demand curve) and sorting the sellers in ascending order (as in a supply curve). The total gain

does not change. Changing the price for one or all trades also does not affect the total gain.

Buyer Demand Price	Seller Supply Price	Trans. Price	Buyer Gain	Seller Gain	Total Gain
10	2	6.5	3.5	4.5	8
9	3	6.5	2.5	3.5	6
8	4	6.5	1.5	2.5	4
7	5	6.5	0.5	1.5	2
6	9	6.5	-0.5	-2.5	-3
	Avg. Price	6.5		**Total Gain**	17

Explaining this to the students as I do this is important, but actually making the changes takes only seconds, and shouldn't take any longer for even quite a few more students. The point that should become clear here is that some trades should not take place, because they reduce total gain. For example, by eliminating the last trade above, excluding a high-cost seller and a low-value buyer, total gain goes up.

Buyer Demand Price	Seller Supply Price	Trans. Price	Buyer Gain	Seller Gain	Total Gain
10	2	6.5	3.5	4.5	8
9	3	6.5	2.5	3.5	6
8	4	6.5	1.5	2.5	4
7	5	6.5	0.5	1.5	2
	Avg. Price	6.5		**Total Gain**	20

By going through these steps in two or three rounds, as prices converge, students can see that buyers who value the good a lot find it easier to find trading partners, and sellers who have low costs find it easy to trade, but high-cost sellers and low cost buyers find it more difficult. The trades that take place are the ones that generate positive value.

The ability of markets to maximize efficiency by screening out inefficient exchanges is an important lesson. Most students can easily see that low-cost sellers and high-value buyers are increasingly likely to be involved in exchanges as the market converges to equilibrium, but they often have trouble understanding why it is efficient for some participants to be excluded, especially if they are assigned a role that makes it less likely to

find a trade during the experiment. They may feel that, since all trades are mutually beneficial between the trading partners, the more trades that take place, the better. I try to reinforce the lesson with a follow-up example during the debriefing discussion we have during the next class period.

Using the same supply and demand data that were used in the experiment, I assert that it is hypothetically possible for all the participants to find a mutually beneficial trade. I illustrate with the following set of exchanges:

Buyer Demand Price	Seller Supply Price	Trans. Price	Buyer Gain	Seller Gain	Total Gain
10	8	9	1	1	2
9	7	8	1	1	2
8	6	7	1	1	2
7	5	6	1	1	2
6	4	5	1	1	2
5	3	4	1	1	2
4	2	3	1	1	2
3	1	2	1	1	2
	Avg. Price	5.5		**Total Gain**	16

Everyone gains a little from this set of trades. But if this is an ongoing market, with repeated trading activity, High-value buyers will soon learn that they can do better, and so will low-cost sellers. If everyone were to trade at the same price, the gains would be redistributed, but the total would remain the same.

Buyer Demand Price	Seller Supply Price	Trans. Price	Buyer Gain	Seller Gain	Total Gain
10	8	5.5	4.5	-2.5	2
9	7	5.5	3.5	-1.5	2
8	6	5.5	2.5	-0.5	2
7	5	5.5	1.5	0.5	2
6	4	5.5	0.5	1.5	2
5	3	5.5	-0.5	2.5	2
4	2	5.5	-1.5	3.5	2
3	1	5.5	-2.5	4.5	2
	Avg. Price	5.5		**Total Gain**	16

Of course, this set of trades would never occur, because most of the trades are *not* mutually beneficial. But sorting the sellers to correspond to a standard supply curve gives the following set of trades:

Buyer Demand Price	Seller Supply Price	Trans. Price	Buyer Gain	Seller Gain	Total Gain
10	1	5.5	4.5	4.5	9
9	2	5.5	3.5	3.5	7
8	3	5.5	2.5	2.5	5
7	4	5.5	1.5	1.5	3
6	5	5.5	0.5	0.5	1
5	6	5.5	-0.5	-0.5	-1
4	7	5.5	-1.5	-1.5	-3
3	8	5.5	-2.5	-2.5	-5
	Avg. Price	5.5		**Total Gain**	16

Here, all the high-value buyers are willing to pay the equilibrium price, and all the low-cost sellers are willing to accept it. They all find mutually beneficial trades. (If the market converges to a single equilibrium price, it doesn't matter who trades with whom.) The others would be unable to find a trade at an acceptable price, so they would voluntarily leave the market. However, eliminating those trades increases the total gain substantially.

Buyer Demand Price	Seller Supply Price	Trans. Price	Buyer Gain	Seller Gain	Total Gain
10	1	5.5	4.5	4.5	9
9	2	5.5	3.5	3.5	7
8	3	5.5	2.5	2.5	5
7	4	5.5	1.5	1.5	3
6	5	5.5	0.5	0.5	1
	Avg. Price	5.5		**Total Gain**	25

I then go back to the supply and demand curves to show that if the 6th, 7th, and 8th units are produced, they are not worth what they cost to any buyer who isn't willing to pay the equilibrium price. This is an important function of markets (when price signals are right): eliminating inefficient activity. I can refer back to this lesson in discussing comparative advantage, opportunity cost, increasing marginal cost, and externalities later in the semester.

Hazlett, Denise. 2005. *Using Classroom Experiments to Teach Economics.* TIP Workshop materials. adapted from a chapter in Teaching Economics to Undergraduates: Alternatives to Chalk and Talk, edited by William E. Becker and Michael Watts, 2005.

Parker, Jeffrey, 1995. *Using Laboratory experiments to Teach Introductory Economics.* http://academic.reed.edu/economics/parker/exp.htm