

Bilateral Trade Game: Overview for Participants

Alastair Fischer

1. Introduction

You are about to take part in an interactive game. To get the most out of the game, you are asked to adhere to the rules and objectives. In this case, that is simple. Your objective is to make as much “profit” as you can. You must also not divulge to any of the other participants any of the information you will be given on an individual basis in the game.

You will be a participant in a market, either buying or selling a hypothetical good, and trying to make as much profit (or satisfaction, if you are a consumer/buyer) as you can from doing so. Second, the controller will not knowingly tell you any lies in the conduct of the game.

Part A

- (1) Reference to money refers to “game money”, which is worthless outside the game.
- (2) You are either the buyer or the seller of a good, called X. All units of X are similar, and you cannot tell them apart. If you are a **buyer**, you may buy one or more of X at any one transaction, and you may make as many transactions as you wish in each period (but you cannot re-sell the item or items). At the beginning of the trading period, the controller will give you a piece of paper (BUYER’S SCHEDULE), which will show you how much he or she will pay you for one, two, three (etc) units of item X. For example, suppose that the buyer’s schedule is as follows:

| BUYER’S SCHEDULE | | | |
|--|------------|-------------|------------|
| Redemption prices | | | |
| | First unit | Second unit | Third unit |
| £ | 19 | 13 | 8 |
| Don’t show this piece of paper to anyone else. | | | |

This says that the controller will pay you £19 for supplying (him) with a first unit of X, a further £13 for supplying (him) with a second unit, and a further £8 for a third unit. In total, you will get £19 for supplying one unit, $£(19 + 13) = £32$ for two units, and $£(19 + 13 + 8) = £40$ for three units. Suppose that you pay £15 to one of the other participants for a unit. If it is the first unit you supply to the controller, he will give you £19 for it, so you can pocket £4. If you have already supplied the controller with one unit, then you will only be paid £13 for the next

unit you supply (i.e. the second unit), so you would make a loss of £2. As you don't wish to do that, you will only supply the controller with a single unit. Of course, if you can obtain the second unit for £12 or less, you will buy it as well as the first one. Similarly for the third unit.

- (3) Each **seller** has a piece of paper (SELLER'S SCHEDULE) which shows how much it costs him or her to produce the various units as shown in the example below:

| SELLER'S SCHEDULE | | | |
|--|------------|-------------|------------|
| Cost of production | | | |
| £ | First unit | Second unit | Third unit |
| | 7 | 10 | 14 |
| Don't show this piece of paper to anyone else. | | | |

You should sell your first unit if you can get £8 or more for it, but you may wish to shop around for the best buyer. However, you should only sell a second unit if you can get £11 or more for it, or else you will make a loss, as it costs £10 to produce. Similarly, you will need to receive more than £14 if you are to sell a third unit. **You don't have to pay for units that you do not sell:** think of it that you are ordering units of X from a central warehouse when you make a sale.

- (4) A buyer and seller may also trade a package of 2 or 3 units at a time. If you are a seller, and sell the first two units, they will cost you £(7 + 10) to produce (and not £7 each), so your selling price should reflect that. If you have already sold a unit, then the package of the next two units will cost you £(10 + 14) to produce. Similarly, if you are a buyer, the controller will pay you £(19 + 13) for a package of the first two units which you provide, and not £19 each; you will be paid £(13 + 8) for a package of the second and third units provided.
- (5) You will now be given a disc, red for buyers, numbered in turn 1, 2, 3..., and blue for sellers, numbered in turn 11, 12, 13... This is your player number, and you should wear it. There will be an equal, or almost equal, number of buyers and sellers. We can't tell you whether all the buyers' schedules are the same or different; nor can we say about the sellers' schedules.
- (6) If you are buying or selling what is for you a second unit, you may be trading with someone who is selling or buying what is to them a first or a third unit. That doesn't matter, as all the units are exactly the same. Your second unit can quite easily be someone else's first or third, and vice versa. You don't need to know how many units your trading partner has already traded.
- (7) You are given a Summary Sheet like the one below. Write on it your name, date and your participant number in the game. The first period is to last a maximum of

five minutes. As you buy or sell a unit, write the traded price, and the number of the person you traded with, onto the Summary Sheet.

Summary Sheet

Name.....Jorgen Bloggs... Date 7-9-07.... Participant Number...3.....

| Period number | First unit | | Second unit | | Third unit | | Profit |
|---------------|------------|-------------|-------------|-------------|------------|-------------|----------------------------------|
| | Price | Traded with | Price | Traded with | Price | Traded with | |
| 1 | 15 | 12 | 10 | 14 | - | - | $4 + 3 = 7$ |
| 2 | 11 | 12 | 11 | 12 | | | $(19 + 13) - (2 \times 11) = 10$ |
| 3 | etc | | | | | | |

The Sheet shows that you are conducting the game on the seventh of September, and that your Participant Number (3) is that of a buyer. You bought a first unit from seller number 12 for £15, and since the controller will pay you £19 for it, you make a profit of £4. You then bought a second unit for £10 from seller 14, and since you will get £13 back for it, you make a profit of £3. You don't trade a third unit. Your total profit is £7 ($= 4 + 3$).

In period 2, you bought both units for 11 each at the same time from seller 12, giving you a profit of $(19 + 13) - (2 \times 11) = 10$.

- (8) You may now mingle with the other participants and try to conduct exchanges.
- (9) In period 2, we go back to square one and start again, with the same buyer and seller schedules. Sellers have up to 3 more X's to sell, buyers may buy up to 3 more X's. Period 2 and subsequent periods are to last for a maximum of **3 minutes.**
- (10) The game will last from 4 to 6 periods.

2. Part B

In Part A, you conducted the game by meeting on a one-to-one basis. This is how many markets operate. For example, if you buy a car, you go to a salesman in one company, then on to another salesman in another company, etc. You don't usually have 2 or 3 salesmen talking to you at once. But there are other ways of trading, and we now look at one of them. It is called a double auction, and essentially follows the same rules as the Stock Exchange.

Using the same buyer or seller schedule as in Part A, you are to conduct trading as one large group. Here are the trading rules:

- (1) Sellers can sell up to 3 X's and buyers can buy up to 3 X's. Unlike a Stock Exchange, any one person cannot both buy and sell. You can only trade one X at a time, to make the process manageable manually.
- (2) To trade, call out your participant number and the words "to buy at (price)" or "to sell at (price)". E.g. "3 to buy at 9" or "12 to sell at 17". (Remember that if you are buying, you start off trying to pay as little as possible, and raising your bid if necessary, but if you are selling, start asking high and then come down.)
- (3) The auctioneer writes all bids and offers on the overhead projector. Buying bids must go up and selling offers go down during the course of trade in one period.
- (4) To accept a buying or selling offer, call out your participant number and say "accepts (price)" e.g. "4 accepts £15".
- (5) When a trade takes place, the seller passes a token to the buyer. Buyer and seller immediately record the sale, and the change in cash holdings on their record sheet.
- (6) The trading period lasts up to 3 minutes, after which there will be one minute to fill in the record sheet.

Documents to be handed to individual participants as appropriate

| | | | |
|---|------------------|-------------------|------------------|
| BUYER'S SCHEDULE Redemption prices: Buyer 1 | | | |
| £ | First unit 49 | Second unit 19 | Third unit 17 |
| Don't show this piece of paper to anyone else. | | | |

| | | | |
|---|------------------|-------------------|------------------|
| BUYER'S SCHEDULE Redemption prices: Buyer 2 | | | |
| £ | First unit 47 | Second unit 21 | Third unit 15 |
| Don't show this piece of paper to anyone else. | | | |

| | | | |
|---|------------------|-------------------|------------------|
| BUYER'S SCHEDULE Redemption prices: Buyer 3 | | | |
| £ | First unit 45 | Second unit 23 | Third unit 13 |
| Don't show this piece of paper to anyone else. | | | |

| | | | |
|---|------------------|-------------------|------------------|
| BUYER'S SCHEDULE Redemption prices: Buyer 4 | | | |
| £ | First unit 43 | Second unit 25 | Third unit 11 |
| Don't show this piece of paper to anyone else. | | | |

| | | | |
|---|------------------|-------------------|-----------------|
| BUYER'S SCHEDULE Redemption prices: Buyer 5 | | | |
| £ | First unit 41 | Second unit 27 | Third unit 9 |
| Don't show this piece of paper to anyone else. | | | |

| BUYER'S SCHEDULE | | | |
|--|------------|-------------|------------|
| Redemption prices: Buyer 6 | | | |
| £ | First unit | Second unit | Third unit |
| | 39 | 29 | 7 |
| Don't show this piece of paper to anyone else. | | | |

| BUYER'S SCHEDULE | | | |
|--|------------|-------------|------------|
| Redemption prices: Buyer 7 | | | |
| £ | First unit | Second unit | Third unit |
| | 37 | 31 | 5 |
| Don't show this piece of paper to anyone else. | | | |

| BUYER'S SCHEDULE | | | |
|--|------------|-------------|------------|
| Redemption prices: Buyer 8 | | | |
| £ | First unit | Second unit | Third unit |
| | 35 | 33 | 3 |
| Don't show this piece of paper to anyone else. | | | |

| SELLER'S SCHEDULE | | | |
|--|------------|-------------|------------|
| Cost of production: seller 11 | | | |
| £ | First unit | Second unit | Third unit |
| | 2 | 17 | 18 |
| Don't show this piece of paper to anyone else. | | | |

| SELLER'S SCHEDULE | | | |
|--|------------|-------------|------------|
| Cost of production: seller 12 | | | |
| £ | First unit | Second unit | Third unit |
| | 3 | 16 | 19 |
| Don't show this piece of paper to anyone else. | | | |

| SELLER'S SCHEDULE | | | |
|--|-----------------|-------------------|------------------|
| Cost of production: seller 13 | | | |
| £ | First unit 4 | Second unit 15 | Third unit 20 |
| Don't show this piece of paper to anyone else. | | | |

| SELLER'S SCHEDULE | | | |
|--|-----------------|-------------------|------------------|
| Cost of production: seller 14 | | | |
| £ | First unit 5 | Second unit 14 | Third unit 21 |
| Don't show this piece of paper to anyone else. | | | |

| SELLER'S SCHEDULE | | | |
|--|-----------------|-------------------|------------------|
| Cost of production: seller 15 | | | |
| £ | First unit 6 | Second unit 13 | Third unit 22 |
| Don't show this piece of paper to anyone else. | | | |

| SELLER'S SCHEDULE | | | |
|--|-----------------|-------------------|------------------|
| Cost of production: seller 16 | | | |
| £ | First unit 7 | Second unit 12 | Third unit 23 |
| Don't show this piece of paper to anyone else. | | | |

| SELLER'S SCHEDULE | | | |
|--|-----------------|-------------------|------------------|
| Cost of production: seller 17 | | | |
| £ | First unit 8 | Second unit 11 | Third unit 24 |
| Don't show this piece of paper to anyone else. | | | |

SELLER'S SCHEDULE

Cost of production: seller 18

| | | | |
|---|-----------------|-------------------|------------------|
| £ | First unit 9 | Second unit 10 | Third unit 25 |
|---|-----------------|-------------------|------------------|

Don't show this piece of paper to anyone else.

Record Sheet – Buyers

| | Period 1 | Period 2 | Period 3 | Period 4 |
|---|----------|----------|----------|----------|
| Price paid: unit 1 | | | | |
| unit 2 | | | | |
| unit 3 | | | | |
| <u>Total price paid (ΣP)</u> | | | | |
| Redemption values (for units bought only) unit 1 | | | | |
| unit 2 | | | | |
| unit 3 | | | | |
| <u>Total redemption values (ΣR)</u> | | | | |
| <u>Profit or surplus = $\Sigma R - \Sigma P$</u> | | | | |

Record Sheet - Sellers

| | Period 1 | Period 2 | Period 3 | Period 4 |
|---|----------|----------|----------|----------|
| Price paid: unit 1 | | | | |
| unit 2 | | | | |
| unit 3 | | | | |
| <u>Total price paid (ΣP)</u> | | | | |
| Cost of production (for units sold only) unit 1 | | | | |
| unit 2 | | | | |
| unit 3 | | | | |
| <u>Total cost of production(ΣC)</u> | | | | |
| <u>Profit or surplus = $\Sigma P - \Sigma C$</u> | | | | |

Summary Sheet

Name.....Date.....Participant Number.....

| Period number | First unit | | Second unit | | Third unit | | Profit |
|------------------|------------|-------------|-------------|-------------|------------|-------------|--------|
| | Price | Traded with | Price | Traded with | Price | Traded with | |
| 1 | | | | | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |
| 4 | | | | | | | |
| 5 | | | | | | | |
| 6 | | | | | | | |

Questions to guide discussion and analysis of Bilateral Trade Game

These can be used to facilitate discussion as a group or for individual assessment purposes.

1. Table 1 gives the total set of redemption values for the buyers when there are 8 buyers and sellers.

Table 1

| Player number | Unit 1 | Unit 2 | Unit 3 |
|---------------|--------|--------|--------|
| 1 | 49 | 19 | 17 |
| 2 | 47 | 21 | 15 |
| 3 | 45 | 23 | 13 |
| 4 | 43 | 25 | 11 |
| 5 | 41 | 27 | 9 |
| 6 | 39 | 29 | 7 |
| 7 | 37 | 31 | 5 |
| 8 | 35 | 33 | 3 |

Question 1:

(1) How many units will controller buy for a price of £49 or more?

(2) How many will he/she buy for a price of £48 or more?

(3) “ “ “ “ “ “ “ “ “ £47 “ “ ?

(4) “ “ “ “ “ “ “ “ “ £45 “ “ ?

(5) Draw a step-function graph with price on the vertical axis and number of units (quantity) on the horizontal axis to show the amounts the controller will buy at all prices.

(6) What do you think the resulting graph might be called?

2. Table 2 gives the costs of all the producers.

Table 2

| Player number | Unit 1 | Unit 2 | Unit 3 |
|---------------|--------|--------|--------|
| 11 | 2 | 17 | 18 |
| 12 | 3 | 16 | 19 |
| 13 | 4 | 15 | 20 |
| 14 | 5 | 14 | 21 |
| 15 | 6 | 13 | 22 |
| 16 | 7 | 12 | 23 |
| 17 | 8 | 11 | 24 |
| 18 | 9 | 10 | 25 |

Question 2:

- (1) *If the price were £2, how many units in total should be produced and sold?*
- (2) *If the price were £3, how many units in total should be produced and sold?*
- (3) *If the price were £4, how many units in total should be produced and sold?*
- (4) *Draw a step-function graph with price on the vertical axis and number of units on the horizontal axis to show the amounts that should be sold at different prices. Draw this on the same page as for the graph in Q1.*
- (5) *What would you think this curve is called?*

Question 3:

- (1) *Do the graphs cross? If so, where? (i.e. What values of p and q ?)*
- (2) *How would you interpret the point at which they cross?*
- (3) *Would you expect that **all** trades should **eventually** take place at the same price? Why, or why not? If not, what would be the range of prices?*

Question 4:

- (1) *What happens if there are only 7 sellers? Suppose seller 18 is missing: redraw the graph of Q 2.*
- (2) *Answer the questions about p and q again in Q 3, but now with 7 sellers.*

3. Let us look at actual data obtained from a previous running of this game. These were the trades in **period 1**, in £.

5, 6, 10, 10, 12, 13, 15, 15, 16, 20, 25, 25, 30, 34.

There were 14 trades at an average of £16.86. We can measure the dispersion by averaging the absolute difference of each observation from the mean. This comes to £7.10. By period 6, prices were 16, 18, 18, 18, 19, 19, 20, 20, 20, 20, 20, 21, 21, 28, 31.

The graph and Table 3 give the values of q , average p and dispersion of p for each of the 6 periods.

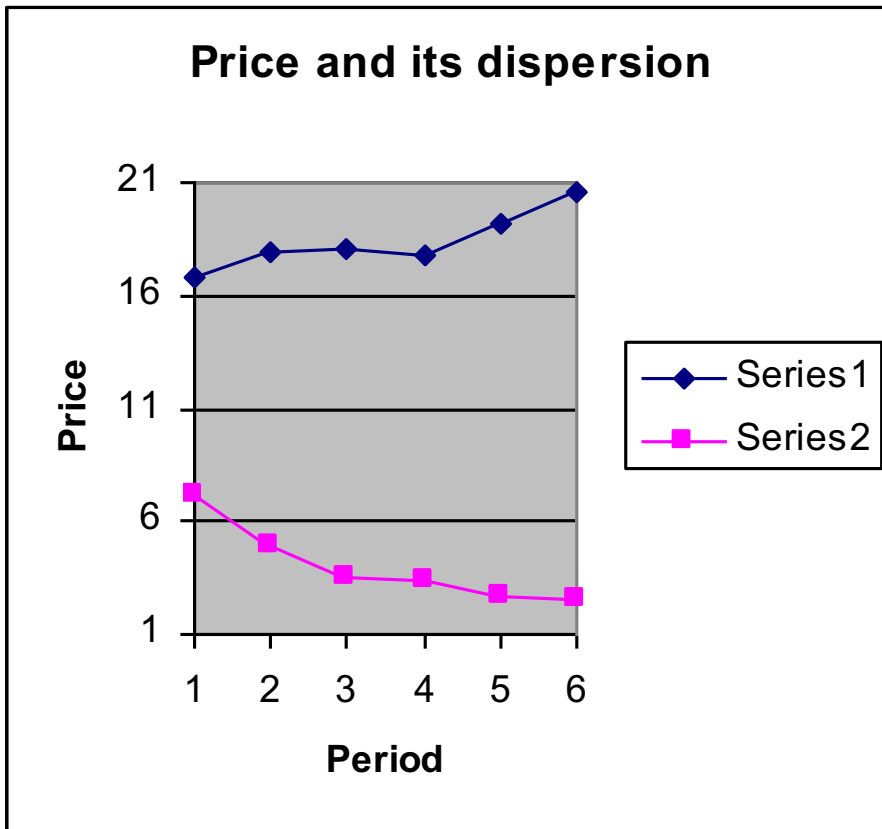


Table 3

| Period | Quantity traded | Average price | Price dispersion |
|--------|-----------------|---------------|------------------|
| 1 | 14 | 16.86 | 7.10 |
| 2 | 14 | 17.93 | 4.92 |
| 3 | 14 | 18.00 | 3.57 |
| 4 | 13 | 17.85 | 3.35 |
| 5 | 15 | 19.13 | 2.69 |
| 6 | 15 | 20.60 | 2.56 |

Question 5:

- (1) Does the quantity traded appear to be approaching the amount predicted by the theory?
- (2) Does the average price appear to be approaching the amount predicted by theory? Draw in the theoretical equilibrium price as a horizontal straight line on the diagram.

4. Now let us look at buyer and seller rationality. Here is an example of a trade that took place in a previous game.

| | | | |
|---------|--------|--------|--------|
| Buyer: | Unit 1 | Unit 2 | Unit 3 |
| | 46 | 20 | 14 |
| Seller: | 9 | 10 | 25 |

The three units were traded as a bundle for £60, an average of £20 a unit

Question 6:

- (1) Work out the total redemption value (add 46, 20 and 14) and therefore compute the profit to the buyer. Also work out the profit per unit by dividing the result by 3.*
- (2) Work out the total cost of production and therefore compute the total profit for the seller. Additionally, work out the average profit per unit.*
- (3) Now see how much profit they each would have made if they had only traded 2 units each, at a price of £20.*
- (4) The last unit bought or sold is called the **marginal unit**. What rule would you expect a rational seller would use when comparing the **marginal cost of production** and the price of that unit? And what rule would you expect a rational buyer would use in comparing the **marginal redemption value** and the price of that unit?*
- (5) What role (if any) do the **average** redemption value (for the buyer) and the **average** cost of production (for the seller) have in the decision-making process?*
- (6) What would you think would happen if the sellers all had to pay £10 per period to enter the market (e.g. rent on a market stall)? We can regard this as a **fixed cost**, as it does not depend on the number of units sold. The **variable cost** is the cost of production, and is the sum of all the marginal costs.*
- (7) Suppose that the seller has to give up a secure Government job paying £10 per period to sell X's. This is known as an **opportunity cost**, as it is the cost of foregoing something in order to get something else. Will this cost have the same effect on the seller's decision to enter the market as the £10 cost in (6) above?*
- (8) What if the job given up is an insecure one, selling X's on a period-by-period basis for an existing seller? (We now have to **discount** the opportunity cost because of **risk**. Discounting is also carried out for **future** costs and benefits.)*

Question 7:

(1) *In the game described, how many units should each buyer and seller trade?*

Question 8:

(1) *Let us look at the game **that we have just performed**. How many trades took place in each round?*

(2) *Identify where:*

- (a) *buyers bought units that would not have been bought in equilibrium,*
- (b) *buyers did not buy units that would have been bought in equilibrium,*
- (c) *sellers sold units that would not have been sold in equilibrium, and*
- (d) *sellers did not sell units that would have been sold in equilibrium.*

Question 9:

(1) *From the graph drawn in question 3, draw in a horizontal line to denote the equilibrium (passing through the intersection of the S and D curves). If this is the price line at which all units are sold, how much “profit” will the first buyer make on the first unit sold? Represent this by a column of area one unit wide, from the redemption curve down to the equilibrium price line you have drawn in for unit 1. Shade the area.*

(2) *Do the same in turn for units 2, 3, 4, ...etc. This triangular area (with a sawtooth edge) represents the “profit” made by the buyers if they buy the equilibrium quantity of units at the equilibrium price. It is called **consumer surplus**.*

(3) *Work out the difference between the equilibrium price and the cost of production for the first unit of seller 11 (the cheapest unit to produce). This may be represented by the area one unit wide from the beginning of the cost schedule to the equilibrium price line.*

(4) *Do the same for all the other units which should be sold at equilibrium. The area mapped out is known as the **producer surplus**.*

5. The amount of total surplus (consumer + producer surpluses) can be shown to be at a maximum when the market is in equilibrium. This is a simple but very powerful result, because it is at the heart of most of the economic “reforms” of the past 15 to 20 years. It says that a competitive market (as long as it is in equilibrium) creates more surplus than any other. Let us see why.
6. Suppose the last trade before equilibrium is not made. Then a little bit of surplus is lost. Suppose that an out-of-equilibrium trade takes place, between a buyer prepared to pay a lot, and a seller who is selling a third unit a bit above equilibrium price. As a

result, someone else who would have sold at the equilibrium price or below misses out on a sale. So an expensive supplier takes the place of a cheaper one. This represents a **real** loss of resources. Let us see how efficient our market has been.

7. We shall calculate the total profit of all the buyers to give us the consumer surplus, and all the sellers to get the producer surplus, and express it as a % of the maximum possible surplus. Thus we shall fill out Table 4: Consumer surplus, producer surplus, total surplus and what is called **allocative efficiency**.

Table 4

| | Consumer surplus | Producer surplus | Total surplus | Allocative Efficiency |
|-----------------|------------------|------------------|---------------|-----------------------|
| In equilibrium: | | | | |
| Actual: | | | | |
| Period 1 | | | | |
| Period 2 | | | | |
| Period 3 | | | | |
| Period 4 | | | | |
| Period 5 | | | | |
| Period 6 | | | | |

8. Now let us turn our attention to the double auction. It should be the case that the double auction converged very rapidly to equilibrium. This would happen because now there is a lot more information. Everyone knows what all the sellers are willing to sell for, at least in aggregate, and simultaneously what all the buyers in aggregate are willing to pay. So we should see far greater efficiency in this market.
9. Now suppose that there is only one seller, who owns all the slips of paper saying SELLERS SCHEDULE (i.e. can produce up to $8 \times 3 = 24$ units).

Question 10:

- (1) *What would happen if the single seller tried to restrict the supply of goods? Would it be possible to extract more producer surplus than the producer surplus of the competitive market?*
- (2) *What if the producer decided to try to price at 22? From the demand curve (aggregate redemption schedule) how many units would be demanded?*
- (3) *Where would the seller maximise his amount of surplus? What are the implications for the control of monopolies?*