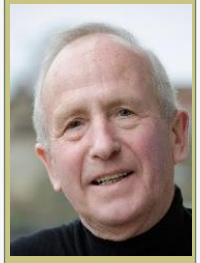
WHAT EXPERIMENTS CAN TELL US ABOUT HUMAN ECONOMIC BEHAVIOUR

JOHN HEY



A QUESTION FOR YOU

What would you think about a scientist who wants to test the efficiency of a drug, who collects data on the sale of the drug (in some town or region or country) and data on the incidence of the problem that the drug is supposed to cure (in that town or region or country), and statistically looks at the relationship between the latter and the former?

A SECOND QUESTION

What would you think about a scientist who wants to test whether a new brand of tyres is safer than the old one, who collects data on the sales of the tyre (in some town or region or country) and data on motor accidents (in that town or region or country) and statistically looks at the relationship between the latter and the former?

A FINAL QUESTION

What would you think about a scientist who wants to test whether raising interest rates increases saving, who collects data on interest rates over time in some country and saving in that country, and statistically looks at the relationship between the latter and the former?

THE ANSWERS IN EACH CASE?

- Not a lot.
- In the first two cases the scientist would conduct a laboratory experiment.
- Keeping all other factors (not of interest) fixed.
- Why cannot economists do the same?
- Well, experimental economists do.

WHAT IS AND HOW DO YOU RUN AN EXPERIMENT?

- Experiments are to test theories.
- Recruit some participants. We usually call them *subjects*.
- Pose them some decision problem that is presented in the theory that you are testing.
- Provide them with an appropriate incentive (specified in the theory that you are testing).
- Observe what they do.
- See if what they do is what the theory says that they should do.
- If so, great! If not, revise the theory.

ECONOMICS

- Economics is *theory driven* and based on *axioms*.
- Economics has strong notions about *rationality*, particularly about rational expectations and dynamic behaviour.
- Central to economics is *equilibrium*.
- Economics mostly assumes that people are *self-interested*.
- Economics usually relies on *indirect* tests of theories (using data from the economy with many uncontrolled factors) rather than *direct* experimental tests under controlled conditions.

‘RULES’ OF ECONOMICS EXPERIMENTS

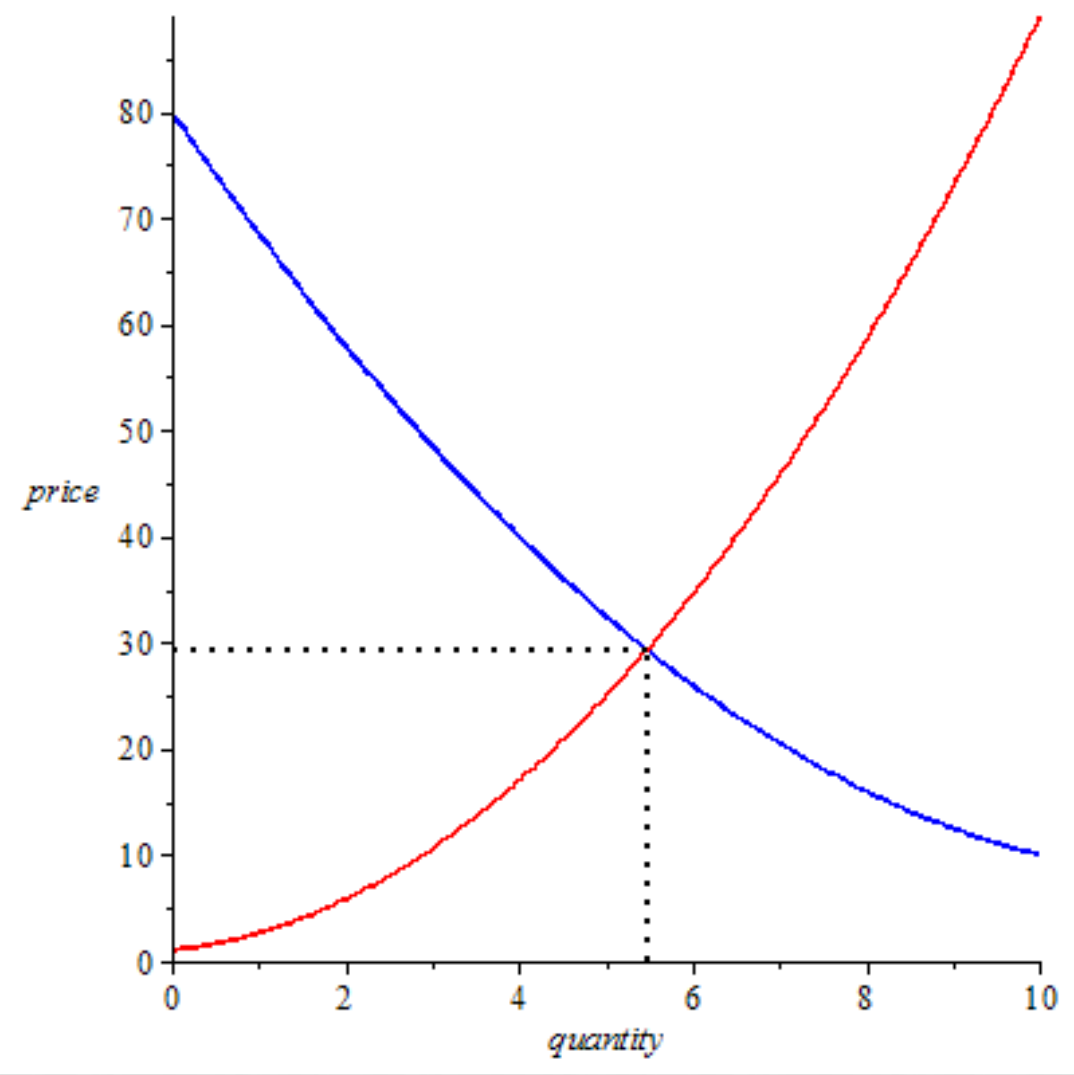
- Control is essential.
- Incentives are crucial (not always so in psychology).
- Deception is outlawed (not always so in psychology).
- Clear Instructions and briefing are important.
- When analysing the data you should take into account the fact that behaviour is noisy.

EXPERIMENTAL ECONOMISTS' CLAIMS

- All theory is built on top of individuals (usually maximising their own self-interest).
- Theory does not specify which individuals.
- We can test/investigate most economic theories, including macro models and those of international trade – as these usually involve a small number of (representative) agents.
- Experiments enable us to find what is wrong with existing theories and to suggest new ones.
- This appears to us to be scientific progress.

- Let me start with an example. A competitive market.

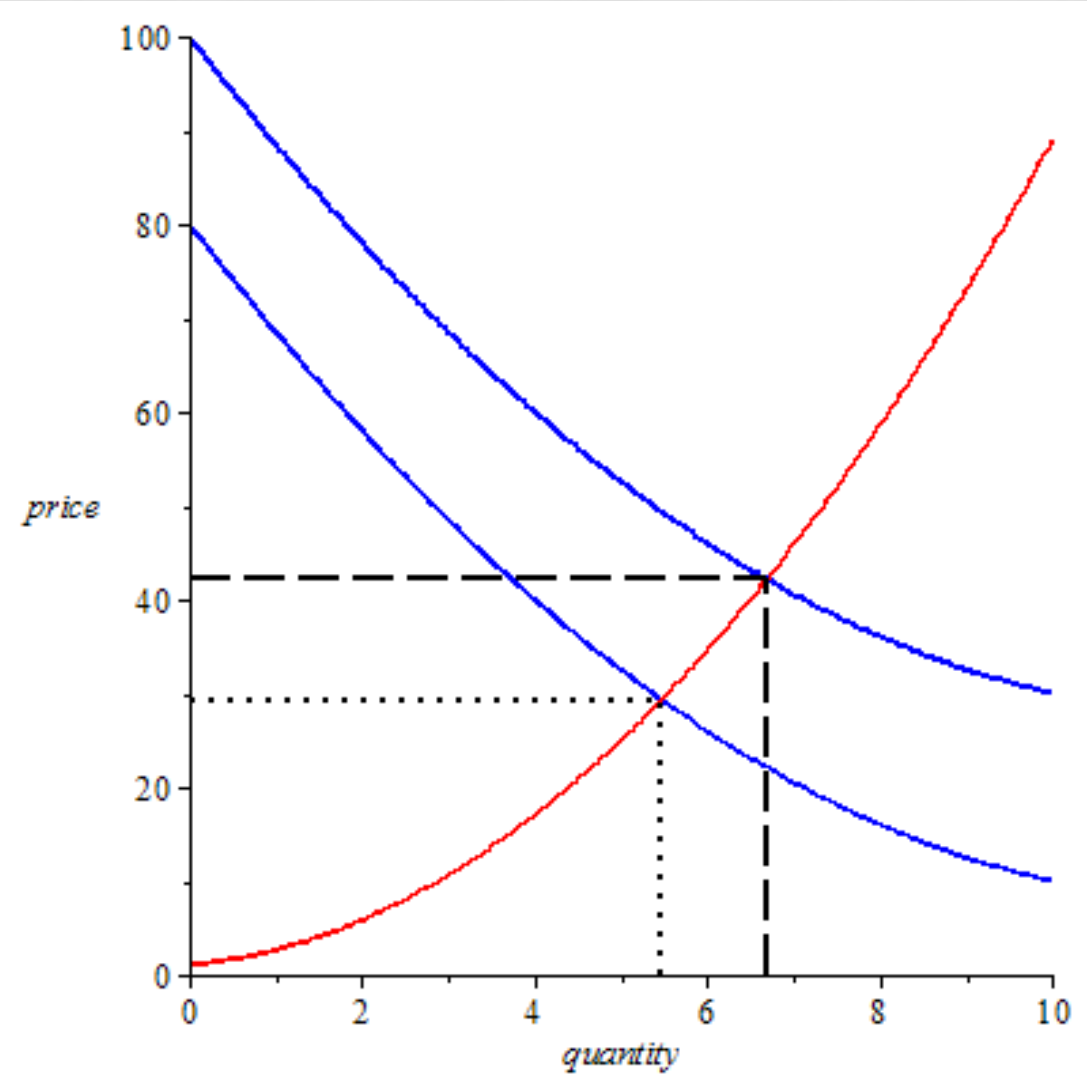
EQUILIBRIUM



A competitive market

Meaning that they are many participants and they are all so small that they are all price-takers.

COMPARATIVE STATICS



WHAT DOES THE THEORY SAY?

- That equilibrium *exists*.
- It is an equilibrium in the sense that once we are there, *no individual* can gain by changing his or her decision.

- That if there is an upwards shift in the demand curve then the *equilibrium* price and quantity increase.

- Does it say that the equilibrium will be attained?
- No.
- Does it say that the price will move upwards?
- No.

- It cannot – because there is no-one to set the price.

SO WHY NOT SEE WHAT HAPPENS?

- We need to give the agents the ability to announce prices (not necessarily set them).
- (We may be looking for an Austrian Economics concept of the emergence of spontaneous order.)

- This is what Vernon Smith (Nobel Prize Winner in 2002) did in his path- breaking experiments in the 1960's.

- We need to give incentives to the agents/subjects.

HOW WE SET UP A MARKET EXPERIMENT

- The market is for a hypothetical good.
- How do we get people to act as potential buyers?
- How do we get people to act as potential sellers?

- How is the price formed?

- What might the experiment tell us about the theory?

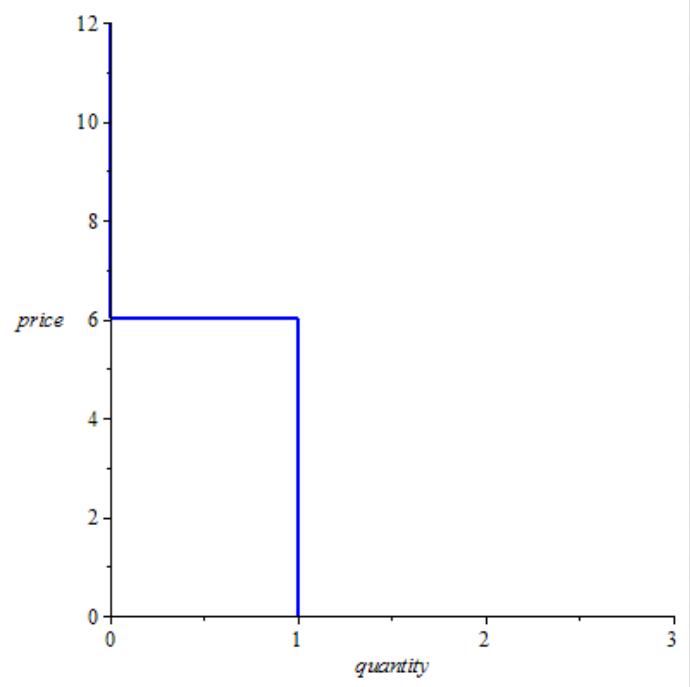
DEMANDERS

- What is a demand curve?
- What are reservation prices?
- What does a demand curve for a **discrete*** good look like?

- Suppose an individual wants to buy at most one unit of a discrete good and his/her reservation price for the one unit is 6. What does his/her demand curve look like? what does it tell us?

- * one traded in integer units.

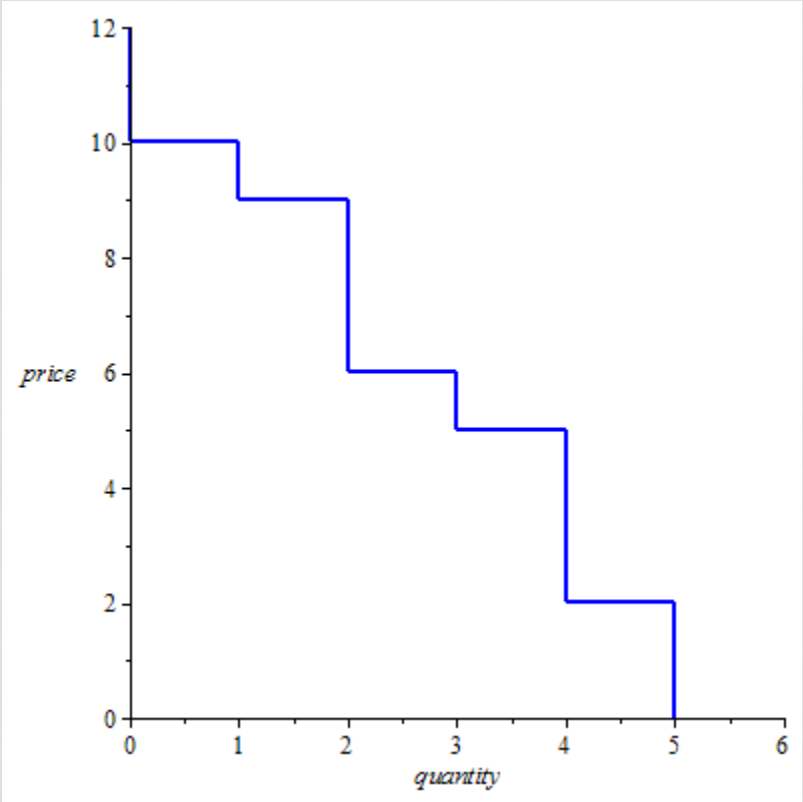
DEMAND CURVE OF THIS DEMANDER



This individual is willing to pay *at most* 6 for one unit, but would be happier to pay less. His/her 'happiness' is measured by his *surplus*.

- Suppose there are five demanders, each wanting to buy at most one unit, with reservation prices 10, 9, 6, 5 and 2. What does their aggregate demand curve look like?

AGGREGATE DEMAND CURVE



INDUCING SUBJECTS TO ACT AS DEMANDERS

- How do we do this?
- We tell each subject that they are potential buyers of a hypothetical good that will be traded in the experiment, and that if they buy they will be paid by the experimenter a given sum of money (their reservation value – but we do not use this word) and that they will have to pay the price agreed out of this money.
- An obvious incentive mechanism. They get their surplus.

- We can obviously generalise this.

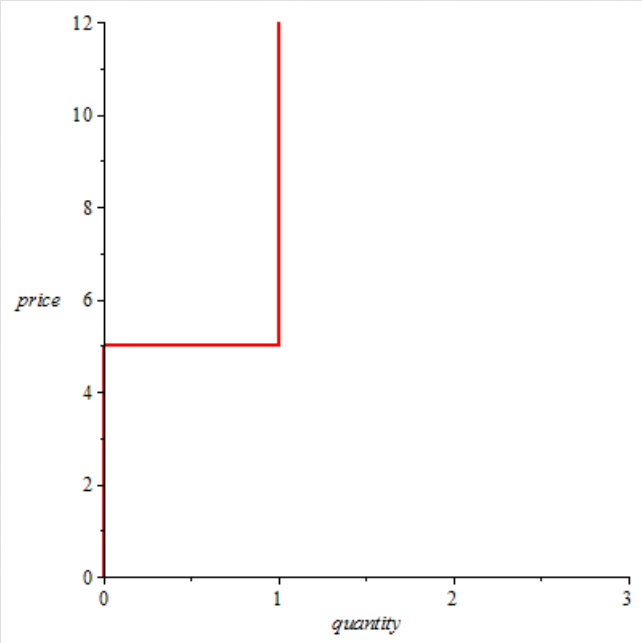
SUPPLIERS

- What is a supply curve?
- What are reservation prices?
- What does a supply curve for a **discrete*** good look like?

- Suppose an individual wants to sell at most one unit of a discrete good and his/her reservation price for the one unit is 5. What does his/her supply curve look like?

- * one traded in integer units.

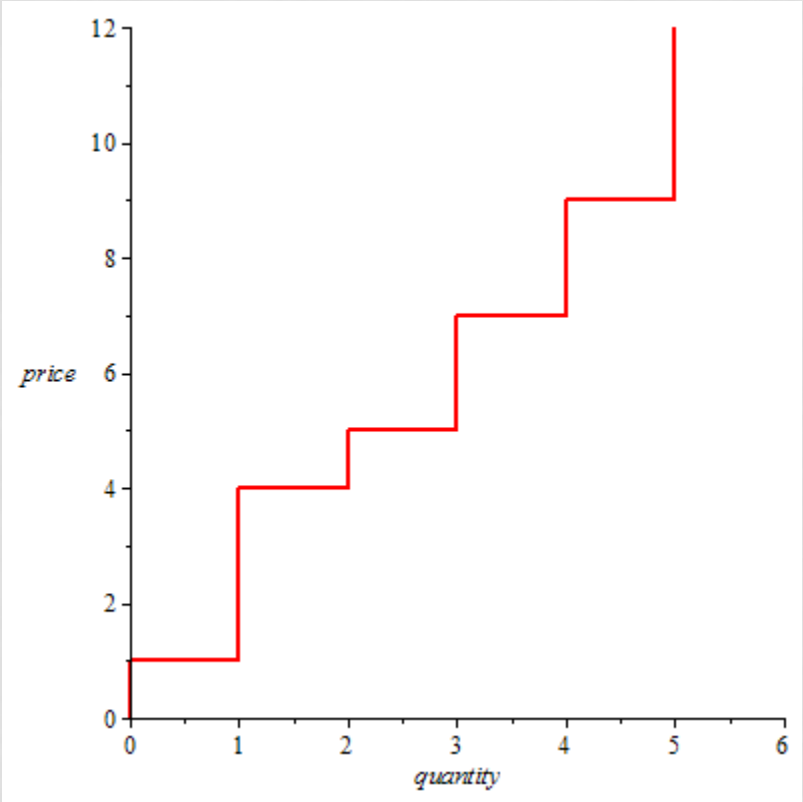
SUPPLY CURVE OF THIS SUPPLIER



This seller is willing to sell for at least 5, but would be happy to sell for more. His/her 'happiness' is measured by the *surplus*.

- Suppose there are five suppliers, each wanting to sell at most one unit, with reservation prices 1, 4, 5, 7 and 9. What does their aggregate supply curve look like?

AGGREGATE SUPPLY CURVE

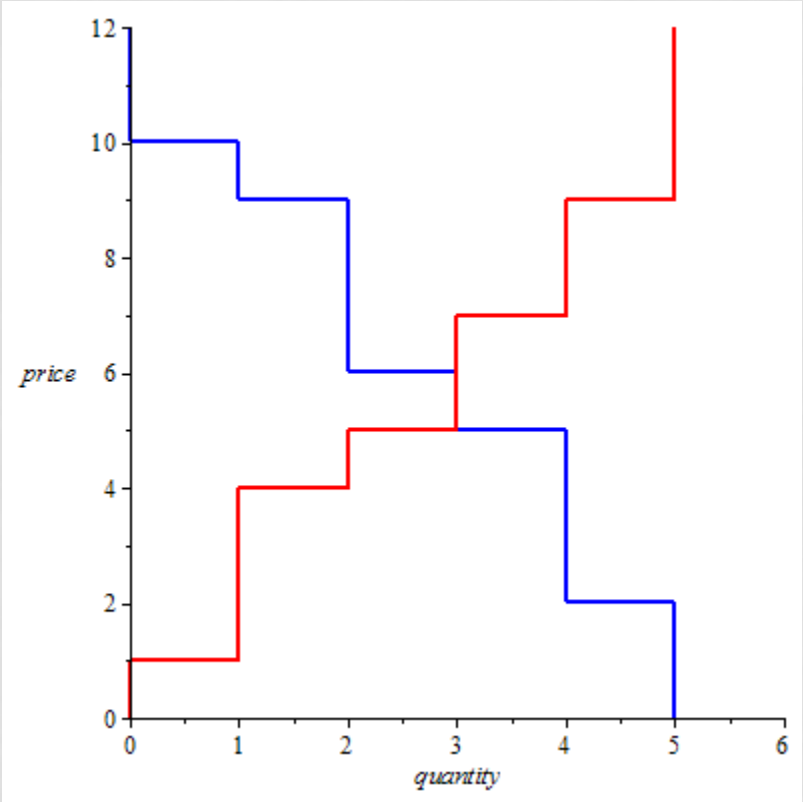


INDUCING SUBJECTS TO ACT AS SUPPLIERS

- How do we do this?
- We tell each subject that they are potential sellers of a hypothetical good that will be traded in the experiment, and that if they sell they will receive the price agreed and that they will have to pay to the experimenter a given sum of money (their reservation value – but we do not use this word) out of this money.
- An obvious incentive mechanism. They get their surplus.

- We can obviously generalise this.

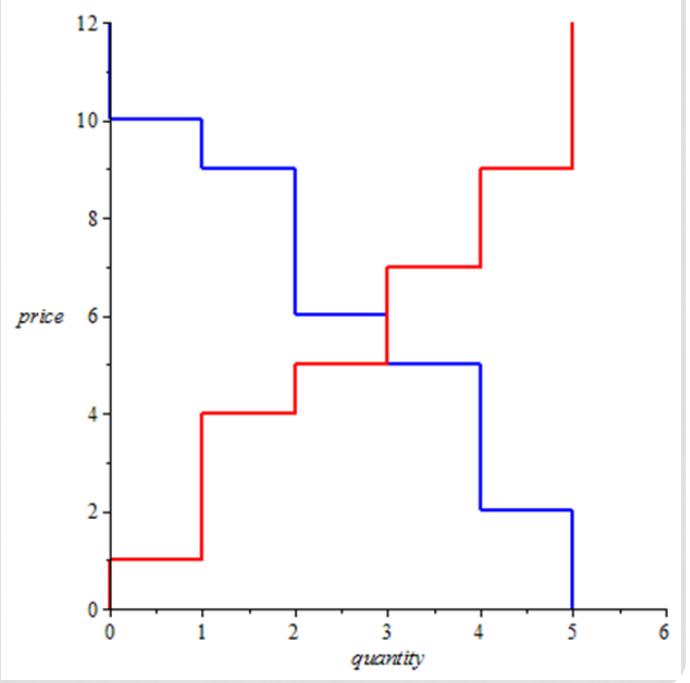
THE MARKET



The competitive equilibrium is any price between 5 and 6.

WHO TRADES?

- Do all in the competitive equilibrium?
- Can all outside competitive equilibrium?
- Why do we like competitive equilibrium?



TRADING MECHANISMS?

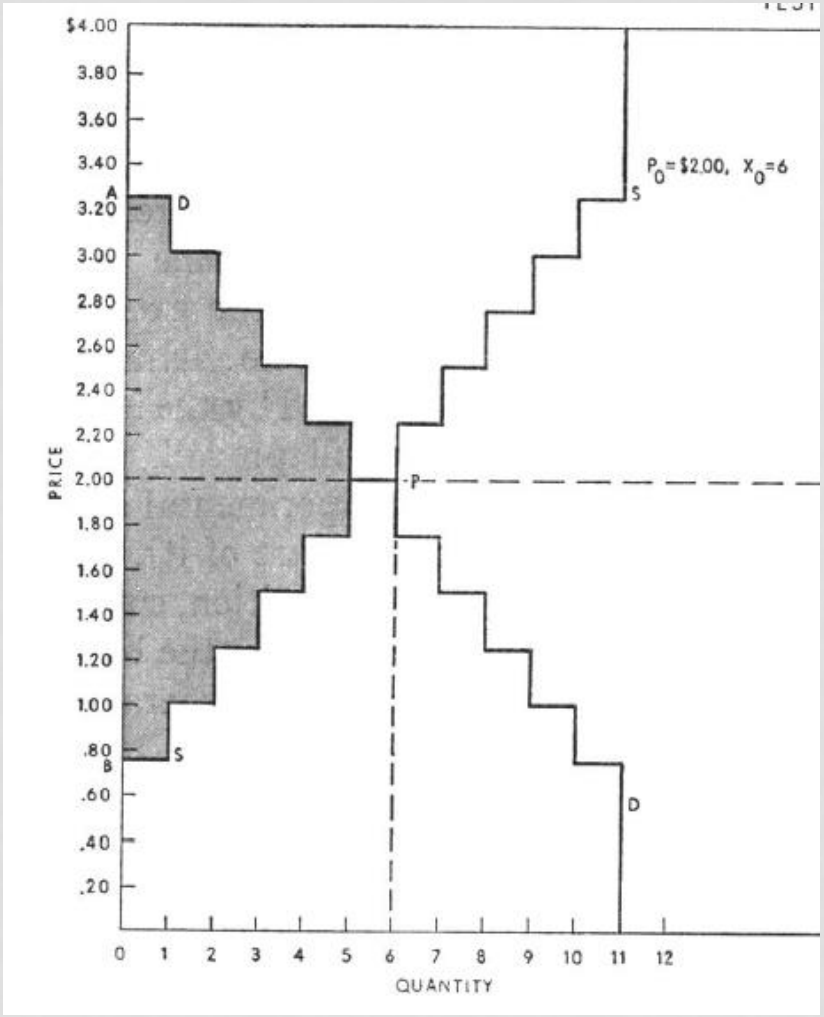
- In the theory? In the real world?

- I list some here.
  - Double Auction
  - Walrasian Auctioneer
  - Clearing House
  - Bilateral Bargaining
  - Sellers set prices
  - Buyers set prices
  - …

DOUBLE AUCTION EXPERIMENT

- The market period lasts a pre-determined time.
- At any point buyers can make *bids*: a price at which they are willing to buy.
- At any point sellers can make *asks*: a price at which they are willing to sell.
- Bids and asks are posted.
- At any time a buyer can accept a posted ask of a seller – and then a trade takes place at that price.
- At any time a seller can accept a posted bid of a seller – and then a trade takes place at that price.
- There is no communication between the subjects and they do not know each others reservation prices.

THE CLASSIC EXAMPLE FROM SMITH 1962

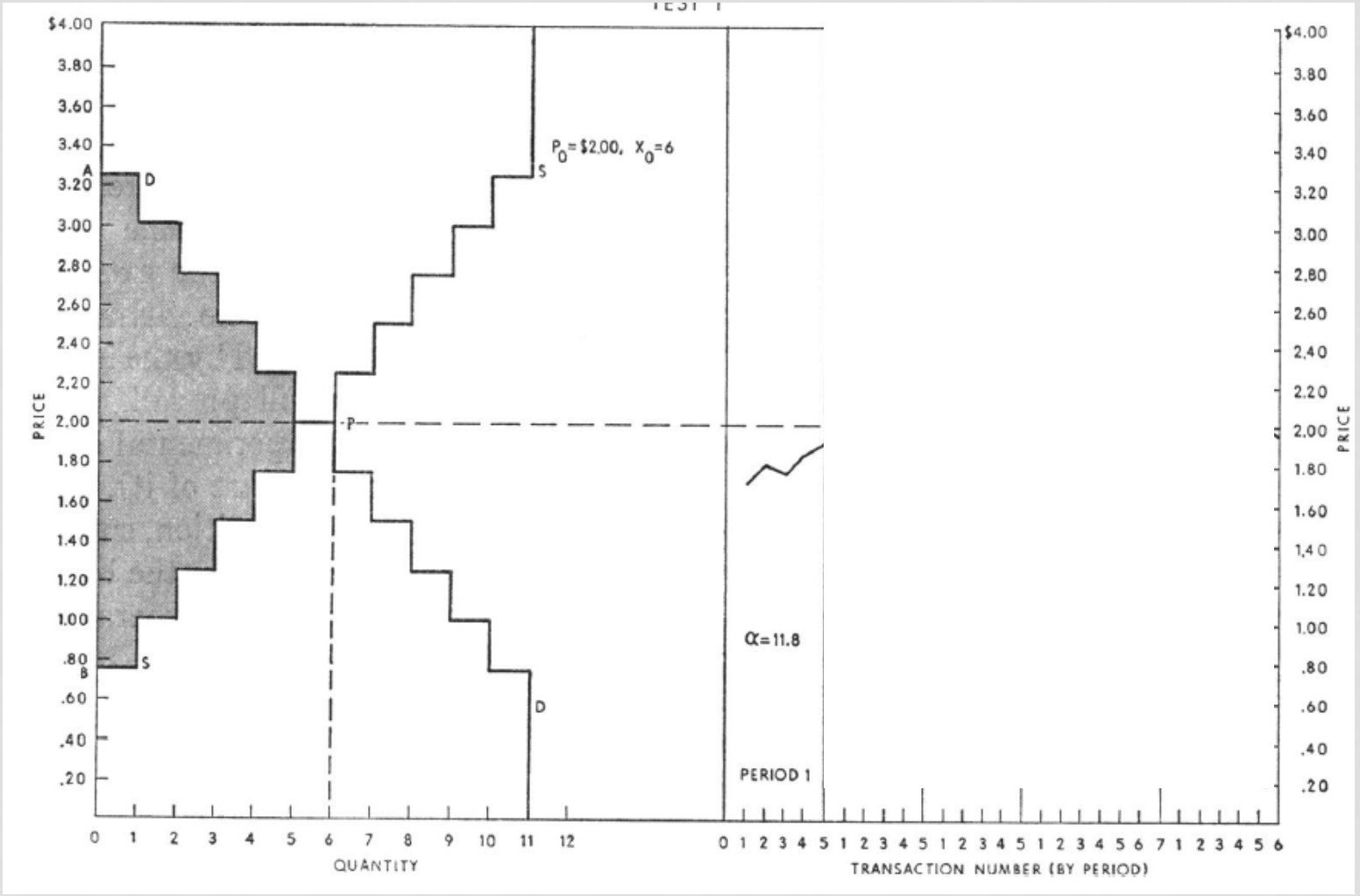


11 potential buyers with reservation prices from 3.25 to 0.75.

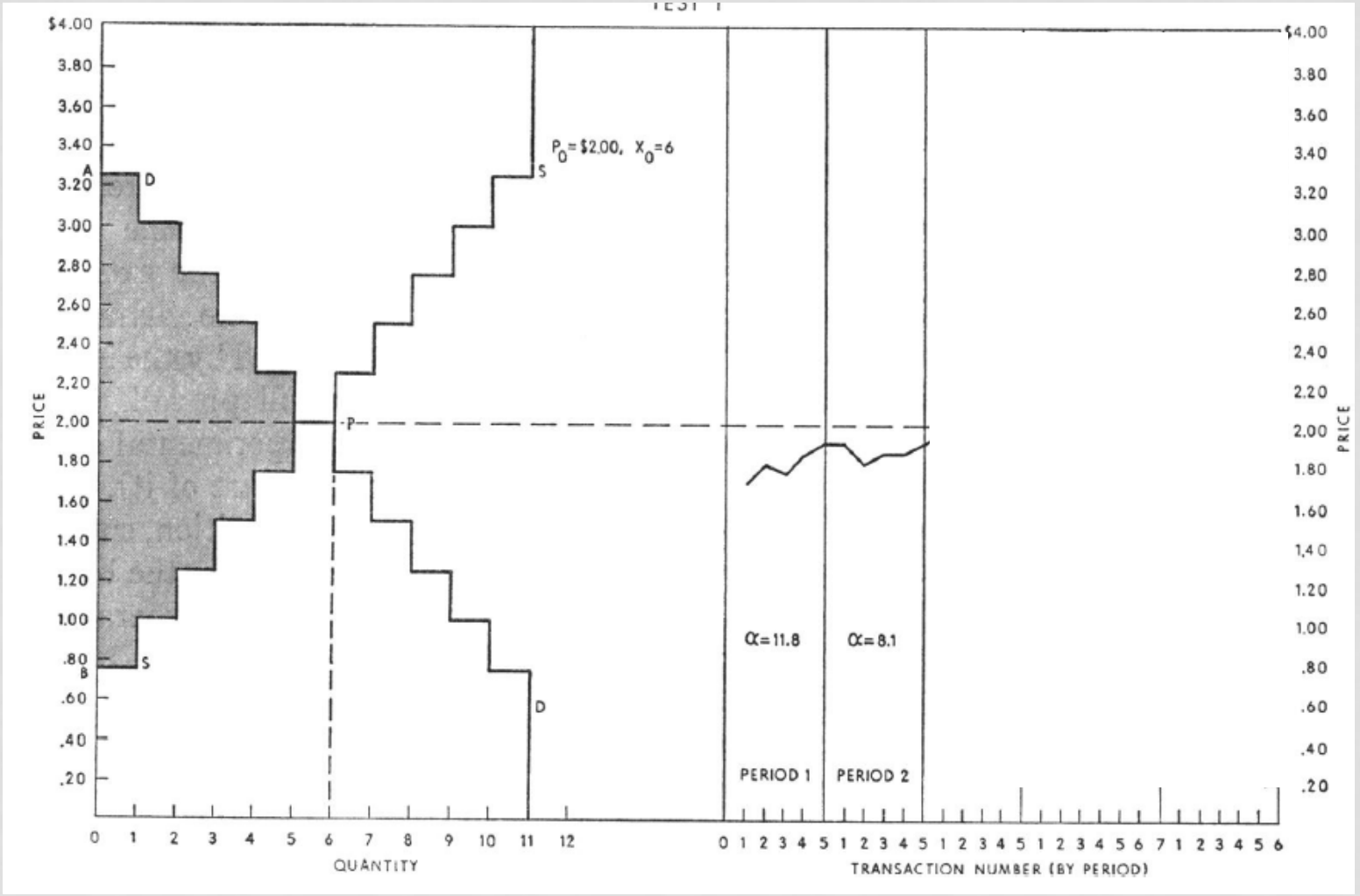
11 potential sellers with reservation prices from 0.75 to 3.25.

Equilibrium price 2.00.

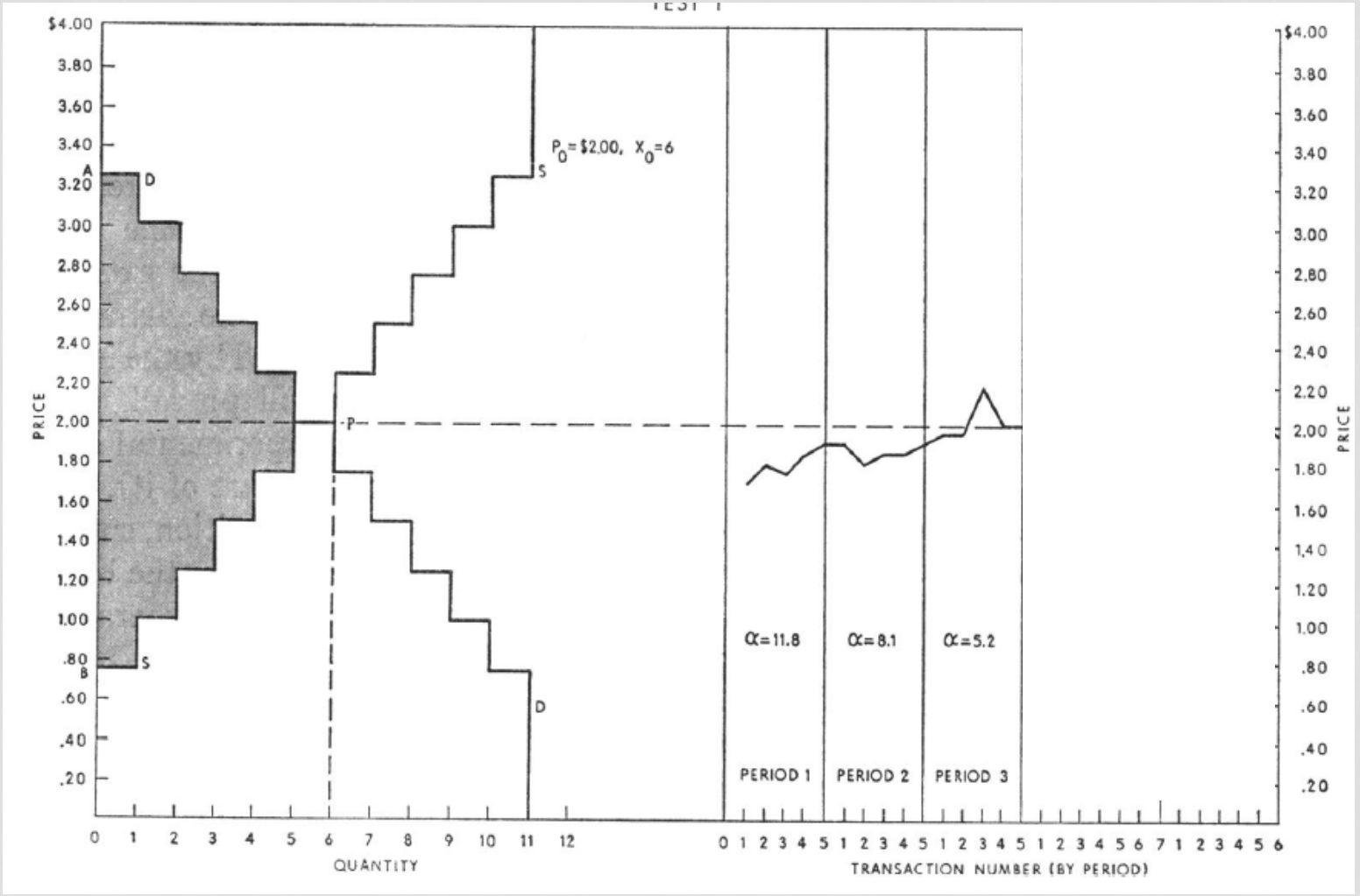
WHAT HAPPENED IN PERIOD 1?



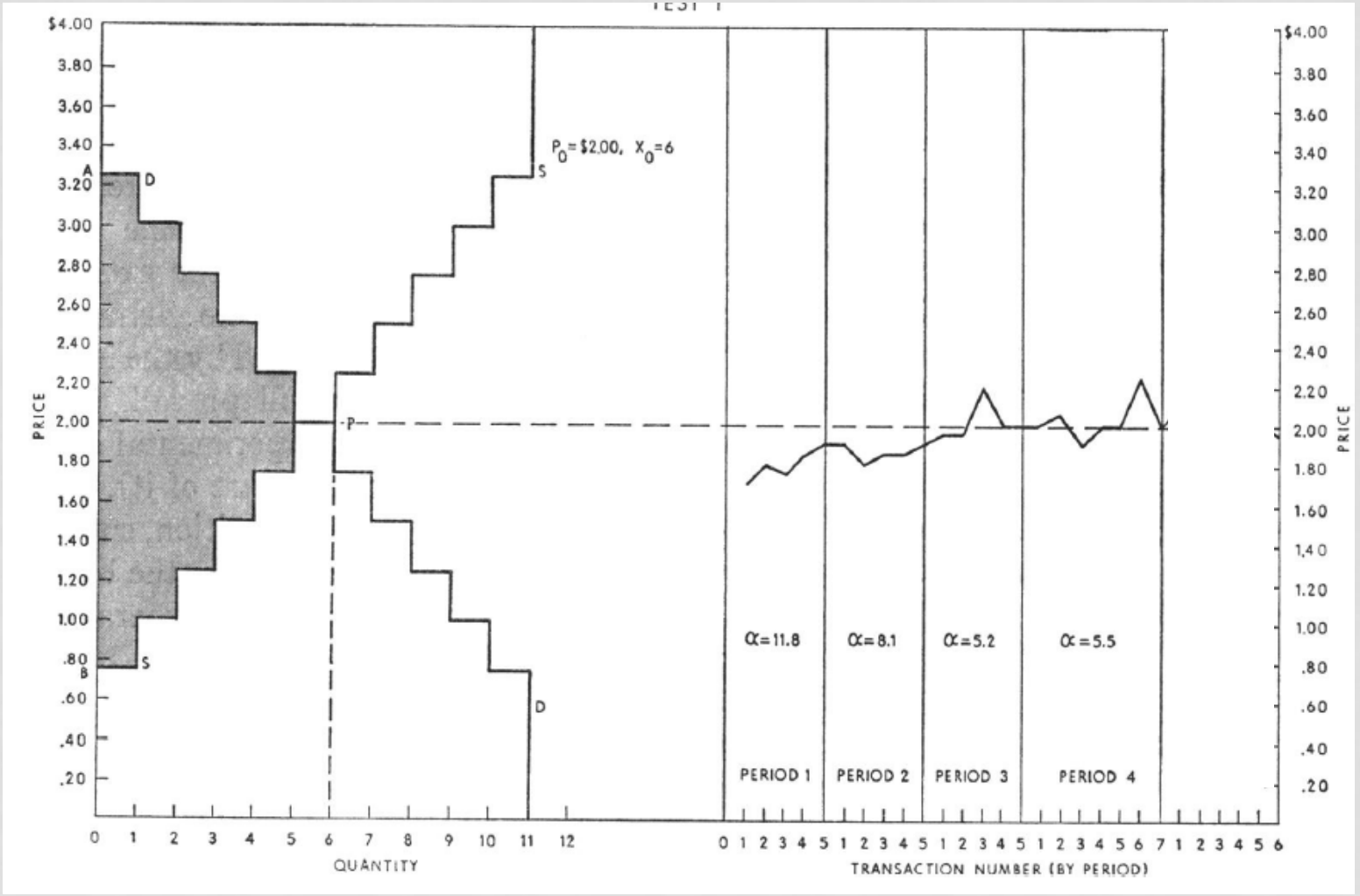
WHAT HAPPENED IN PERIOD 2?



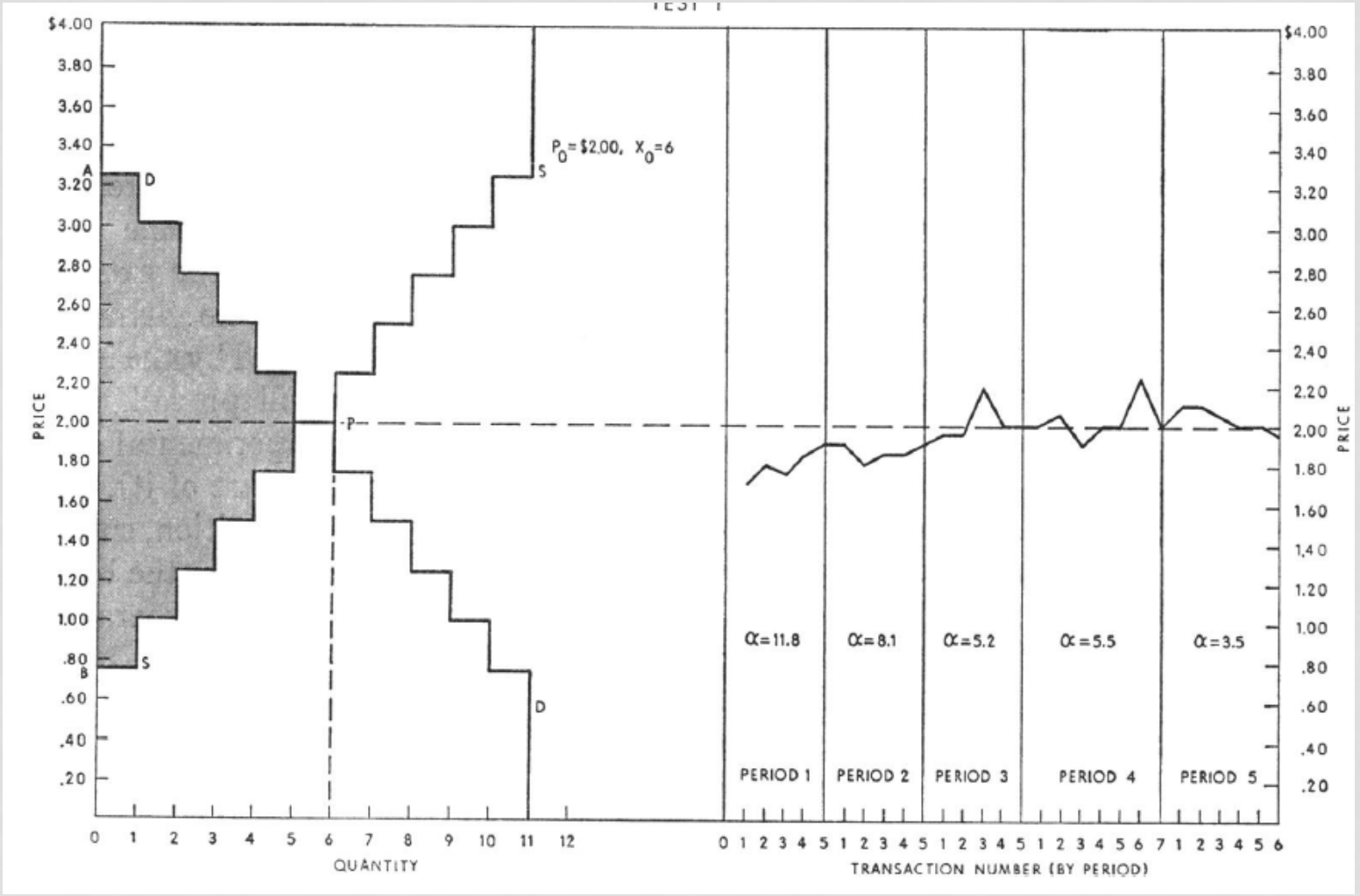
WHAT HAPPENED IN PERIOD 3?



WHAT HAPPENED IN PERIOD 4?

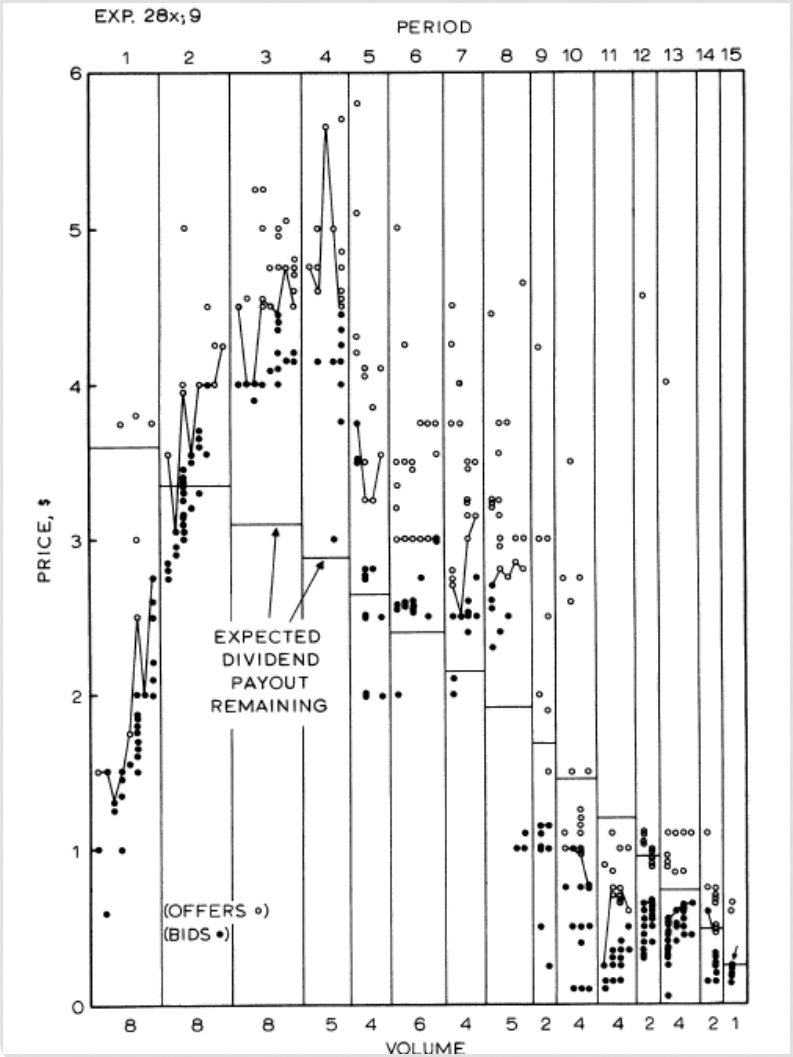


WHAT HAPPENED IN PERIOD 5?



Magic!?

THE THEORISTS ARE VINDICATED!



But…

A repeated market – repeated 15 times.

From Smith, Suchanek and Williams 1998

All subjects endowed a the start with units of an asset that paid a random dividend with mean 24 cents each period. Endowed also with ultimately worthless experimental money with which to trade.

We observe a bubble and a crash.
What was happening?

GAME THEORY

- Again here theorists are obsessed with equilibrium – here the Nash Equilibrium…
- … in which everybody is doing the best for themselves given what everyone else is doing.
- It is an equilibrium in the sense that once we are there, no individual can gain by changing his or her decision.

- But is it attained?
- Only experiments can tell us.

A SYMMETRIC GAME

- The two players move simultaneously.

		Player B	
		1	2
Player A	1	£10, £10	£12, £0
	2	£0, £12	£11, £11

- First number – payoff to A; second - payoff to B.
- What would you do?
- What does the theory predict?
- The theory works! Experiments with real money prove it.
- (Two subjects; they make choices independently and we pay them what they get.)

BUT…

- The two players move simultaneously

		Player B	
		1	2
Player A	1	£1, £1	£1001, £0
	2	£0, £1001	£1000, £1000

- First number – payoff to A; second - payoff to B.
- What would you do?
- What does the theory predict?
- The theory does not work! Experiments with real money prove it.
- (Two subjects; they make choices independently and we pay them what they get.)

WHAT DOES THIS TELL US?

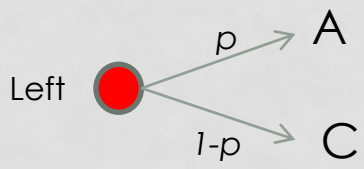
- Game theory 'predictions' are satisfied sometimes but not always.
- It depends on the out-of-equilibrium payoffs – which are irrelevant to the theory.
- Is out-of-equilibrium play a sign of trust, other-regarding preferences, or better-than-Nash rationality?
- Other experiments can tell us.

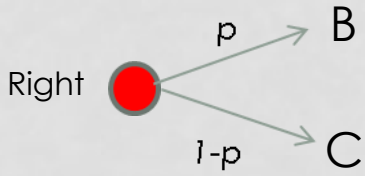
A SEQUENTIAL-PLAY GAME

- A simple sequential one-shot Trust Game.
- Two players, A and B. A has some money given to him/her by the experimenter; he can pass some to B and the amount becomes quadrupled.
- Then B has to decide how much to pass back to A.
- What is the Nash Equilibrium?
- What do experiments show?
- That Player A does pass some money – often 50% of the given amount.
- Trust? Other-regarding preferences? Better-than-Nash rationality?

AXIOMS

- Economists love axioms – definitions of 'rationality'.
- They are beautiful and intellectually appealing.
- Consider this axiom – which is called the Independence Axiom.
- Suppose you prefer A to B, where A and B can be anything.
- Now suppose you are offered the following risky choice: between Left and Right. Which would you choose? C is anything. *p* is anything.

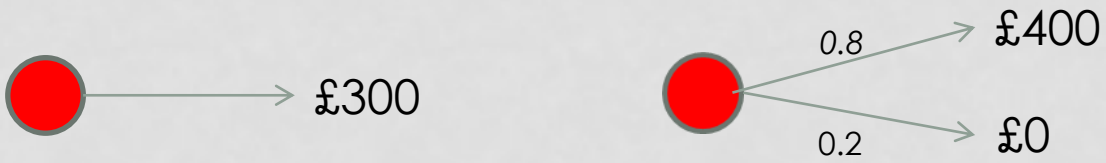




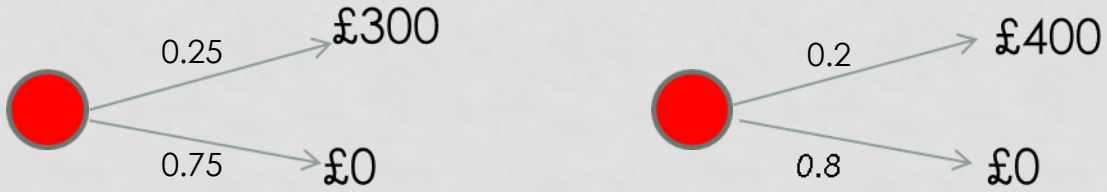
These are both risky choices with probabilities *p* and *1-p*.

NOW A TEST

What would you choose here?



And here?



Are your decisions consistent with the Independence Axiom?

THIS IS THE ALLAIS 'PARADOX'

- The Independence Axiom is the crucial part of Expected Utility theory.
- Experimental tests of this axiom and others have led to the development of new theories of behaviour under risk, most notably Prospect theory and Rank-Dependent Expected Utility theory.
- Allais (Nobel Prize 1988) was an early experimenter in the field.

DYNAMIC CHOICE

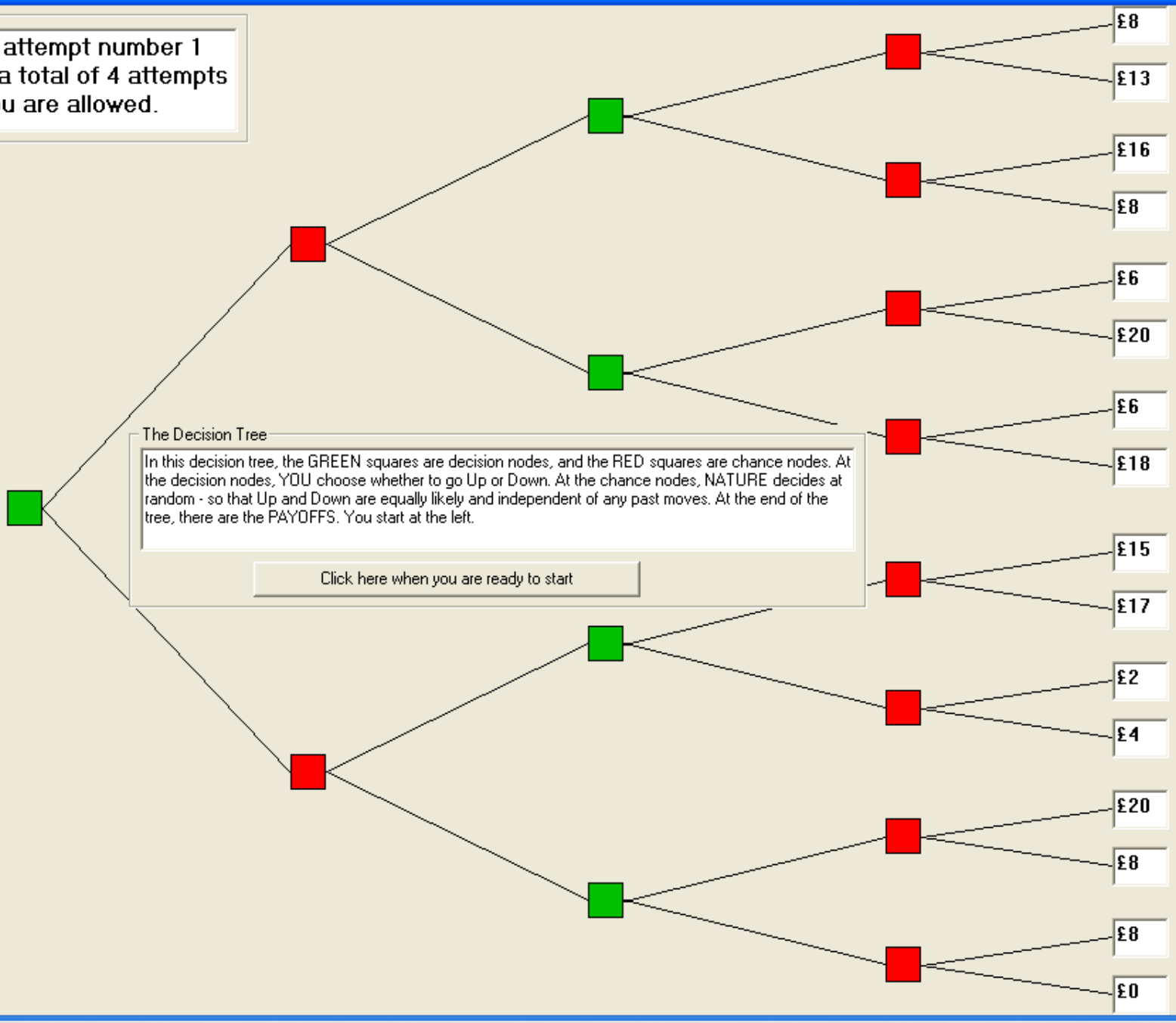
- Dominated by strong ideas of rationality, particularly that of solving dynamic problems by *backward induction* (underlies rational expectations).
- Consider the following dynamic problem.
- In these green squares are *decision* nodes and red squares are where *Nature* moves, moving Up or Down with equal probabilities.
- The amounts at the end are *payoffs*.
- What would you do at the first decision node?

- This is from an experiment of The Three Johns.

Decision Tree

Attention!

This is attempt number 1 out of a total of 4 attempts that you are allowed.



The Decision Tree

In this decision tree, the GREEN squares are decision nodes, and the RED squares are chance nodes. At the decision nodes, YOU choose whether to go Up or Down. At the chance nodes, NATURE decides at random - so that Up and Down are equally likely and independent of any past moves. At the end of the tree, there are the PAYOFFS. You start at the left.

Click here when you are ready to start

THE EXPERIMENTAL DESIGN

- The payoffs in the top half of the tree are
  8, 13,16, 8, 6, 20, 6,18
- The payoffs in the bottom half of the tree are
- 15, 17, 2, 4, 29, 8, 8, 0
- The *ordered* payoffs in the top half of the tree are
- 20, 18, 16, 13, 8, 8, 6, 6
- The *ordered* payoffs in the bottom half of the tree are
- 20, 17, 15, 8, 8, 4, 2, 0
- Top *dominates* bottom …
- … but this ignores the second decision.

THE SECOND NODES

- The decision maker would choose Down, Up, Up and Down (assuming *dominance*) therefore eliminating 8, 13, 6, 8, 2, 4, 8 and 0, leaving
- 16, 8, 6, 20 in the top (ordered 20, 16, 8 and 6) and
- 15, 17, 20, 8 in the bottom (ordered 20, 17, 15 and 8)
- Now bottom dominates top.

- The experiment showed that well under half the subjects chose wrongly…
- …and even forcing them to pre-commit to the second decision did not push the right choice to over 50%!

WHAT THE EXPERIMENT SHOWS

- People do not plan ahead – even in the context of this simple example.
- People do not backwardly induct.
- What does economists' theory of saving assume?
- … backward induction from the date of death.

SAVINGS

- Economists, with their life-cycle theory of saving, assume that agents backwardly induct from the date of their death.
- How do you do an experiment to test this?
- An experiment with a finite number of periods in each of which the agent gets an income in tokens. Savings earn interest. Each period they have to decide how much of their wealth to convert into money – through a conversion scale *u(.)*.
- What do such experiments show?
- That people under-save in early periods. Myopia?

SO WHAT HAVE WE LEARNT?

- That spontaneous action can lead to equilibrium.
- That equilibrium may not be achieved; that other factors are at play.
- That the concepts of rationality used in much of economics are too strong.
- People are myopic and do not use backward induction.
- That people care about other people and trust them.
- Experiments have led to new theories.

WHAT HAS BEEN LEARNT ELSEWHERE?

- People are different. Interesting?
- Cultures are different. Interesting?
- The more micro you look the more the differences.
- People have noise in their behaviour but are not completely random.
- Emotion seems to affect behaviour.
- The environment seems to affect behaviour.
- If we are interested in aggregate micro behaviour perhaps these differences cancel out?
- But the behaviour of the average is not the average of behaviour.

OTHER EXPERIMENTS

- I have not mentioned *Field Experiments* as I do not do them.
- They are experiments carried out 'in the field' with perhaps the subjects not knowing that they are in an experiment.
- Some experiments are carried out in low-income countries as one can provide higher incentives.

WHAT NON-EXPERIMENTERS SAY

- "We know that the theory is true."
- Economics is about aggregates not individuals.
- Your incentives are not large enough.
- These axiomatic violations cancel out.
- No comment.
- Why are your theories about individuals?
- We have tested whether their size makes a difference.
- How do you know?