

Experimental Economics

Monopolies and Duopolies (Cournot markets)

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Outline for today

- Monopolies
- Duopolies & Cournot markets
- Your experiment
- Lab report 3

Main questions for today

1. What is the equilibrium in a monopoly?
2. What is the equilibrium in a duopoly?
3. Do we find equilibrium behavior in an experiment?

Market structure

From the producer side

- The **number of firms** in the industry
- The **nature of the product** produced
- The **degree of power** each firm has
 - degree to which the firm can influence price
 - firms' behavior – **pricing strategies, non-price competition, output levels**
- The **extent of barriers to entry**
- The impact on **efficiency**

Market structure: perfect competition

- Abstract concept → impossible in reality
 - industry with low or no barriers to entry or exit
 - equal market share among firms → resources equally and fairly divided
 - each firm has same industry knowledge and sells identical products
 - complete information about prices and products available to all buyers
- Price determined by supply and demand, no firm can control price
→ everybody is price taker
- Examples of near-perfect competition: flea market, crop markets

Firms make just enough profit to stay in business. No firm is more profitable than another because the market causes them to operate on a level playing field, canceling out any advantage one may have over another.

Market structure: pure monopoly

- A sole seller of good/service in a market
 - due to high barriers to entry (airplanes)
 - or exclusive access to resources (diamonds)
- No substitutes for the good
 - rarely exists in reality → usually some form of substitute available
- Thus, monopoly exists where one firm dominates the market and uses this power to
 - restrict output to generate higher prices (i.e., artificial scarcity)
 - influence prices to prevent competition or drive competitors out of the market
 - impose barriers to entry (e.g., certification)
 - firms may be investigated for monopoly power when market share exceeds 25%
- Examples: *Microsoft* (operating systems), *Google* (search engine)
- How do you call a market with a sole buyer instead? → Monopsony

Market structure

From the producer side

Perfect
Competition

Pure
Monopoly



→
The further right on the scale, the greater the degree of
monopoly power exercised by the firm.

←
The further left on the scale, the greater the degree of competition

How does the degree of competition affect consumers?

The value of a model

- Models help in analyzing and evaluating a reality → **offer a benchmark**
- Characteristics of a model
 - Number and size of firms that make up the industry
 - Control over price or output
 - Control freedom of entry and exit from the industry
 - Nature of the product – degree of homogeneity (similarity) of the products in the industry (extent to which products can be regarded as substitutes for each other)
 - Diagrammatic representation – the shape of the demand curve, etc.

General model of monopoly

Central to the analysis of antitrust issues because it can be applied more widely.

All sellers in a market can collude, set quantity and price that maximizes the *total profit*, which is then divided among them.

→ monopoly model is relevant

- for providing a prediction of P and Q , or
- as a benchmark to **measure the success of the cartel**

General model of Monopoly

From the monopolist's point of view

Demand function reveals amount that can be sold for each possible price, with high prices resulting in lower sales quantities.

→ Useful to invert this demand relationship and think of **price as a function of quantity**, i.e., selling a larger quantity will reduce price.

$$P = a - bQ$$

a : vertical intercept of demand in a graph (i.e., price on the vertical axis)

b : is the slope, with $b > 0$

Treatment 1: Monopoly

Each participant had the **role of a monopoly seller** in a market with a constant cost of \$1 per unit and a simulated linear demand curve:

$$P = 13 - Q + \varepsilon$$

$$\text{Profit} = P * Q - 1 * Q$$

$$\text{Max } E(\text{Profit}), \text{ note that } E(\varepsilon) = 0$$

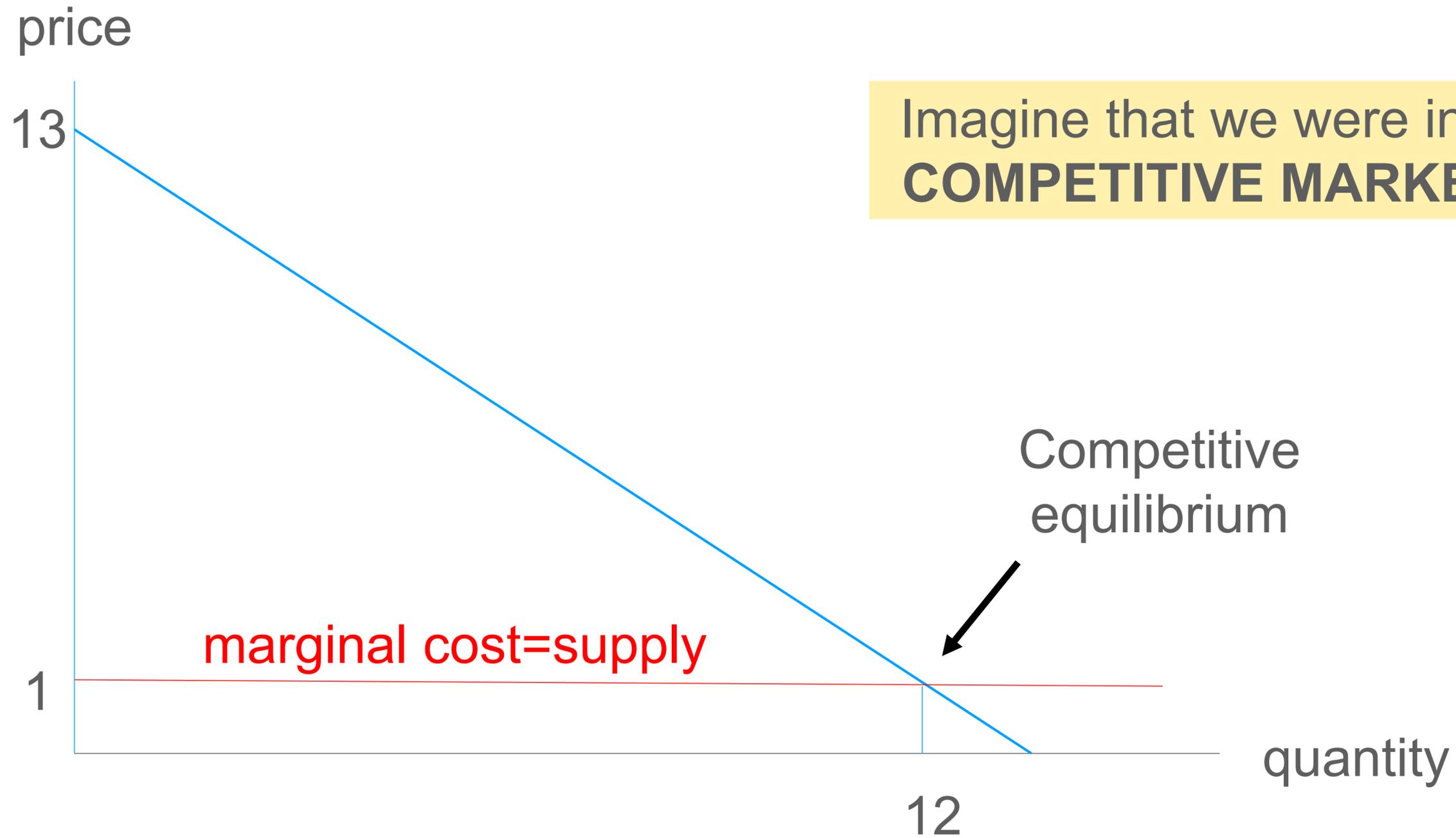
$$\rightarrow MR = MC$$

Appropriate if the market has a very large number of consumers, none of whom have any significant size or power to bargain for reductions from the monopoly price.

where P is price and Q is the quantity selected by the monopolist.

Slope = -1: i.e., each additional unit of output raises the cost by \$1 and reduces the price by \$1.

Treatment 1: Monopoly

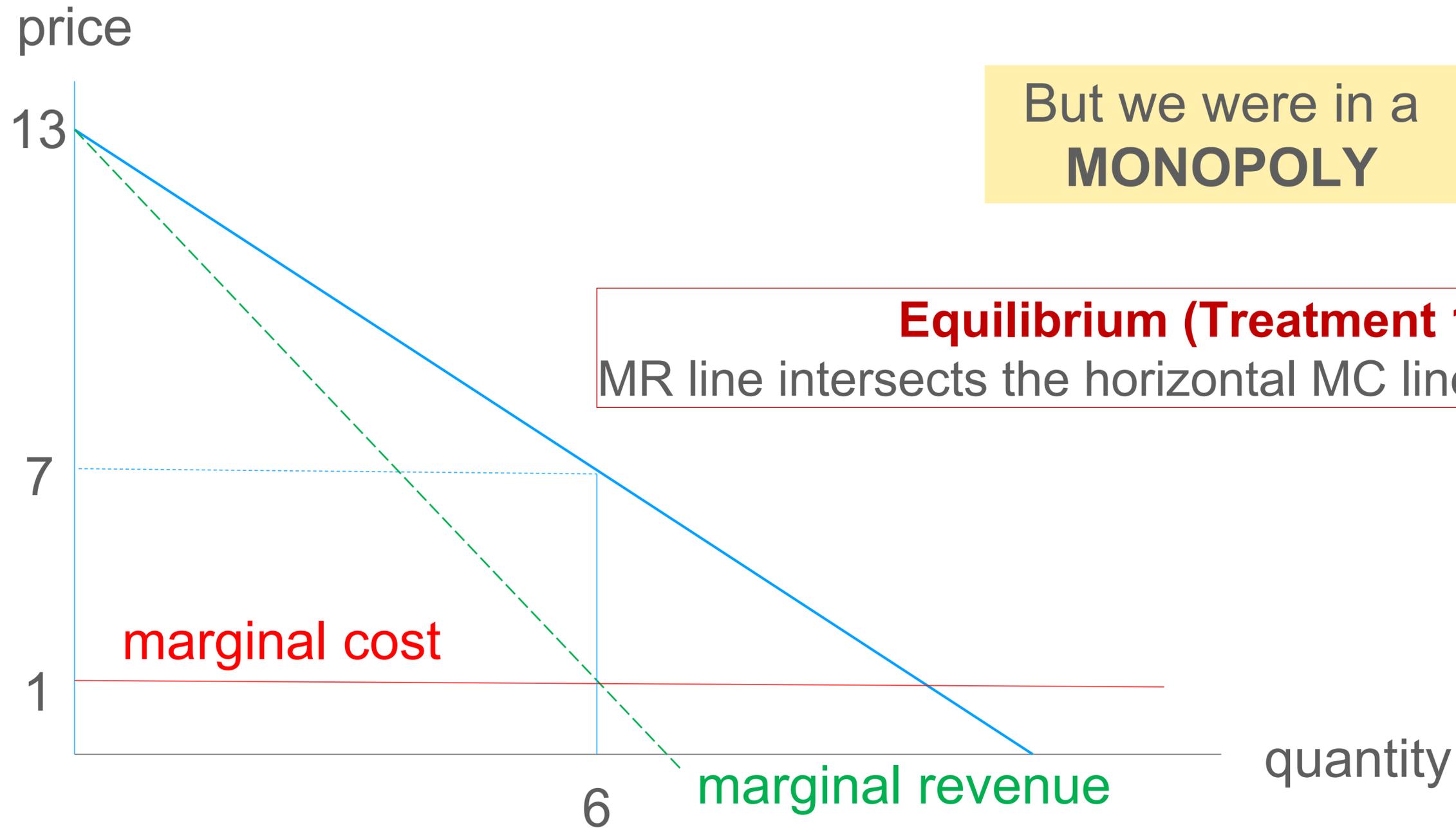


Treatment 1: Monopoly

Imagine that we were in a **COMPETITIVE MARKET**

Quantity	0	1	2	3	4	5	6	7	8	9	10	11	12	13
Price	13	12	11	10	9	8	7	6	5	4	3	2	1	0
TR=P*Q	0	12	22	30	36	40	42	42	40	36	30	22	12	0
TC=c*Q	0	1	2	3	4	5	6	7	8	9	10	11	12	13
Profit	0	11	20	27	32	35	36	35	32	27	20	11	0	-13
MR=13-2Q	13	11	9	7	5	3	1	-1	-3	-5	-7	-9	-11	-13
MC	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Treatment 1: Monopoly



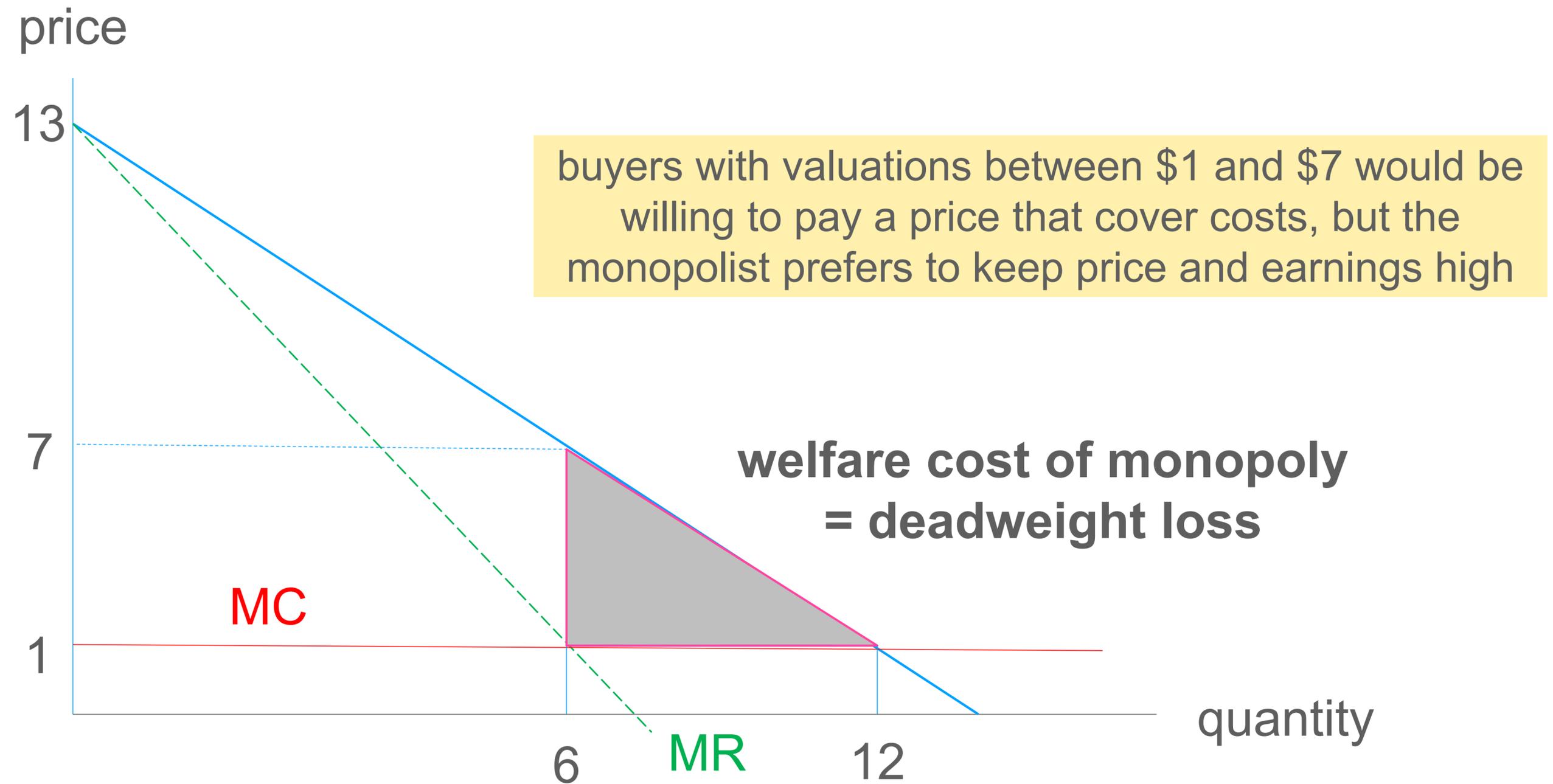
Treatment 1: Monopoly

But we were in a
MONOPOLY

Quantity	0	1	2	3	4	5	6	7	8	9	10	11	12	13
Price	13	12	11	10	9	8	7	6	5	4	3	2	1	0
TR=P*Q	0	12	22	30	36	40	42	42	40	36	30	22	12	0
TC=c*Q	0	1	2	3	4	5	6	7	8	9	10	11	12	13
Profit	0	11	20	27	32	35	36	35	32	27	20	11	0	0
MR=13-2Q	13	11	9	7	5	3	1	-1	-3	-5	-7	-9	-11	-13
MC	1	1	1	1	1	1	1	1	1	1	1	1	1	1

profit is going up as long as $MR > MC$

Treatment 1: Monopoly



Monopoly vs. perfect competition

1. Output and Price in Equilibrium:

Perfect competition: $P=MC$ at the equilibrium output

Monopoly: $P>MC$, equilibrium at $MR=MC$

→ Monopoly price is higher than perfect competition price

→ Perfect competition output is higher than monopoly output

2. Entry restrictions:

Perfect competition: no restrictions on the entry (or exit) of firms into the industry

Monopoly: strong entry barriers in order not to lose monopoly

3. Profits:

Perfect competition: firms make just enough profit to stay in business (theoretically 0)

Monopoly: difference between price and MC lead to monopoly profits > 0

Monopoly vs. perfect competition

4. Supply Curve of Firm:

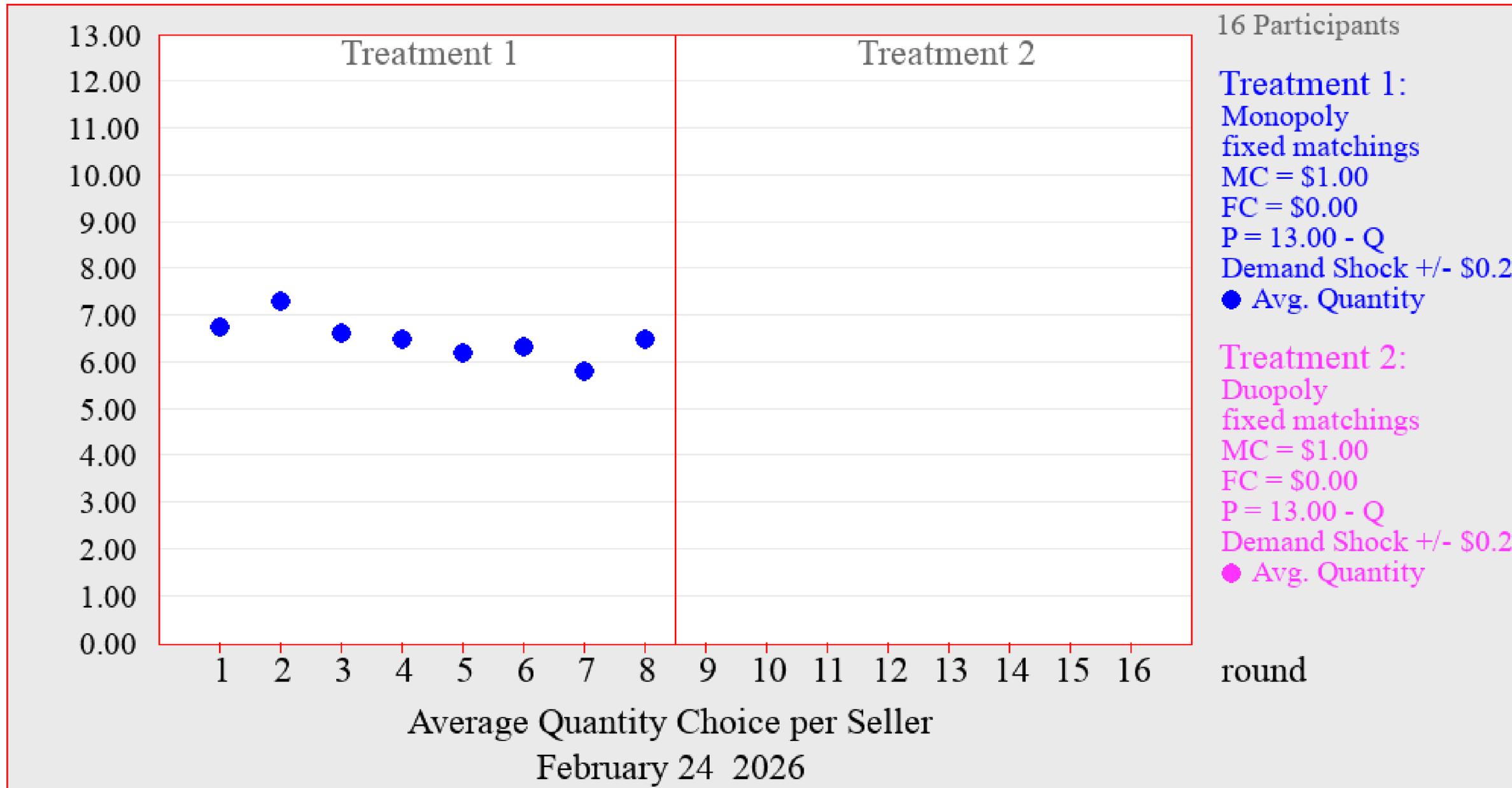
Perfect competition: supply curve can be known (derived from the costs)

Monopoly: supply curve must not be known. **MC curve is not the supply curve of the monopolist.**

5. Goals of Firms:

Under perfect competition and monopoly the firm aims at to maximize its profits (*given they behave rationally*)

Treatment 1: Monopoly – your data



Experiment treatment 1: Monopoly

Each participant has the role of a monopoly seller in a market with a constant cost of \$1 per unit, $c(q) = q$, and a simulated linear demand curve with a random shock ε , $E(\varepsilon) = 0$,

$$p = 13 - q + \varepsilon$$

$$\pi(q) = pq - c(q)$$

$$\pi(q) = (13 - q)q - q = 12q - q^2$$

$$\frac{\partial \pi}{\partial q} = 12 - 2q$$

$$\max_q \pi \rightarrow q = 6$$

Treatment 2: Cournot Duopoly

What happens if a second firm enters the market?

- Both firms have constant marginal costs of \$1
- Each selects an **output quantity**
- Price is determined by the sum of their quantities: $P = a - b * (q_1 + q_2) + \varepsilon$

$$E(\pi_1(q_1)) = q_1 * [13 - (q_1 + q_2) + E(\varepsilon)] - c(q_1) = 12q_1 - q_1^2 - q_1q_2$$

Since in equilibrium, $q_1 = q_2$

$$\max_{q_1} \pi_1 \rightarrow q_1 = 4$$

Experiment treatment 2: Duopoly

What happens if a second firm enters the market?

Both firms have constant marginal costs of \$1. Each firm selects an output quantity q_1, q_2 .

$$p = 13 - (q_1 + q_2) + \varepsilon$$

$$\pi_1(q_1) = (13 - (q_1 + q_2))q_1 - q_1 = 12q_1 - (q_1)^2 - q_1q_2$$

$$\frac{\partial \pi_1}{\partial q_1} = 12 - 2q_1 - q_2$$

$$\frac{\partial \pi_1}{\partial q_1} = 0$$

$$q_1 = \frac{12 - q_2}{2} = 6 - \frac{q_2}{2}$$

in equilibrium it must be $\rightarrow q_1 = q_2$

$$\rightarrow q_1 = 4$$

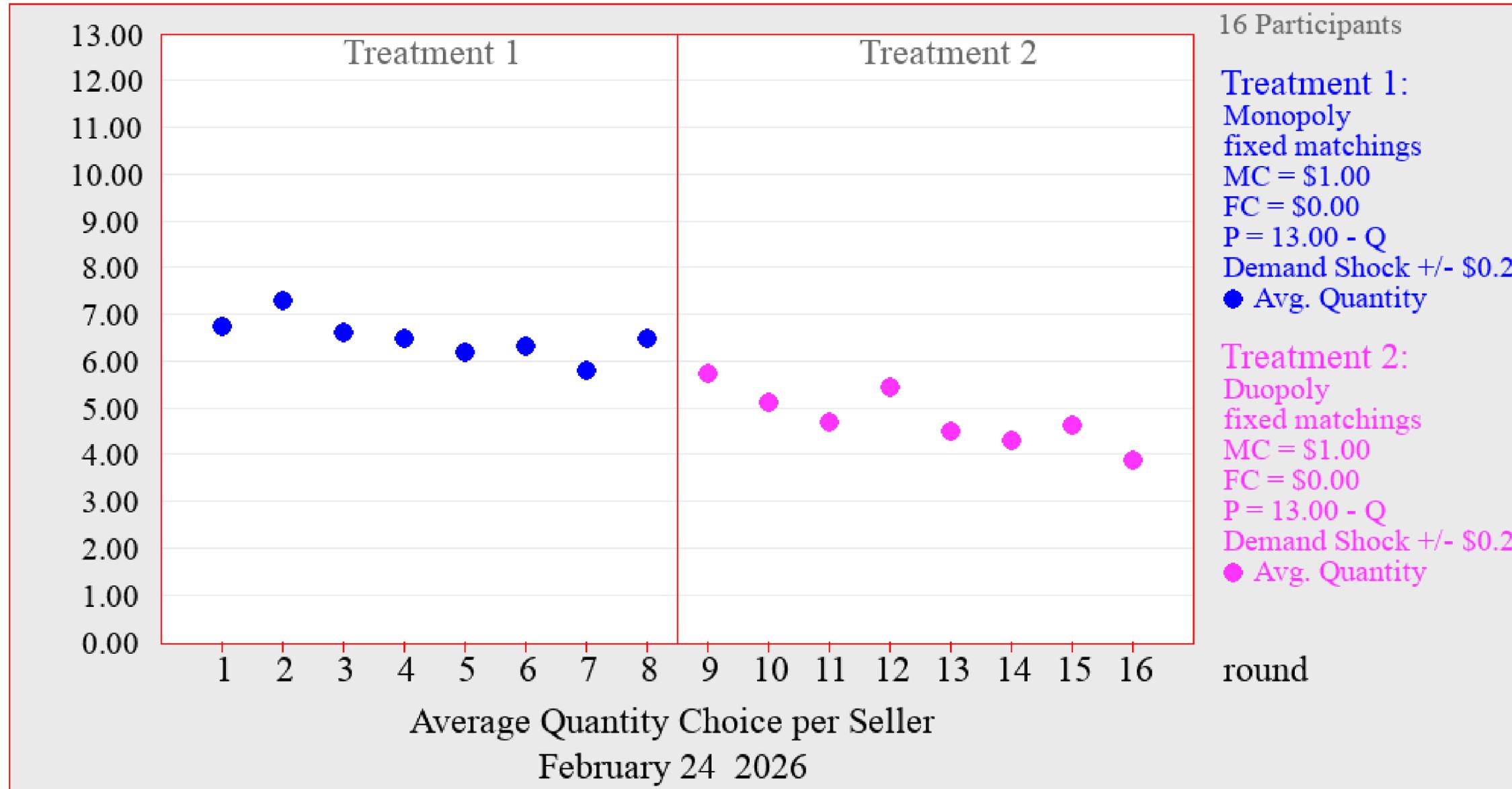
$$q_2 = R_2(q_1 = 4) = 4$$

Cournot Duopoly: profit matrix and best responses

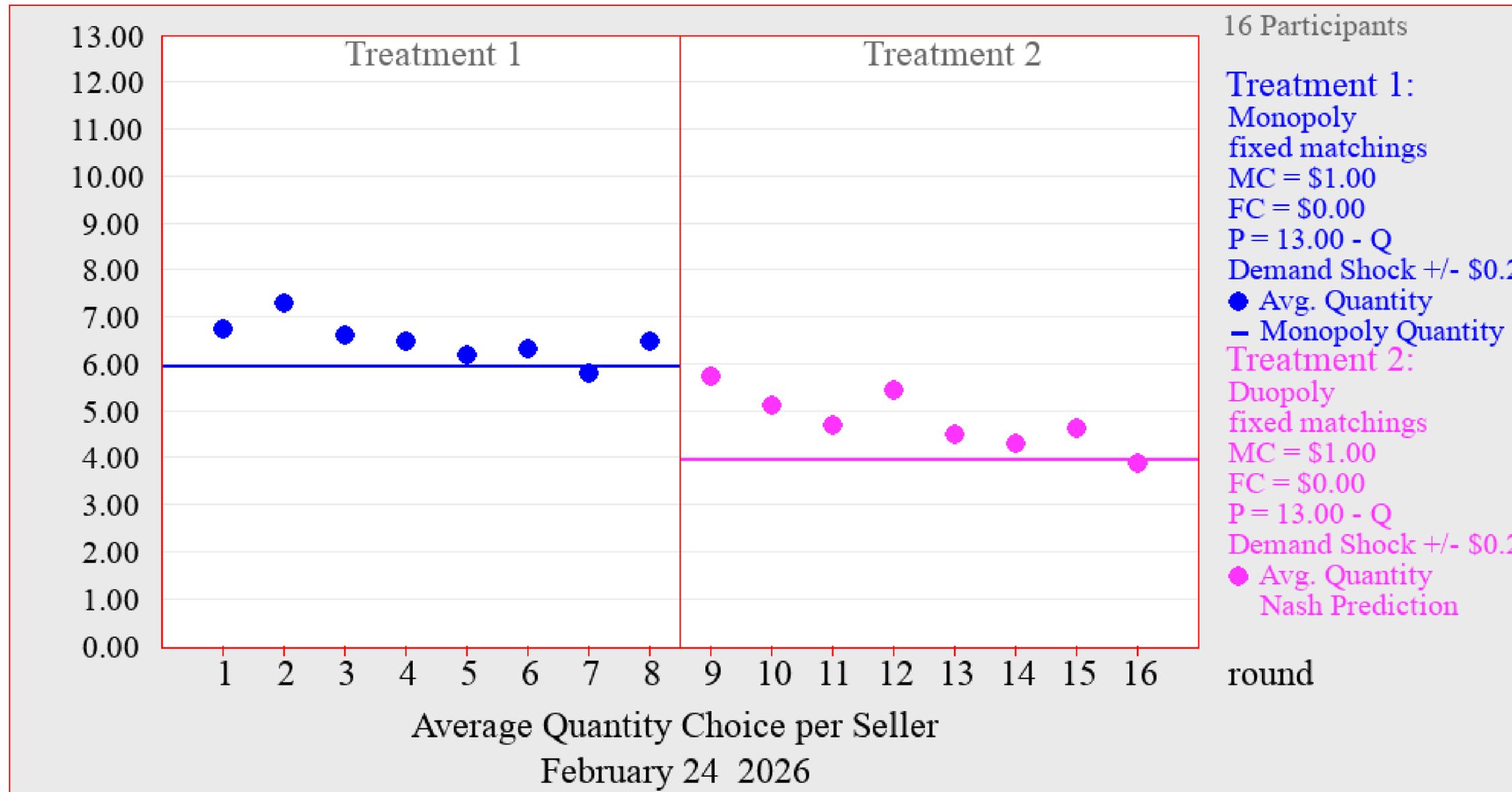
What happens if a second firm enters the market?

		Firm 2 (entrant)								
		0	1	2	3	4	5	6	...	
Firm 1 (incumbent)	Chosen quantity by each firm									
	0	0, 0	0, 11	0, 20	0, 27	0, 32	0, 35	0, 36	...	
	1	11, 0	10, 10	9, 18	8, 24	7, 28	6, 30	5, 35	...	
	2	20, 0	18, 9	16, 16	14, 21	12, 24	10, 25	8, 24	...	
	3	27, 0	24, 8	21, 14	18, 18	15, 20	12, 20	9, 18	...	
	4	32, 0	28, 7	24, 12	20, 15	16, 16	12, 15	8, 12	...	
	5	35, 0	30, 6	25, 10	20, 12	15, 12	10, 10	5, 6	...	
	6	36, 0	30, 5	24, 8	18, 9	12, 8	6, 5	0, 0	...	
...		

Treatment 2: Duopoly – your data



Treatment 2: Duopoly – your data



The quantities, which start at an average of 6 for each firm in period 9, begin to decline in subsequent periods.

The outputs fall to an average of 4 for each seller, the equilibrium, in the sense that if one seller is choosing 4, the best response of the other is to choose 4, too.

NEXT CLASS

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