LECTURE 5.0

PRODUCT DIFFERENTIATION

OUTLINE

5.0 Product differentiation

5.1 Horizontal product differentiation

5.2 Preemption

5.3 Pricing complementary products

READING

Chapter 4, ”Differentiation” in McAfee (2002) *Competitive Solutions*

A link to this chapter is in the Week 5 reading page on Canvas.

VALUE CREATION

Think of value as the sum of producer and consumer surplus.

- Net value to consumer is (Willingness to Pay minus Price), i.e. consumer surplus.
- Net value to seller is (Price minus marginal cost), i.e. Producer surplus
- Hence total value equals (Willingness to Pay minus marginal cost), i.e. Total Surplus.

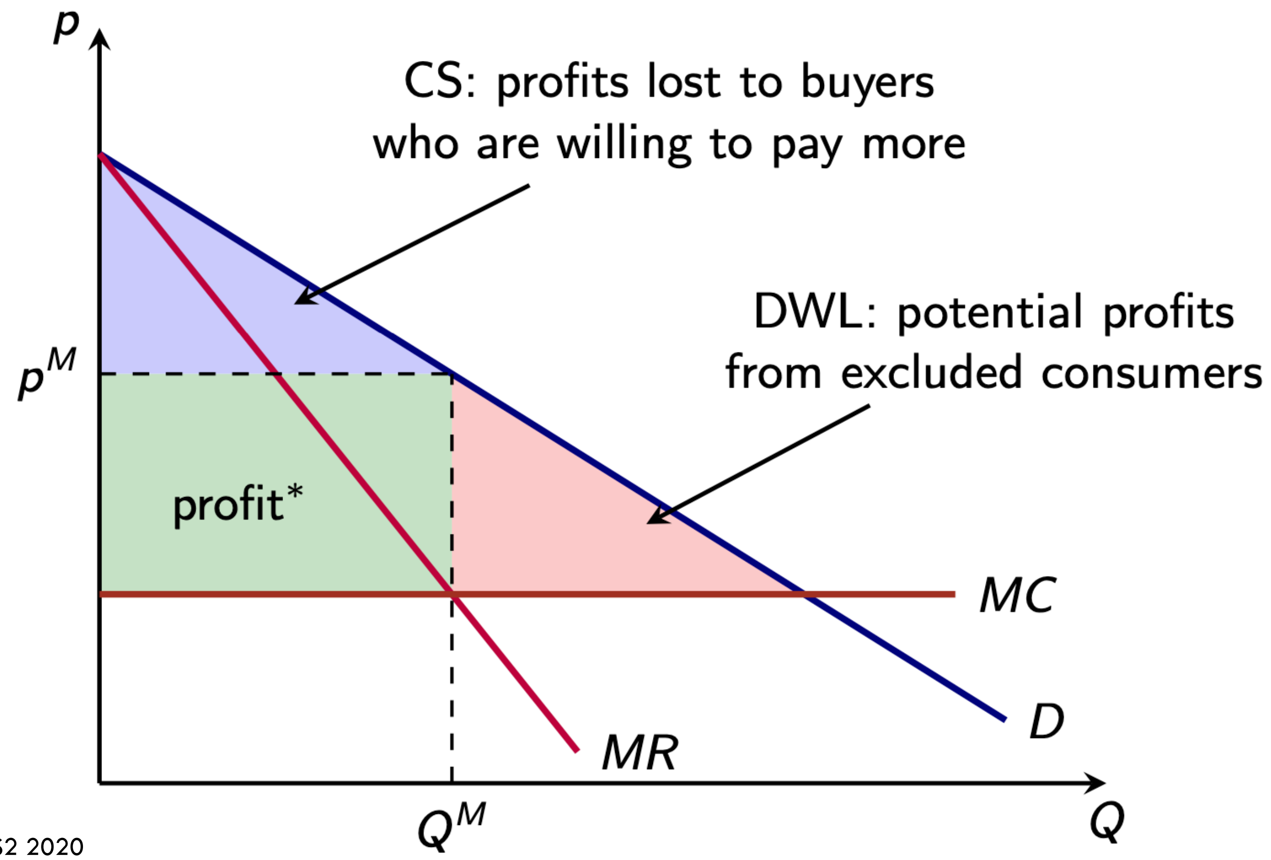
It is important to note how to think about willingness to pay.

- For consumers it reflects the utility derived from consumption of good or service.
- For business buyers it reflects the next best alternative: e.g. sugar versus corn syrup in soft drink production

As we have already considered in the context of pricing, it is important to note that Willingness to Pay will vary over buyers

VALUE CREATION

Recall this diagram from last week.



PRODUCT DIFFERENTIATION

The question for a firm is how can they capture more of the value.

One strategy to capture value is product differentiation

- By making your self different or creating some uniqueness, i.e. offering a product no one else sells.
- By doing so you create some market power.
- This could come through market entry or it could come from creating a new product in an existing market

PRODUCT DIFFERENTIATION

Competing products often have distinguishing characteristics

- physical differences
- perceived differences (e.g. pharmaceuticals, home brands)
- service quality
- location

Product differentiation alters the strategic interaction between firms

- product differentiation provides firms with market power
- firms have downward sloping demand curves
- one explanation for pricing above marginal cost

PRICE COMPETITION WITH DIFFERENTIATED PRODUCTS

With differentiated products, demand depends on the prices of all related products:

$$q_i = q_i(p_1, p_2, \dots, p_n)$$

e.g. suppose firms 1 and 2 produce imperfectly substitutable products

$$q_1 = 100 - 2p_1 + p_2$$

How does this demand curve compare with the Bertrand model?

PRICE COMPETITION WITH DIFFERENTIATED PRODUCTS

Suppose there are two firms who compete by simultaneously setting prices. They face the market conditions below. Find equilibrium prices.

Demand:

$$q_1 = 100 - 2p_1 + p_2 \qquad i, j = 1,2$$

Costs:

$$C_i(q_i) = 10q_i \qquad i = 1,2$$

PRICE COMPETITION WITH DIFFERENTIATED PRODUCTS

Firm 1 has profits:

$$\pi_1 = (100 - 2p_1 + p_2)(p_1 - 10)$$

To maximise profits, solve FOCs (set the slope of profits to zero):

$$\frac{d\pi_1}{dp_1} = 100 - 2p_1 + p_2 - 2(p_1 - 10) = 0$$

$$4p_1 = 120 + p_2$$

$$p_1 = 30 + \frac{p_2}{4} \equiv R_1(p_2)$$

Similarly, for Firm 2:

$$p_2 = 30 + \frac{p_1}{4} \equiv R_2(p_1)$$

PRICE COMPETITION WITH DIFFERENTIATED PRODUCTS

In equilibrium, both firms operate on their reaction function:

$$p_1 = 30 + \frac{30 + \frac{p_1}{4}}{4}$$

$$p_1 = 40 = p_2$$

TYPES OF DIFFERENTIATION

Horizontal differentiation

- Consumers have different product rankings
- e.g. red BMWs and blue BMWs
- Could think about horizontal differentiation as a choice over location

Vertical differentiation

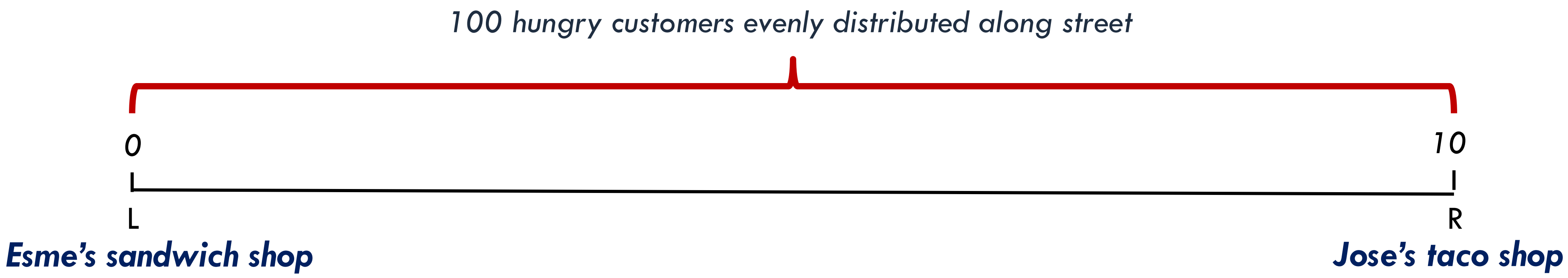
- Consumers agree on the ranking of products
- Consumers have different preferences for quality
- e.g. new BMWs and used Toyota Corollas

LECTURE 5.1

HORIZONTAL DIFFERENTIATION

HORIZONTAL DIFFERENTIATION

We have two shops at each end of a street 10km apart. Consumers prefer to eat nearby. (We considered this example in week 3 in the context of monopolistic competition.)

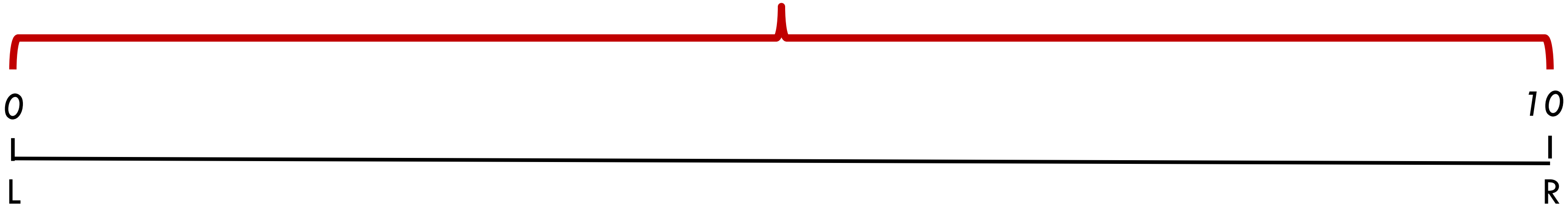


HORIZONTAL DIFFERENTIATION

Consider a consumer is located fraction *x* of way from L to R. Assume the cost of moving from L to R is *c*. The location of the marginal consumer who is indifferent between L and R is:

$$x^* = 0.5 + \frac{P_R - P_L}{2c}$$

100 hungry customers evenly distributed along street

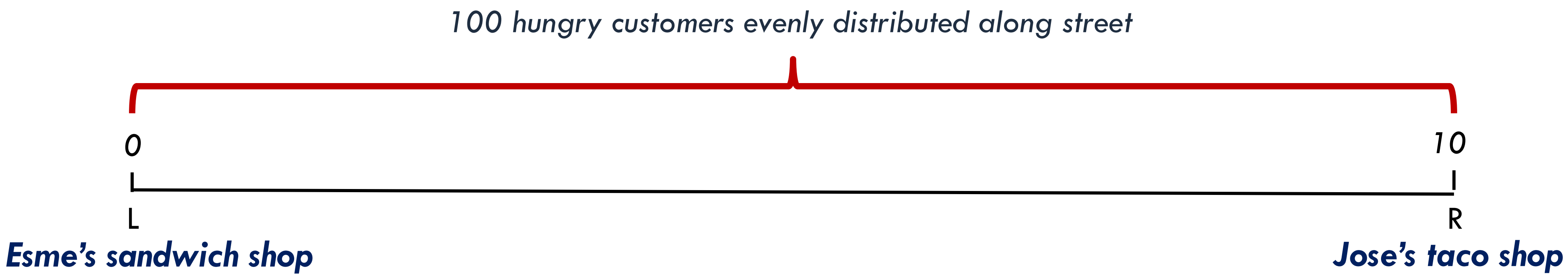


Esme's sandwich shop ***Jose's taco shop***

HORIZONTAL DIFFERENTIATION

If c= \$0.50 per kilometre and P_E=4 and P_J=5:

$$x^* = 0.5 + \frac{5-4}{2(5)} = 0.6$$



HORIZONTAL DIFFERENTIATION

$$x^* = 0.5 + \frac{P_R - P_L}{2c}$$

If firms have the same price the marginal customer is in the middle.

When one of the firm's decreases its price, it increases sales at a rate proportional to $1/2c$.

Hence, when *c* is small business stealing is easy (because 1/2*c* is large). A change in price leads to a large change in demand. (Think about this as the products being barely differentiated – they are close substitutes)

The transportation cost c measures the degree of differentiation.

HORIZONTAL DIFFERENTIATION

What is the profit maximizing price? The share of customers for L is *x**, so if we assume zero production costs the best price for *L* is to choose P_L to maximise:

$$\pi_L = P_L\left(0.5 + \frac{P_R - P_L}{2c}\right)$$

FOC (for L):

$$0.5 + \frac{P_R}{2c} - \frac{P_L}{c} = 0$$

Solving:

$$\mathrm{p_L} = \frac{\mathrm{c} + \mathrm{p_R}}{2}$$

HORIZONTAL DIFFERENTIATION

$$p_L = \frac{c + p_R}{2}$$

Implications:

- An increase in *c* which isolates L from R will lead to an increase in price
- An increase in P_R will lead to an increase in P_L

Prices increase in both the amount of differentiation and the level of competitors prices, but there is less than full pass on.

Nonetheless, in the model above the Nash Equilibrium is that both firms charge c!

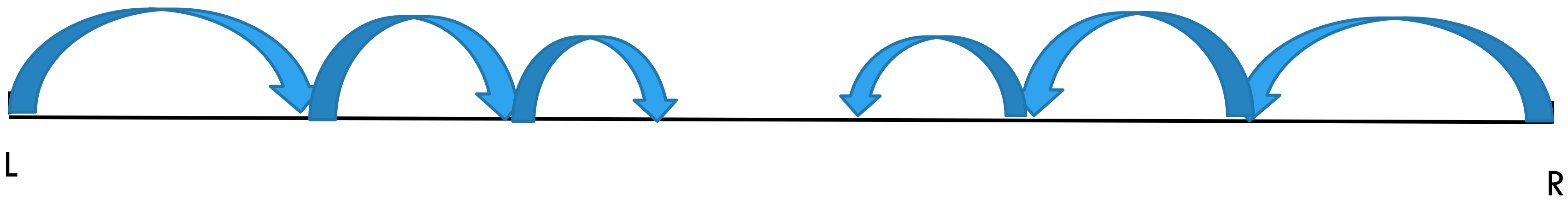
Implication – firm profits increase in the degree of differentiation.

ENDOGENOUS LOCATION

Now ask what the model looks like if we hold prices constant. In this case the model becomes one of location choice.

Moving from L to R, this causes the marginal consumer to move from the L to the R.

Similarly, the firms on the R will have an incentive to move to the L, causing the marginal consumer to move from the R to the L….



ENDOGENOUS LOCATION

Where to the firms end up?

In the middle.

This is why it is claimed that many firms end up offering something similar.

This reasoning is not just confined to firms, but also political parties who try to capture the middle ground.

ENDOGENOUS LOCATION

Note that this result applies for two firms but not for many.

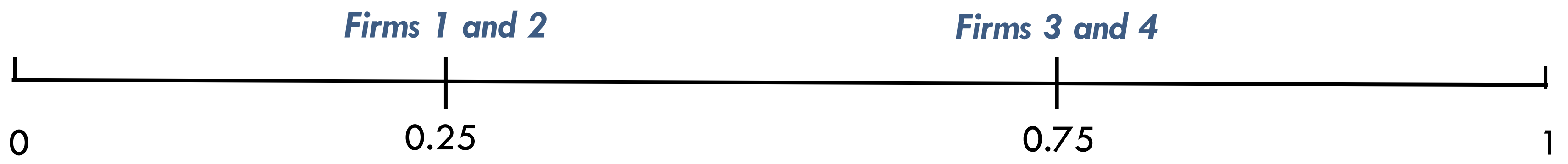
Suppose that there were four firms and they were all in the middle.

What do you think might happen?

So what might the result end up looking like?

ENDOGENOUS LOCATION

We will discuss this in the tutorial, but we would expect in this case:



ENDOGENOUS PRICES AND LOCATION

What happens when prices are adjustable along with firm location?

When prices are flexible you want to be further away from your rivals.

When firms choose best responses (for fixed location) the price was equal to set price equal to *c:* the transportation cost between the two locations.

The higher this distance is the greater is the price and the greater are the profits for each of the firms.

The key constraint is that when you get further away from each other, what is likely to happen?

ENDOGENOUS PRICES AND LOCATION

What does your location do to other firm’s price?

When you move further away from your competitor you tend to increase your own price and also help your competitor.

Why?

Intuitively, for the competitor, the competition is further away and it has a higher price!

But then, the firm that moves away also gets a flow on benefit of the competitor raising its own price.

HORIZONTAL DIFFERENTIATION

We don’t need to confine our differentiation to that of geography or physical location.

Breakfast Cereals

Not sweet *Sweet*

Chips

Healthy *Heart attack inducing*

Movies

Period drama *Action*

LECTURE 5.2

PREEMPTION

PREEMPTION

How can you deter entrants and capture value by filling in the product space?

Idea: increase number of varieties to leave no room for potential entrants in “product space”.

PREEMPTION

Example: ready-to-eat breakfast cereals:

- Consumers differ in preferences for some characteristic (sweetness): uniformly distributed from 0 (Weetbix) to 100 (Chocolate-Frosted Sugar Bombs).
- Monopolist decides on number of varieties and product positioning. Entrant then makes similar decision.
- Each consumer buys 1 unit of the nearest variety (up to distance 30).
- Price is fixed at p=1.
- Cost of new variety equivalent to a market share of 15.

PREEMPTION

What is the monopolist's optimal strategy if there is no potential rival?

- One variety leads to profit $60 - 15 = 45$
- Two varieties lead to profit $100 - 2 \times 15 = 70$.
- Three varieties lead to profit $100 - 3 \times 15 = 55$.
- Four varieties lead to profit $100 - 4 \times 15 = 40$.
- ...

PREEMPTION

The monopoly strategy is not immune to entry:

- Suppose we offer only two varieties (e.g. at 30 and at 70).
- By entering at 50, entrant captures all consumers between 40 and 60.
- Therefore entrant's market share is 20, but cost is only 15.
- After entry, the incumbents profits drop to 80 − 30 = 50.
- A new entrant could also enter at 29 or 71 and capture other customers, completely erasing their profit.

PREEMPTION

Consider a “preemption” strategy:

- Incumbent offers four varieties: at 15, 40, 60 and 85
- Now there is no room for profitable entry!
- Incumbent’s profits are now 100 − 60 = 40 (better than zero, but still less than “pure” monopoly with no potential entry).

PREEMPTION

Preemption can occur with fewer products than would be sold in a competitive equilibrium with zero profit.

The intuition is that by preempting you ‘tie up’ the available product space in such a way that after entry, the entrant is worse off than they would be in a competitive outcome, i.e. earning zero economic profits.

PREEMPTION

Conclusion: product proliferation can deter entry.

- Example: CVS/Walgreens at every corner.

Staples followed a very similar strategy:

> *Staples was trying to build a critical mass of stores in the North- east to shut out competitors... By building these networks [of stores] in the big markets like New York and Boston, we have kept competitors out for a very, very long time.*
>
> Staples founder Thomas Stemberg

LECTURE 5.3

PRICING COMPLEMENTARY PRODUCTS

PRICING COMPLEMENTARY PRODUCTS

Consider what happens if firms can cooperate over complementary products?

Suppose Penelope owns a popcorn stand within Cindy's Cinema. Consumers purchase movies and popcorn together. The demand for movies and popcorn is given by

$$Q = 14 - (P_c + P_P),$$

P_c is the price of a movie, and P_p is the price of popcorn.

The marginal cost of popcorn is \$2, and the marginal cost of an additional cinema patron is \$0.

Cindy and Penelope choose their prices simultaneously. What are the equilibrium prices for Cindy and Penelope? We can see the maximum price of the two goods together must be \$14.

PRICING COMPLEMENTARY PRODUCTS

First, consider Penelope's problem. Her profits are:

$$\pi_P = Q(P_P - c_P) = \big(14 - (P_C + P_P)\big)(P_P - 2)$$

To maximise profits, Penelope solves FOCs:

$$0 = 14 - P_C - P_P - (P_P - 2)$$

$$P_P = 8 - \frac{P_C}{2}$$

This is Penelope's reaction function, as a function of Cindy's price.

PRICING COMPLEMENTARY PRODUCTS

Next, consider Cindy's problem. Her profits are:

$$\pi_P = Q(P_C - c_C) = \big(14 - (P_C + P_P)\big)(P_C - 0)$$

To maximise profits, Cindy solves FOCs:

$$0 = 14 - P_C - P_P - (P_C - 0)$$

$$P_C = 7 - \frac{P_P}{2}$$

This is Cindy's reaction function, as a function of Penelope's price.

PRICING COMPLEMENTARY PRODUCTS

In equilibrium, both Cindy and Penelope are on their reaction functions:

$$P_P = 8 - \frac{7 - \frac{P_P}{2}}{2}$$

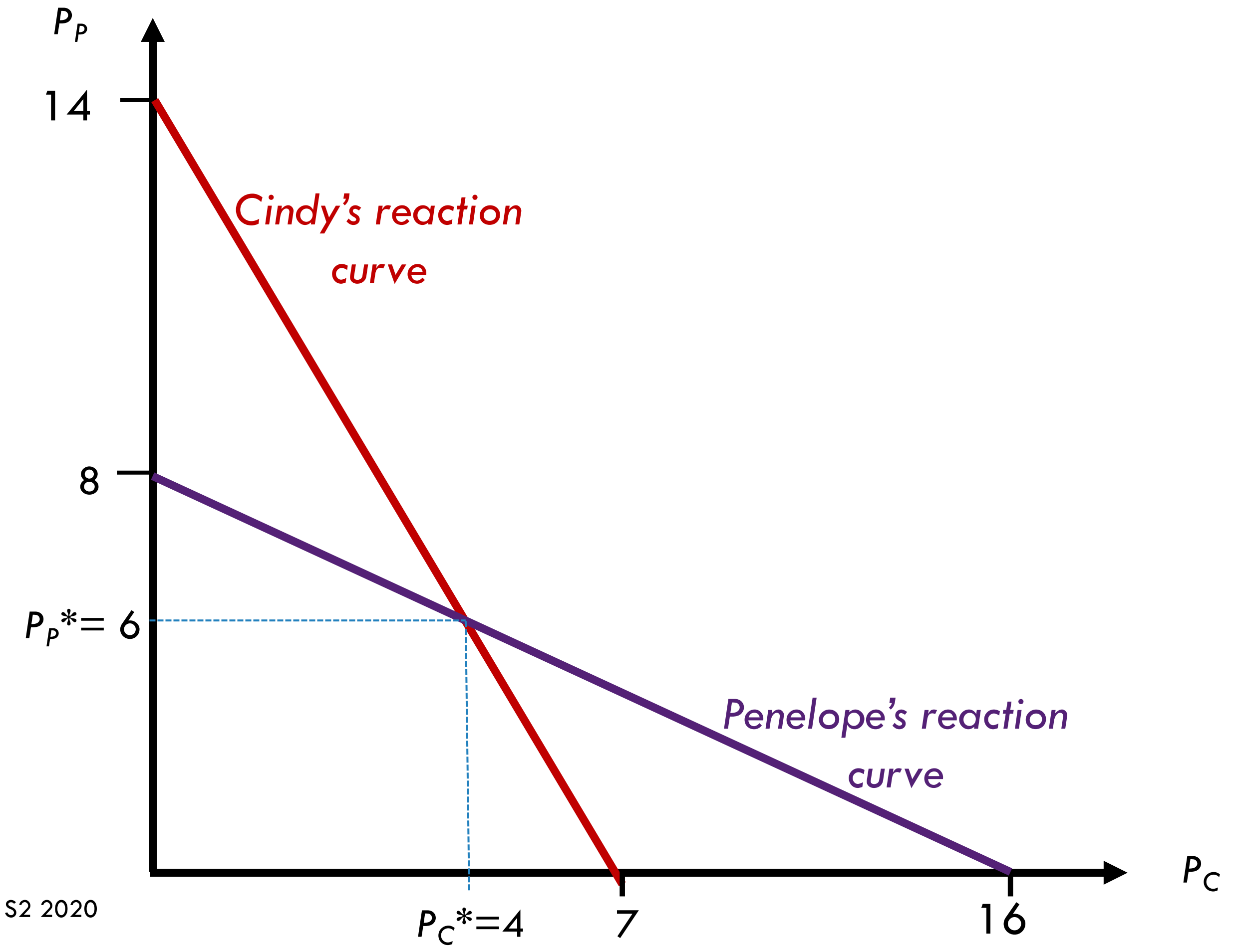
$$P_P = 6$$

Substituting into Cindy's reaction function:

$$P_C = 7 - \frac{P_P}{2} = 4$$

They sell 4 tickets/popcorns. They make $16 profit each.

PRICING COMPLEMENTARY PRODUCTS



A MULTIPRODUCT FIRM

An alternative is for Penelope and Cindy to cooperate over the pricing of complementary products

- create a joint venture
- merge
- cooperate (pricing agreements are illegal)

What is the optimal price of the combined product? Why is this different from the case of separate pricing?

A MULTIPRODUCT FIRM

Recall the demand curve and therefore the marginal revenue curve of the products.

Demand: $Q = 14 - P$

Marginal revenue: $MR = 14 - 2Q$

Now they will sell 6 tickets ($MR = MC = 2$) at a price of $8 each for a total profit of $36.