Industrial Organization - III

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Exam date

The exam will take place the 29^{th} of November at 10AM.
It will last 2 hours.

Organizing the presentations

Here is a link to a spreadsheet you can fill to organize your groups and coordinate over topics.

I would like to see all different topics. Here is the link:

`https://docs.google.com/spreadsheets/d/15sadDcf17ysup4UaTx_TJb_6e0ud57crTLAVw2cvgpM/edit?usp=sharing`

Let me know if it does not work.

The file contains the instructions for the presentation, but do not hesitate to ask me if you have any doubts.

Recap of Cournot

- A model of duopoly where firms compete on quantity.
- Relevant when quantities produced must be decided in advance.
- When the firms have the same technology, they produce the same quantity.
- The price is determined by looking at the total output.
- If there were more than two firms (oligopoly), each firm would still produce positive quantity.
- NEW: If the technology is different, still both produce positive quantity

Today's class

- Bertrand competition: competition on prices.
- Collusion
- Price wars

Bertrand model

A "good" model for situations where firms are flexible adjusting their output.

The framework is:

- Two firms (duopoly)
- Homogeneous products
- Firms **simultaneously set the price**
- Same technology (same MC)

Strategies

What happens if one firm sets the price lower than the competitor?

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The firm that sets the lower price gets the whole market.

What if both firms set the same price?

By setting the same price, the firms split the market.

Let's go back for a second

		Firm 2		
		5	4	3
Firm 1	5	7.5 7.5	12 0	7 0
	4	0 12	6 6	7 0
	3	0 7	0 7	3.5 3.5

Whats is the equilibrium?

Continuous strategies

Differently from the previous game, now the strategy is a price, and can be any price.

Discrete vs. continuous

If **discrete**, a variable can only take specific values (example: 1,2,3,...)
If continuous, a variable can take any value within a range (example: (0,1))

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If continuous, a variable can take any value within a range (example: (0,1))

We cannot use a matrix anymore to represent the game.

Definitions

- p_1 is a function of p_2. A price is a **best response** as long as:

$$\pi_1(p_1^*, p_2) \geq \pi_1(p_1, p_2) \quad \text{for all possible} \quad p_1$$

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- A Nash equilibrium is a couple of prices (p_1^N, p_2^N) such that:

$$\pi_1(p_1^N, p_2^N) \geq \pi_1(p_1, p_2^N)$$
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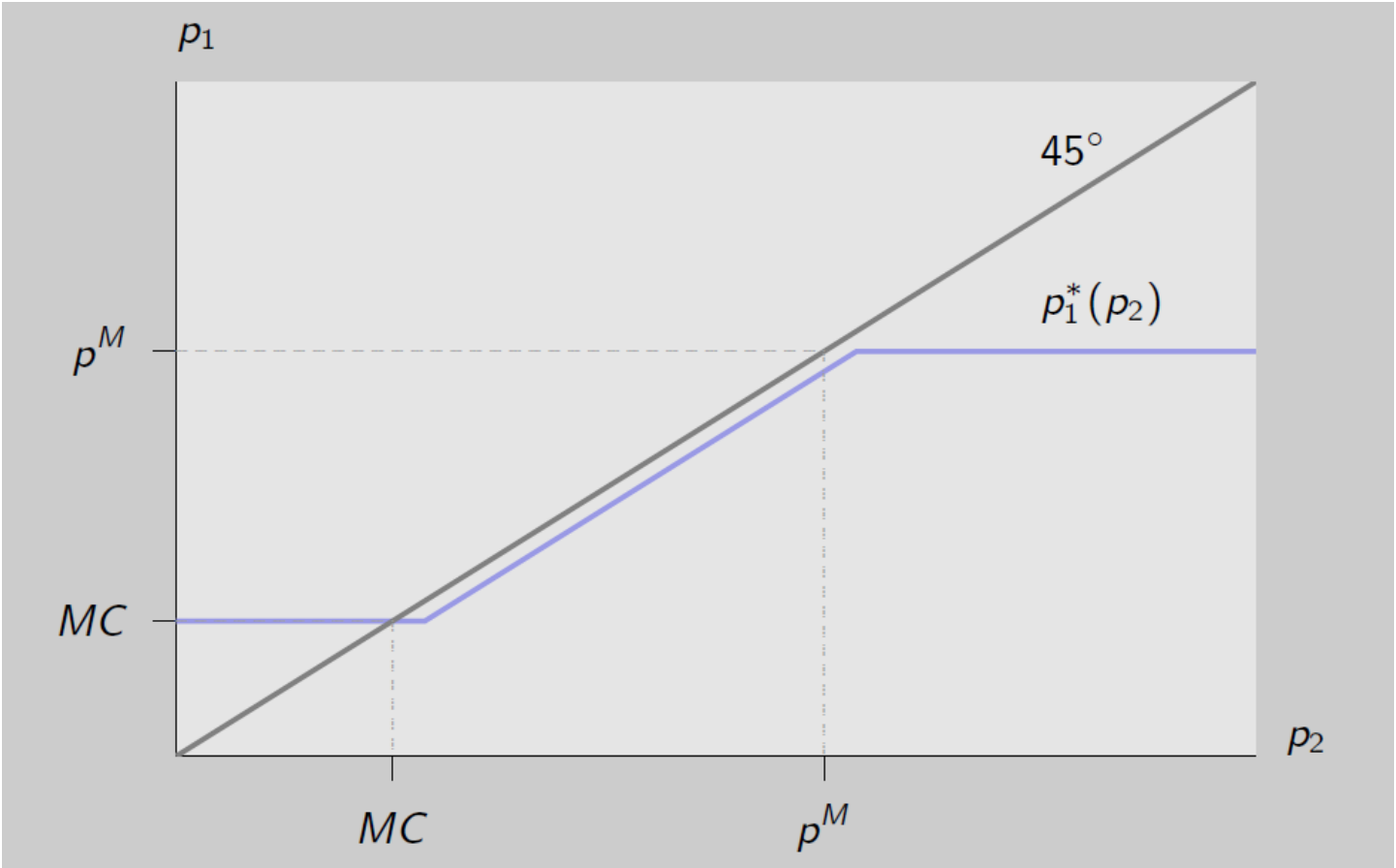
- Equivalent to saying that p_1^N, p_2^N are a best response.

Graphic of best responses



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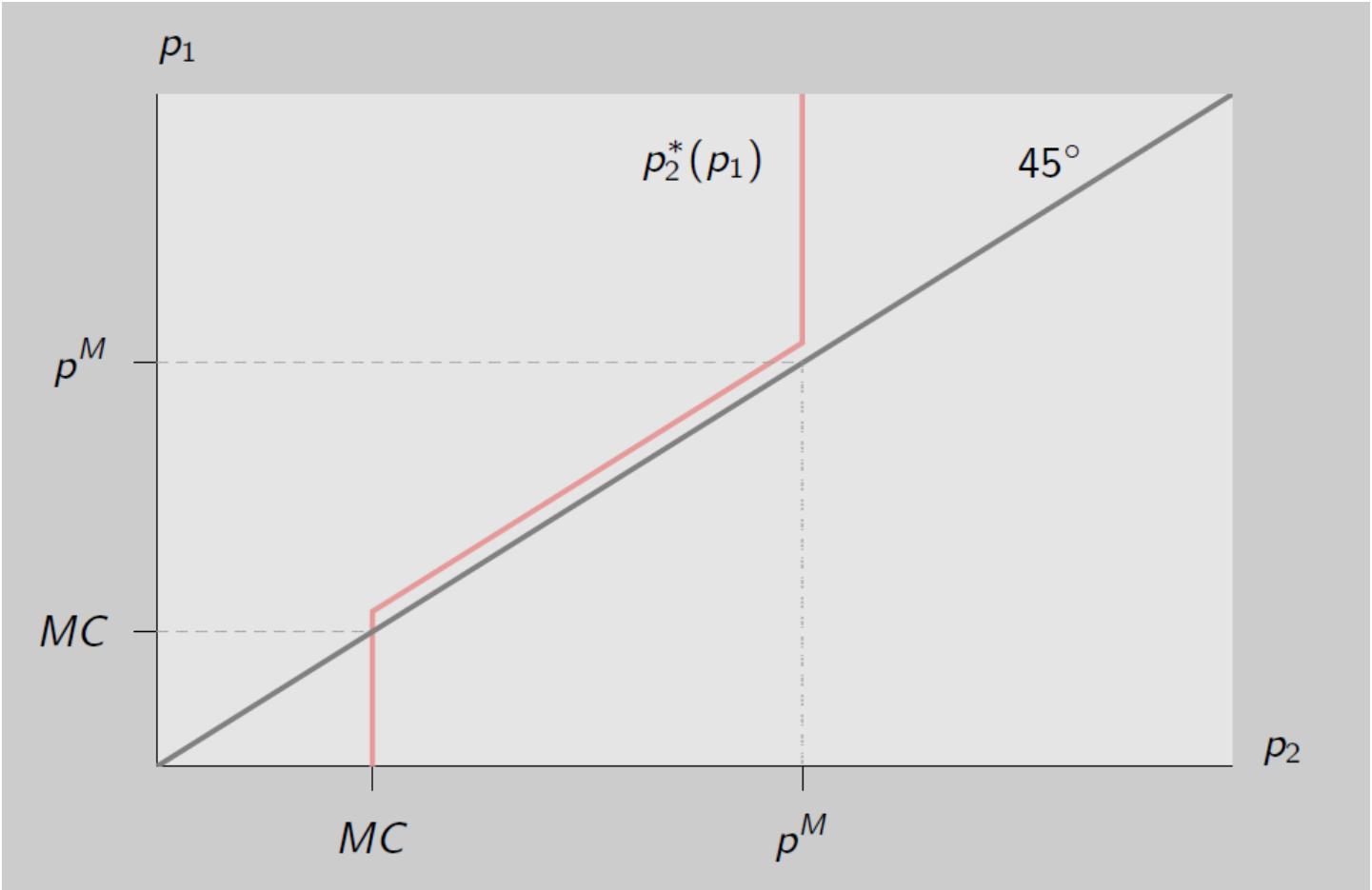
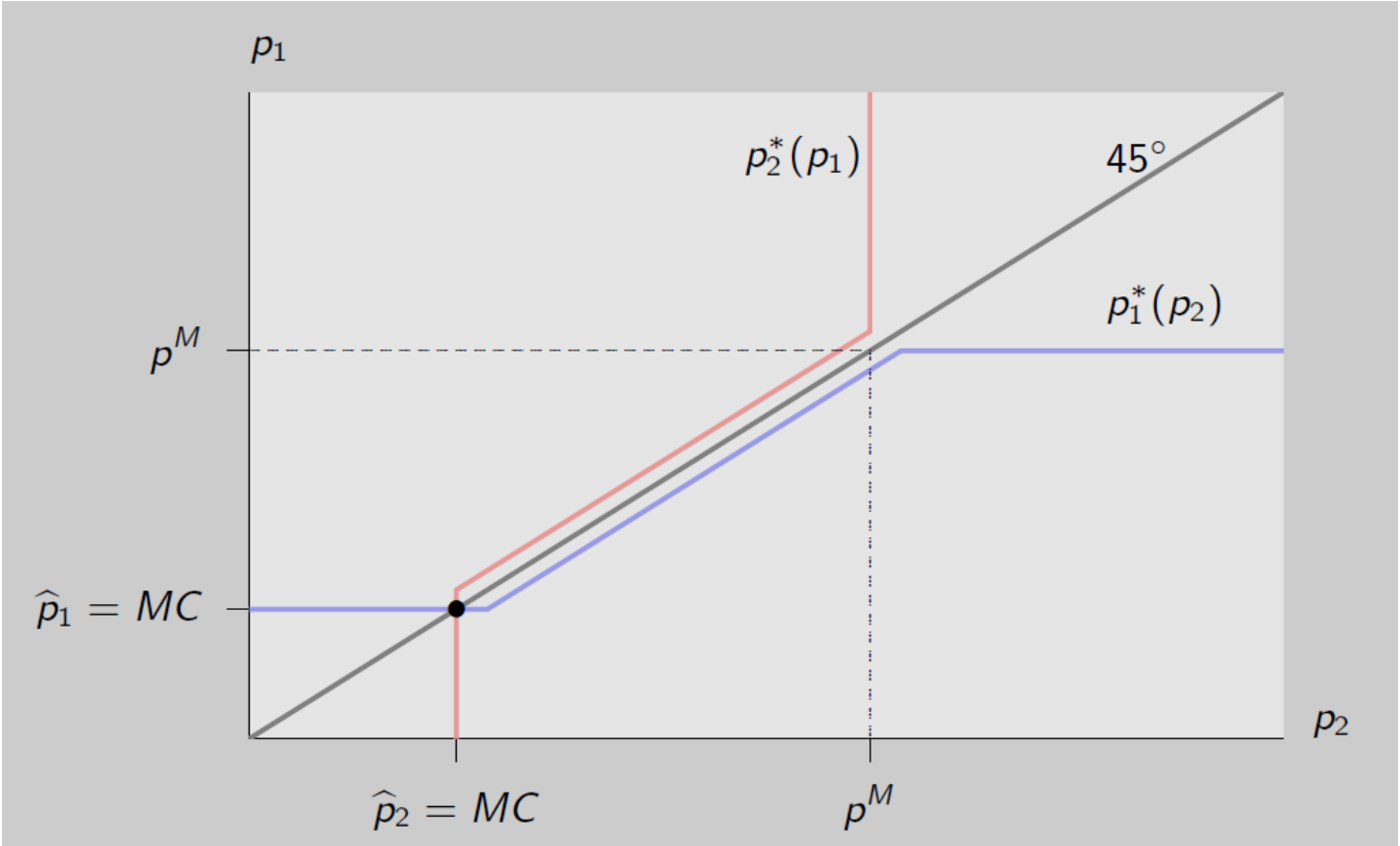


Graphic of Nash equilibrium



Results

- Even with only two firms, price in equilibrium is the same as perfect competition!
- Zero profits.
- Demand or supply (global) shocks do not increase profits in the short run.

How to get out of the Bertrand's trap

- Product differentiation (like monopolistic competition)
- Limit capacity (harder to adjust quantities)
- "Just get good": produce at lower cost than the competition
- Make agreements (explicit or implicit)

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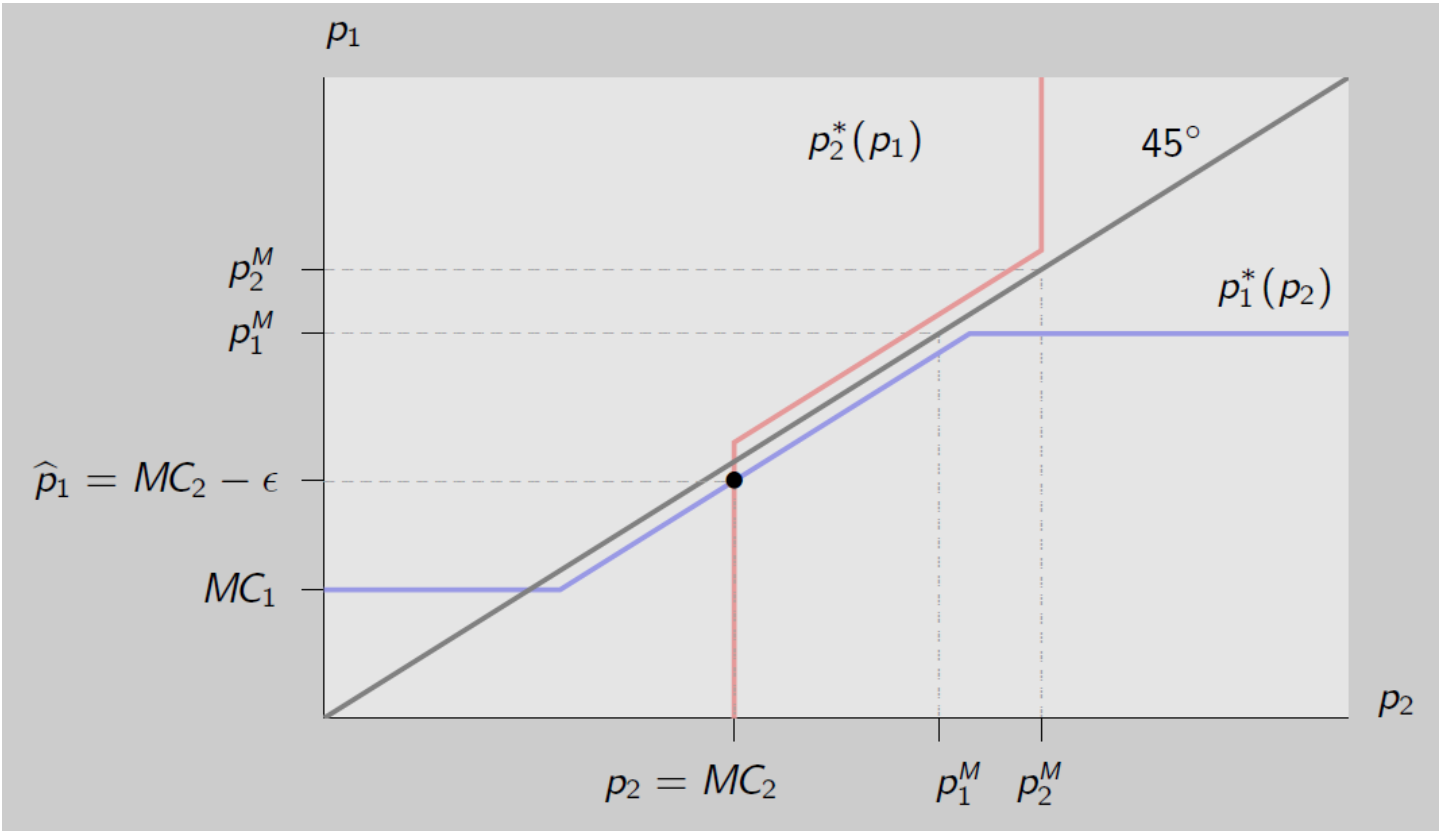
Any issue?

“Just get good”



Collusion

One of the most effective ways to escape the Bertrand's trap is to make agreements:

1. Public and institutional **cartel** agreement
2. Secret agreement
3. Tacit agreement

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Types of agreement:

- Price
- Reduced supply
- Service quality
- Territory restrictions

How to sustain a collusive agreement

If firms play the game once, we fall into Bertrand equilibrium.

Important condition

For collusion to be sustained we need a situation of repeated competition.

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For collusion to be sustained we need a situation of repeated competition.

If two (or more) firms compete over a sequence of periods it is possible to sustain monopoly prices!

Digression: discount factor

Definition

The discount factor is broadly a measure of how individuals value time.

Example:

Do you prefer 100 euros today or 105 euros in one year?

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How about 100 euros today or 110 euros in one year?
...
What if 100 euros today or 150 euros in one year?

Discount factor

We call the discount factor δ that makes an amount of money today equal (in terms of preferences) to a greater amount tomorrow.

The repeated game of competition

We have seen that if both firms set the same price, they would split equally the market.

Firms share the quantity sold, and also the profits (if any).

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Imagine if firms both firms set the monopoly price:

$$p_1 = p_2 = p^M \quad \pi_1 = \pi_2 = \frac{1}{2}\pi^M$$

The sequence of payoff

It is called expected discounted payoff:

$$V = \frac{1}{2}\pi^M$$

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The sequence of payoff

It is called expected discounted payoff:

$$V = \frac{1}{2}\pi^M + \delta\frac{1}{2}\pi^M + \delta^2\frac{1}{2}\pi^M + \dots$$

If we sum infinitely $\delta + \delta^2 + \delta^3 + \dots$ this is a geometric series, and $\delta < 1$

The repeated game of competition - II

We can rewrite our expected discounted payoff (of playing p^M an infinite amount of times):

$$V = \frac{1}{2}\pi^M \frac{1}{1-\delta}$$

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$$V' = \pi^m + 0 + 0 + \dots$$

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because the first period the deviating firm gets all the market at the monopoly price. From the next period the opponent **punishes** by setting competitive price and profits go to 0.

The repeated game of competition - III

The collusion is sustainable whenever $V > V'$.

$$V = \frac{1}{2}\pi^M \frac{1}{1-\delta} > \pi^m + 0 + 0 + \cdots = V'$$

Which is true for all $\delta > \frac{1}{2}$.

The repeated game of competition - III

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Which is true for all $\delta > \frac{1}{2}$.

The big takeaway

If there are repeated interactions, it is possible to sustain monopoly prices in a duopoly, if firms are **patient** enough.

Why is collusion not more frequent?

As we have seen, if *future is important enough* it is possible to sustain collusion.

Back to the discount factor

Broadly, the discount factor measures how one euro next year is worth now (objective measure: interest rate):

$$\delta = \frac{1}{1+r}$$

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Broadly, the discount factor measures how one euro next year is worth now (objective measure: interest rate):

$$\delta = \frac{1}{1+r}$$

Our condition for collusion is $\delta > \frac{1}{2}$, or $r < 100\%$.
Collusion should happen all the time, right?

Why is collusion not more frequent? - II

The discount factor is in general affected by several factors other than the interest rate:

$$\delta = \frac{(1+g)(1-h)}{1+r/f}$$

where:

- r: annual interest rate
- f: frequency of interactions
- g: industry growth rate
- h: hazard rate, or the probability for a firm to fail

Moreover:

- Antitrust policies
- Is it really an infinite time horizon?

Price wars

If firms are in a collusive equilibrium, there is always the temptation to secretly deviate.

The threat to go to a "bad" equilibrium (zero profits) should be enough to deter deviations.

What if deviations cannot be observed?

A case with unobservable actions and demand

- Demand always fluctuates
- Firms observe own price, own demand and **not** the market demand

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A case with unobservable actions and demand

- Demand always fluctuates
- Firms observe own price, own demand and **not** the market demand
- One firm observes low demand: low market demand or price cutting? $->$ Problem!

Temporary punishments

Grim strategy

A strategy where players (firms) play collusion until one deviates, and after that Bertrand pricing $->$ competitive price and zero profits.

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In the collusion model we have studied a strategy where a deviation leads to worst punishment.

- Since the demand fluctuates (fact) a firm is led to cut the price to prevent losses due to a price cut from the opponent.
- The opponent does the same, but *grim strategy* leads to zero payoff forever after.

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- The opponent does the same, but *grim strategy* leads to zero payoff forever after.

What if the punishment is only temporary?
As soon as a firm observes low demand, it cuts the price for T periods, and then switch back to collusion price.

Price wars in equilibrium

Price wars can be essential to the collusive agreement and are sustained in equilibrium.

Unobservable demande shocks

Prices go down during periods of low demand.

Observable demand shocks

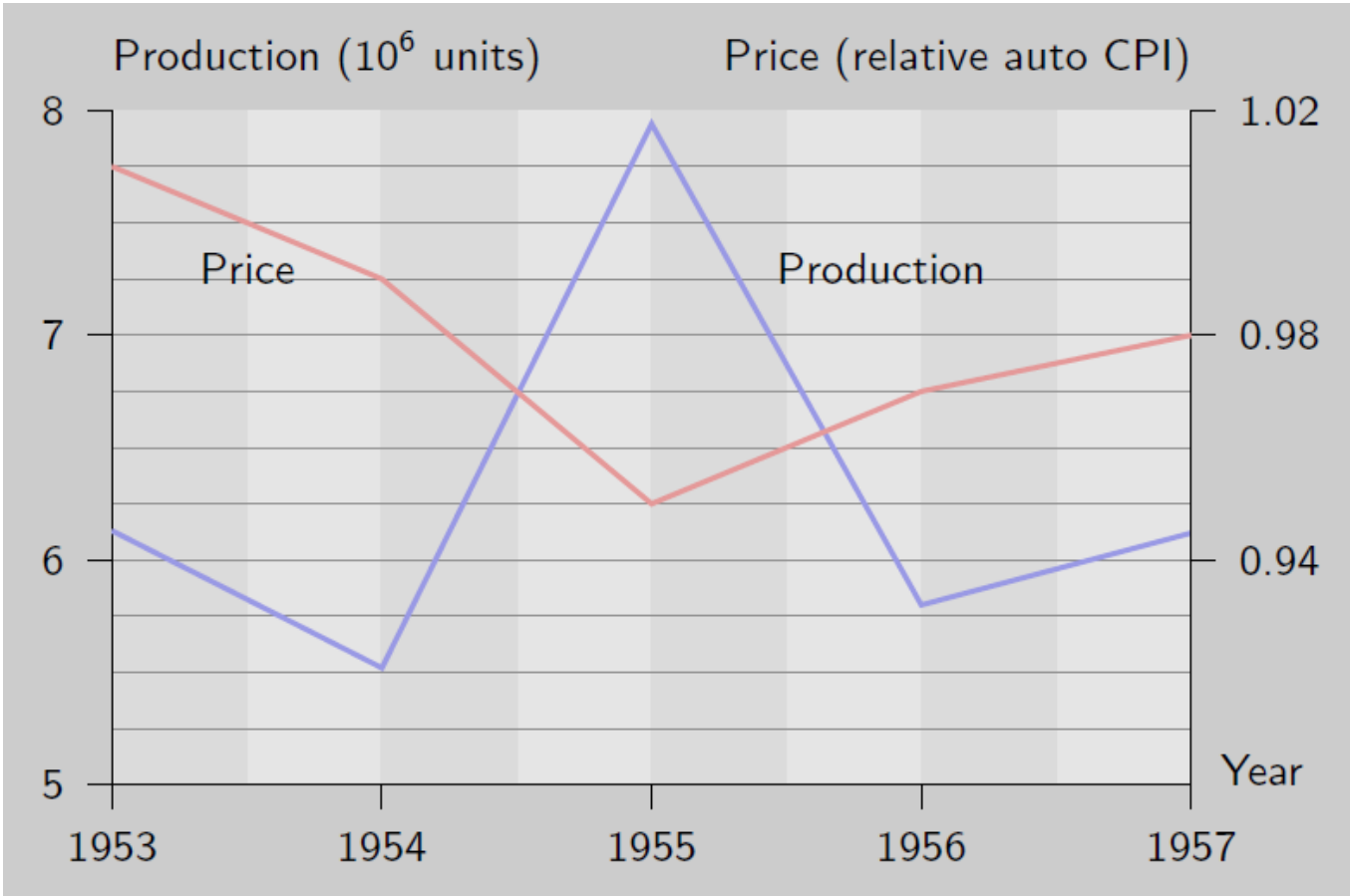
Prices go down during high demand (higher incentives)

Market structure and collusion

- Collusion is more likely in **concentrated markets** than in fragmented ones:
  - Easier to establish a collusive agreement
  - Easier to maintain a collusive agreement
- Easier to maintain collusion among **similar** firms
  - Example: duopoly with different technologies
  - Example: diamond industry

$\rightarrow$ collusion easier among few and similar firms.

1955 car market in the US



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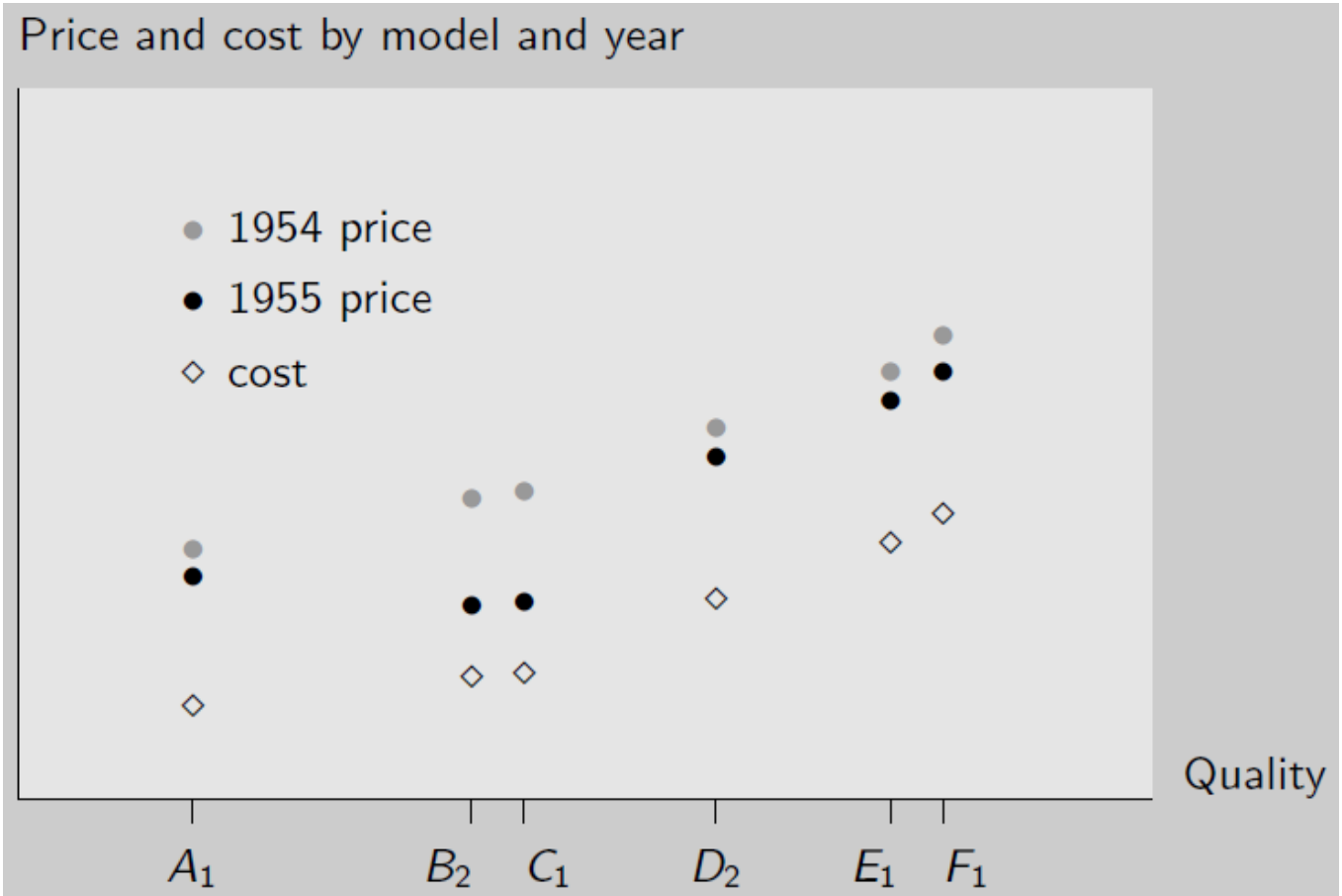

Merci pour votre attention