# lecture 7:
# competition and collusion

# the story so far

Natural monopoly:

- Definitions
- (Ideal) Pricing solutions
- Regulation in practice
- Regulation under asymmetric information

Competition policy:

- Introduction

# outline

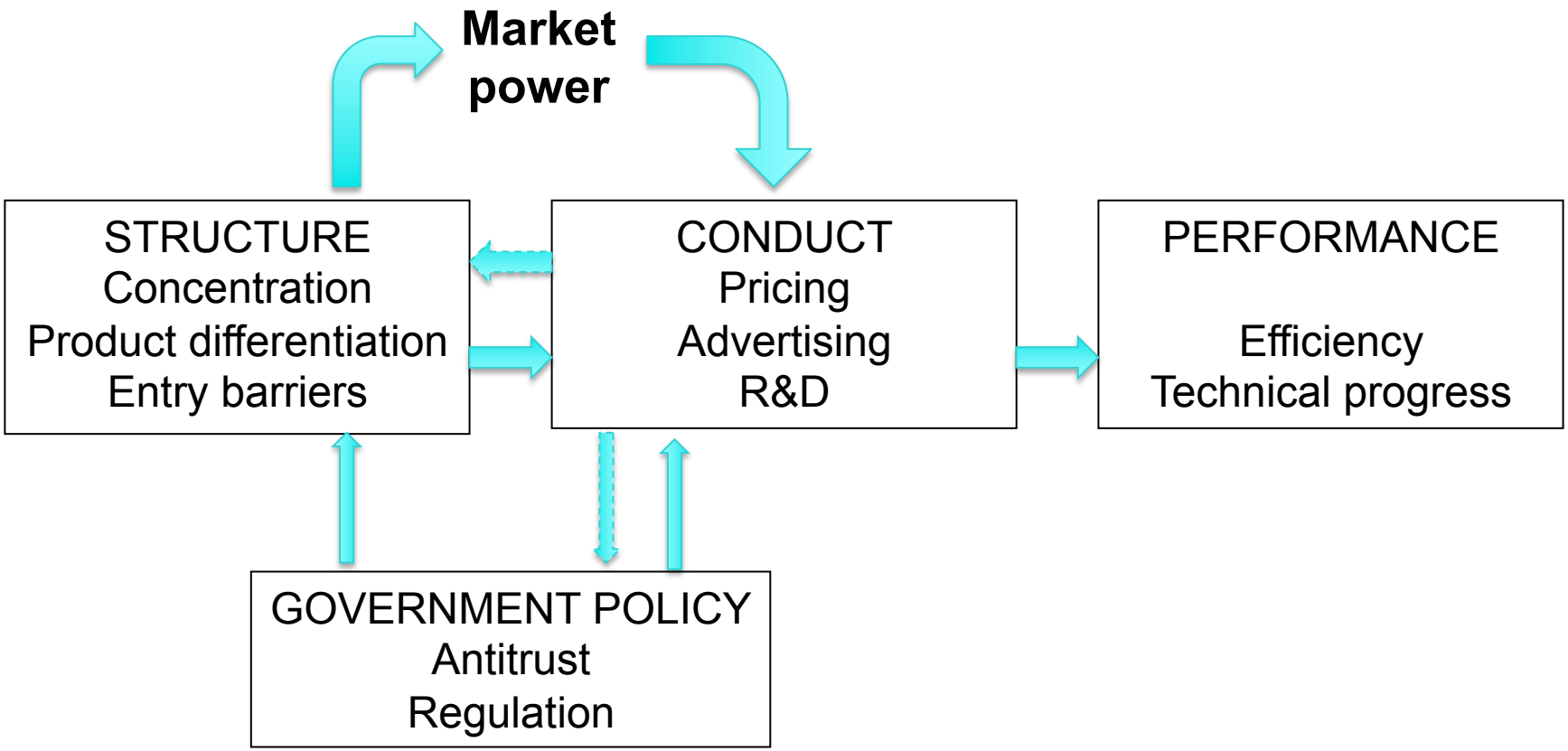
Competition and antitrust

- Introduction: Oligopolies
- Market conduct: Collusion
- Market structure: Concentration, entry conditions and contestable markets

References

- VHV, ch. 3, 5
- MM, ch. 4

# Structure-conduct-performance paradigm of IO



# Nash equilibrium

- A profile of strategies is a Nash equilibrium iff each player's strategy is a best response to the other players' strategies

# Cournot duopoly

- Two identical firms 1 and 2
- Both set quantities assuming that the conjectural variation is zero (e.g., firm 1 assumes dq2/dq1=0)
- Nash equilibrium occurs when a firm does not want to change its output having observed its rival's output

# Cournot duopoly

## example

- $P = 25 - (q1 + q2)$;
- $C1 = 5q1$;
- $C2 = 5q2$.

- Best response functions:

  $$q1 = (20 - q2)/2 \text{ and } q2 = (20 - q1)/2$$

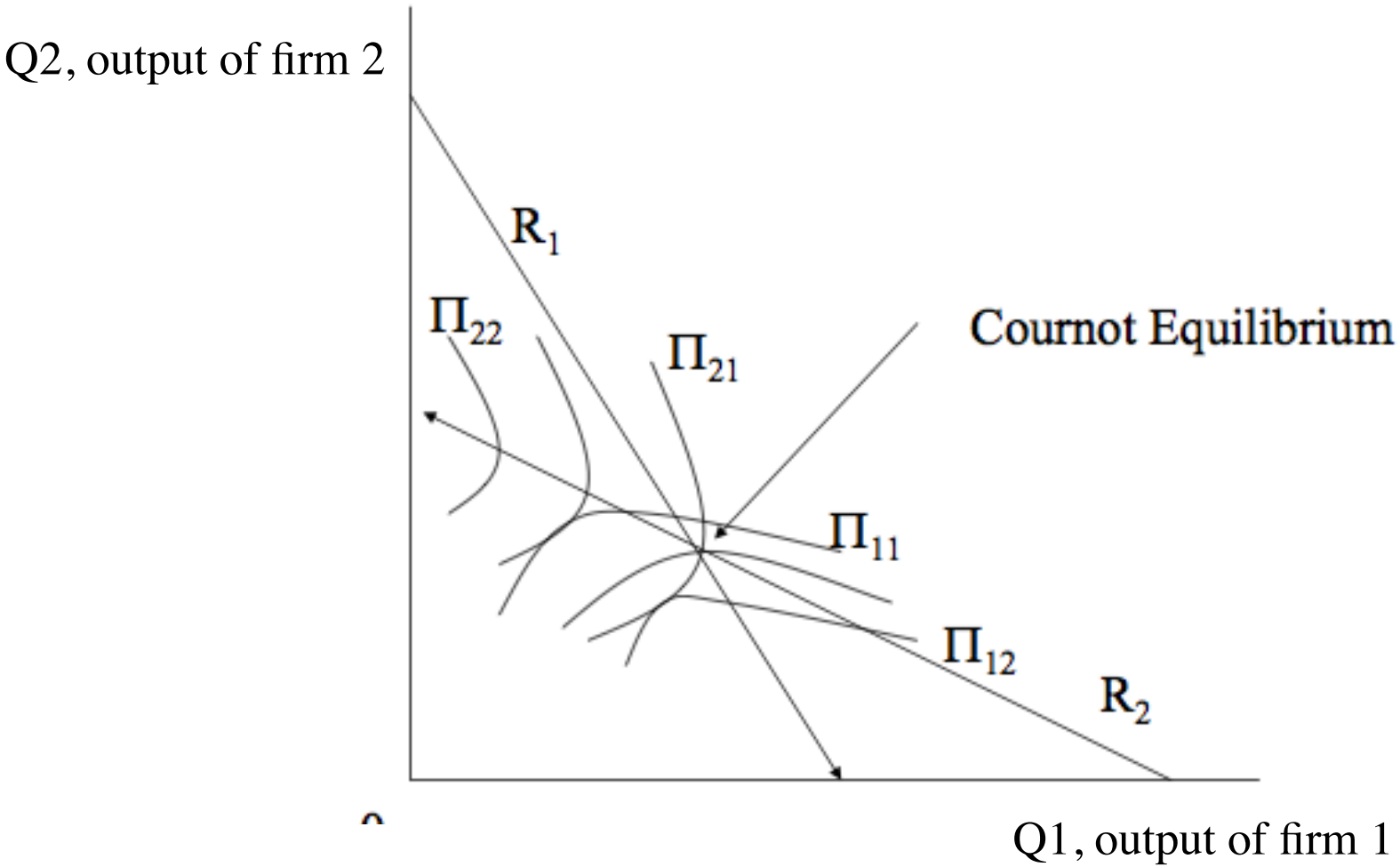
- Solution:

  $$q1 = q2 = 20/3;\ P = 35/3;\ \Pi 1 = \Pi 2 = 400/9 = 44;$$

  $$CS = PS = 800/9;\ TS = 1600/9$$

# Cournot duopoly

## example




Π21 < Π22; Π11 < Π12

# Cournot oligopoly

- $Q = q1 + q2 + \ldots + qn$
- MR = MC for each firm i
- $\Pi i = P(Q).qi - C(qi)$

- Solution:

$$(P\text{-}MCi)/P = si/\eta$$

where si is firm i's market share and $\eta$ is price-elasticity of demand

# Duopoly as a normal form game

| 1 \ 2 | S1=5 | S2=20/3 | S3=10 |
|---|---|---|---|
| S1=5 | (50,50) | (42,55) | (25,50) |
| S2=20/3 | (55,42) | (44,44) | (22,33) |
| S3=10 | (50,25) | (33,22) | (0,0) |

(S2, S2) is the Nash equilibrium
(S1, S1) is the collusive equilibrium
S3 is dominated

# Duopoly as a prisoners' dilemma

| 1 \ 2 | S1=5 | S2=20/3 |
|---|---|---|
| S1=5 | (50,50) | (42,55) |
| S2=20/3 | (55,42) | (44,44) |

# The prisoners' dilemma

| 2 / 1 | Don't Confess | Confess |
|---|---|---|
| Don't Confess | (10,10) | (2,12) |
| Confess | (12,2) | (5,5) |

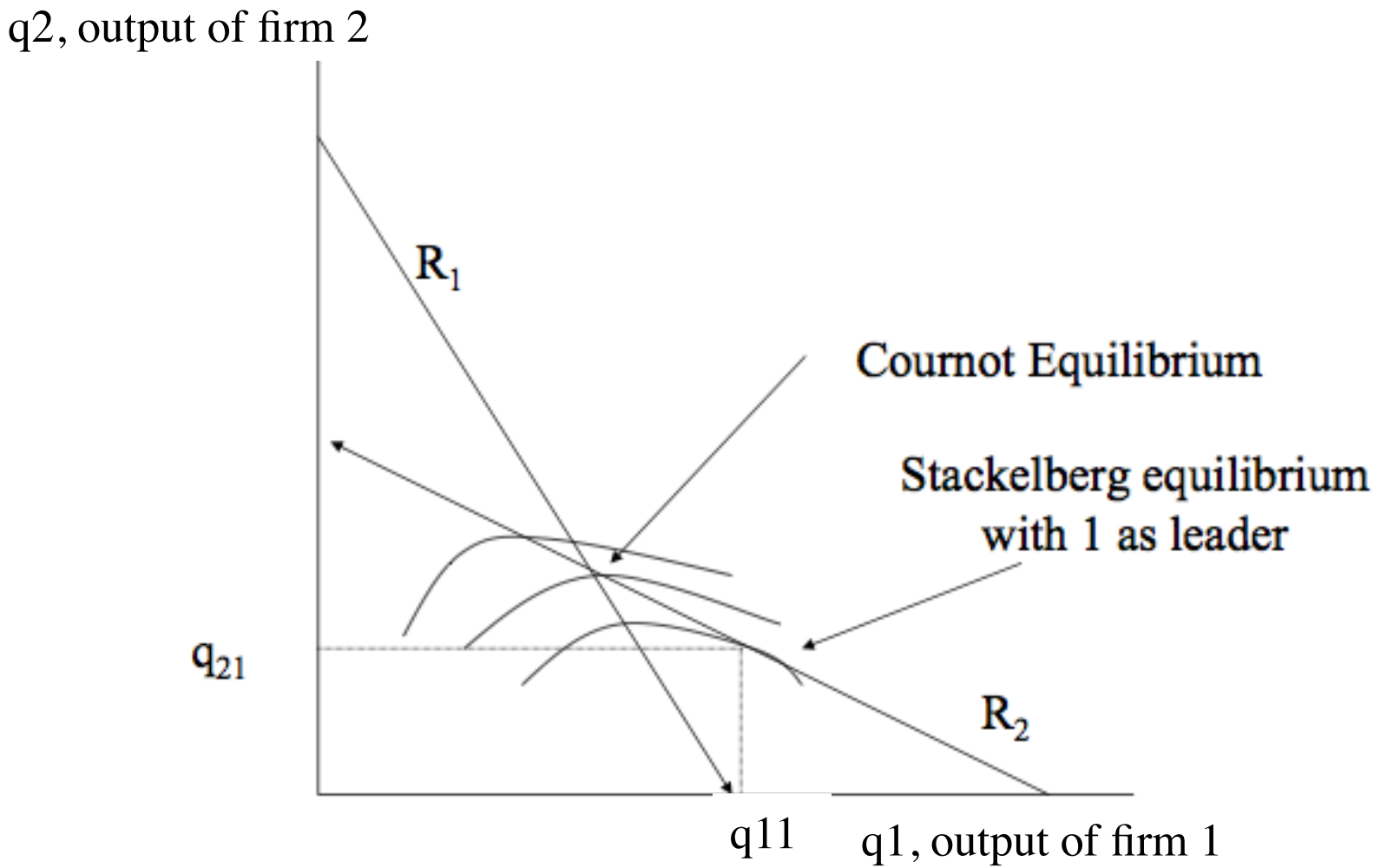
# Stackelberg duopoly

- Firm 1 is the leader and firm 2 is the follower
- Firm 1 knows q2 = (20-q1)/2 and maximizes profits
- Firm 2 plays *a la* Cournot
- Solution:

$$q1 = 10;\ q2 = 5;\ P = 10$$

$$\Pi 1 = 50,\ \Pi 2 = 25;\ PS = 75;\ CS = 112.5;\ TS = 187.5$$

# Stackelberg duopoly



# Bertrand duopoly

- Two identical firms (1 and 2)
- Both set prices assuming the other's choice is independent of its own, i.e., the conjectural variation of price is 0
- Equilibrium occurs when each firm does not want to change its price after having observed what price the other firm has set
- P = MC (= AC)
- Profits are 0

# Bertrand with differentiated products

- Firms 1 and 2 produce similar but not identical products and compete on price
- Demands: $q1 = 20 - p1 + p2$; $q2 = 20 - p2 + p1$
- Assume MC = 0
- Price reaction functions:

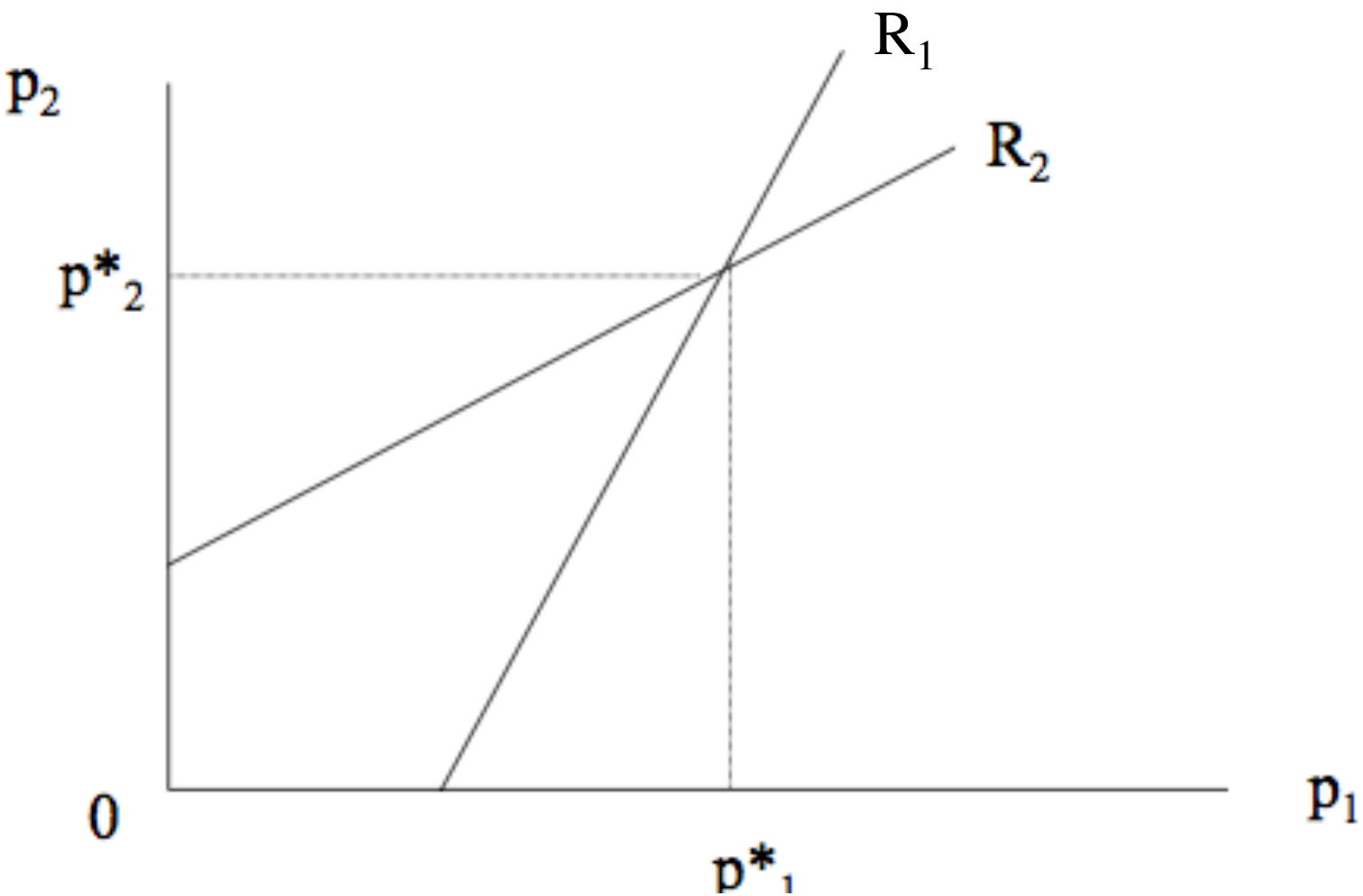
$$p1 = (20 + p2)/2;\ p2 = (20 + p1)/2$$

$$p1 = p2 = 20;\ \Pi 1 = \Pi 2 = 400$$

- If firm 1 is leader,

$$p1 = 30;\ p2 = 25;\ \Pi 1 = 450;\ \Pi 2 = 625$$

# Bertrand equilibrium



# Cournot and collusion

- Collusion involves a non-zero conjectural variation: there is coordination st $dq2/dq1 > 0$
- Coordination of output may result from an agreement (cooperative behavior) or as a result of indefinite repetition or irrational commitments
- In the example, the collusive outcome is $P = 15$ and $q1 = q2 = 5$, with firm profits of 50. If with cheating, the Cournot outcome appears, firms get 44
- Firm 1 compares 1-period gain with multi-period loss: gain is 5 and loss is $6/(1-\delta)$; so, cheat if $\delta < 5/11$ and sustain collusion if $\delta \geq 5/11$

# Collusion
## in general

- Incentive constraints: immediate gain from deviation vs. lost future profits and importance of future

$$\pi_i^c + \delta V_i^c \geq \pi_i^d + \delta V_i^p, \; i = 1, \ldots, n$$

Or: collusion occurs if discount factor is high enough:

$$\delta \geq \frac{\pi_i^d - \pi_i^c}{V_i^c - V_i^p} \equiv \bar{\delta}_i, \; i = 1, \ldots, n$$

# Practices that restrict competition

## Autoridade da Concorrência

- **collusion** [art. 9.º da Lei n.º 19/2012, de 8 de maio, art. 101.º do Tratado sobre o Funcionamento da União Europeia];

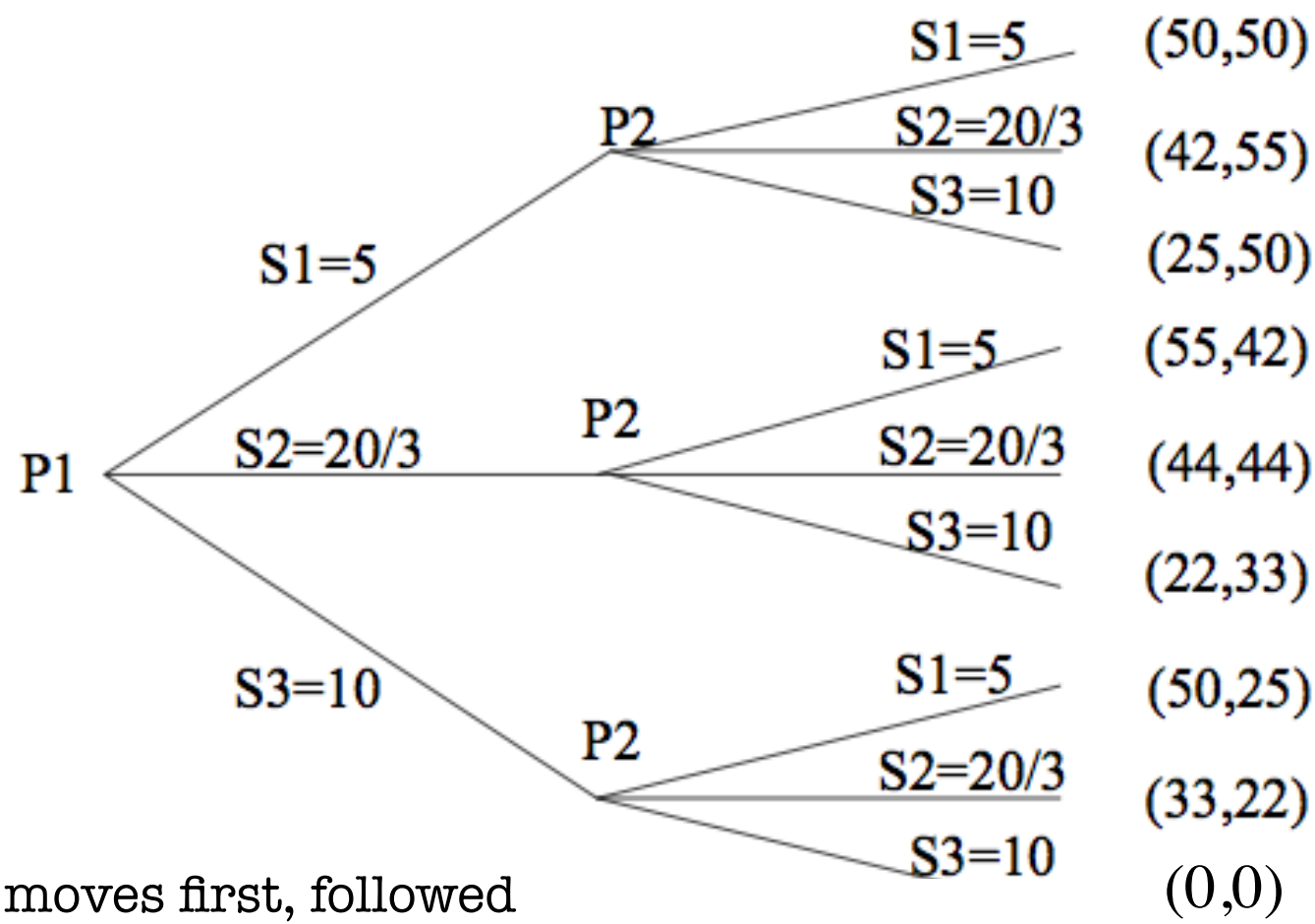
- **dominant postion abuse** [art. 11.º da Lei n.º 19/2012, de 8 de maio, art. 102.º do Tratado sobre o Funcionamento da União Europeia]

- **economic dependency abuse** [art. 12.º da Lei n.º 19/2012, de 8 de maio]

# Collusion
## definition

- In economics: situation where firms' prices are higher than in some competitive benchmark;...
- Exs: firms agree on prices, allocate quotas among themselves, divide markets, or coordinate behavior in other dimension
- Explicit (organized cartel) or tacit (firms act non-cooperatively)
- Only explicit collusion should be illegal
- Ingredients: ability to detect a deviation and possibility to punish
- Under tacit collusion, the problem of coordination on a price arises

# Oligopoly as an extensive form game




Player 1 moves first, followed by 2. (S3, S1) is the Nash equilibrium

# Collusion
## factors

- Structural factors:
  - Concentration: < number of firms ➔ > probability of collusion
  - Entry: < barriers ➔ > difficulty in sustaining collusive prices
  - Cross-ownership or links among competitors ➔ collusion
  - Regularity and frequency of orders ➔ collusion
  - Buyer power: > number of buyers ➔ collusion

# Collusion
## factors

- Structural factors contd.:
  - Demand elasticity: ambiguous effect on likelihood of collusion, but negative effect on the level of max price
  - Evolution of demand: demand stability ➔ collusion
  - Symmetry ➔ collusion
  - Multi-market contacts (same firms meeting in different markets) ➔ collusion
  - Inventories and excess capacities:?

# Collusion
## factors

- Price transparency and communication:
  - Stigler (1964) and Green and Porter (1984): if sellers cannot observe others' prices and demand, a reduction in sales may be due to a demand shock. If the discount factor is high enough, there exist equilibrium collusive prices with finite punishment
  - Exchange of information on past/present quantities and prices ➔ collusion
  - Coordination and communication: if discount factor is large, any price btw MC and fully collusive price may be sustained.
  - Exchange of information on future quantities and prices: private announcements (to competitors) ➔ collusion

# Collusion

## factors

- Pricing rules and contracts:
  - Most-favored nation: a seller applies a buyer the same conditions applied to other buyers; anti-competitive as it's more expensive to give a discount; ? on collusion
  - Meeting-competition: if a buyer receives a lower price offer from a different seller, the seller has to match it ➔ exchange information + < incentives to deviate ➔ collusion
  - Resale price maintenance: vertical agreement whereby a manufacturer imposes retailers the sales price to the final market ➔ collusion

# Collusion
## evidence

- Price level?
- Price evolution?
- Observable evidence verifiable in court: hard evidence on communication
- Check-list to detect collusion in auction bidding

# Collusion
## ex-ante policies

- Important in deterring collusion
- Black-list of facilitating practices: practices as exchange of information, resale price maintenance, best price clauses,... should be forbidden
- Design auctions to minimize collusion: anonymous bidding in sim. asc. bid auctions, final round with sealed bids
- Be vigilant on mergers

# Collusion

## ex-post policies

- (breaking existing cartels)
- Surprise inspections
- Leniency programs:
  - Automatic leniency for firms that report evidence of cartel before an investigation has begun
  - Discretionary leniency: for firms reporting after the investigation begun

# Market structure

- Concentration
- Entry conditions

# Concentration

- IO theory assumes firms are symmetric; but this is not the case!

- Concentration indexes measure the ability of firms to raise price above the competitive level (concerns only actual and not potential competition)

- First step: define the market (includes all products or enterprises with large long-run cross-elasticities of supply of demand)

- Second: measure concentration

# Concentration
## measures

- Herfindahl-Hirschman index

$$HHI = \sum_{i=1}^{N} s_i^2$$

- Concentration ratios

$$CR_m = \sum_{i=1}^{m} s_i$$

# Concentration

- Empirically, high concentration is positively related with high price-cost margins
- Two theories:
  - Collusion hypothesis: > concentration ➔ < competition (collusion easier) ➔ > margin; policy implication: break concentrated industries
  - Differential efficiency hypothesis: firms with lower cost/better products tend to dominate the market; thus, concentration AND margins are high; policy implication: no break up
- The latter has been confirmed empirically

# Concentration

- Most important explanation: magnitude of economies of scale with respect to demand (ex: the automobile industry depends on large scale production to achieve low costs)

# Entry conditions

- Important because:
  - Affect industry concentration
  - Determine the extent of potential competition

- Free-entry equilibrium: in a new industry, if all firms decide to enter simultaneously, a free-entry equilibrium is defined by the number of firms $n$ s.t.:

$$\frac{\pi(n)}{1-\delta} - K > 0 > \frac{\pi(n+1)}{1-\delta} - K$$

where $\delta$ is the discount factor and K is the cost of entry (too simple: initial entry only; no asymmetries)

# Entry conditions

## barriers to entry – (controversial) notion

- Def (J. Bain): “extent to which , in the long run, established firms can elevate their selling prices above minimal average costs of production and distribution... without inducing potential entrants to enter the industry.” (!!!!)

- Def (G. Stigler): cost of producing which has to be born only by firms which seek to enter (narrower)

- Def (C. Weizsacker): socially undesirable limitations to entry of resources due to protection of resource owners already in the market (welfare-based)

# Entry conditions

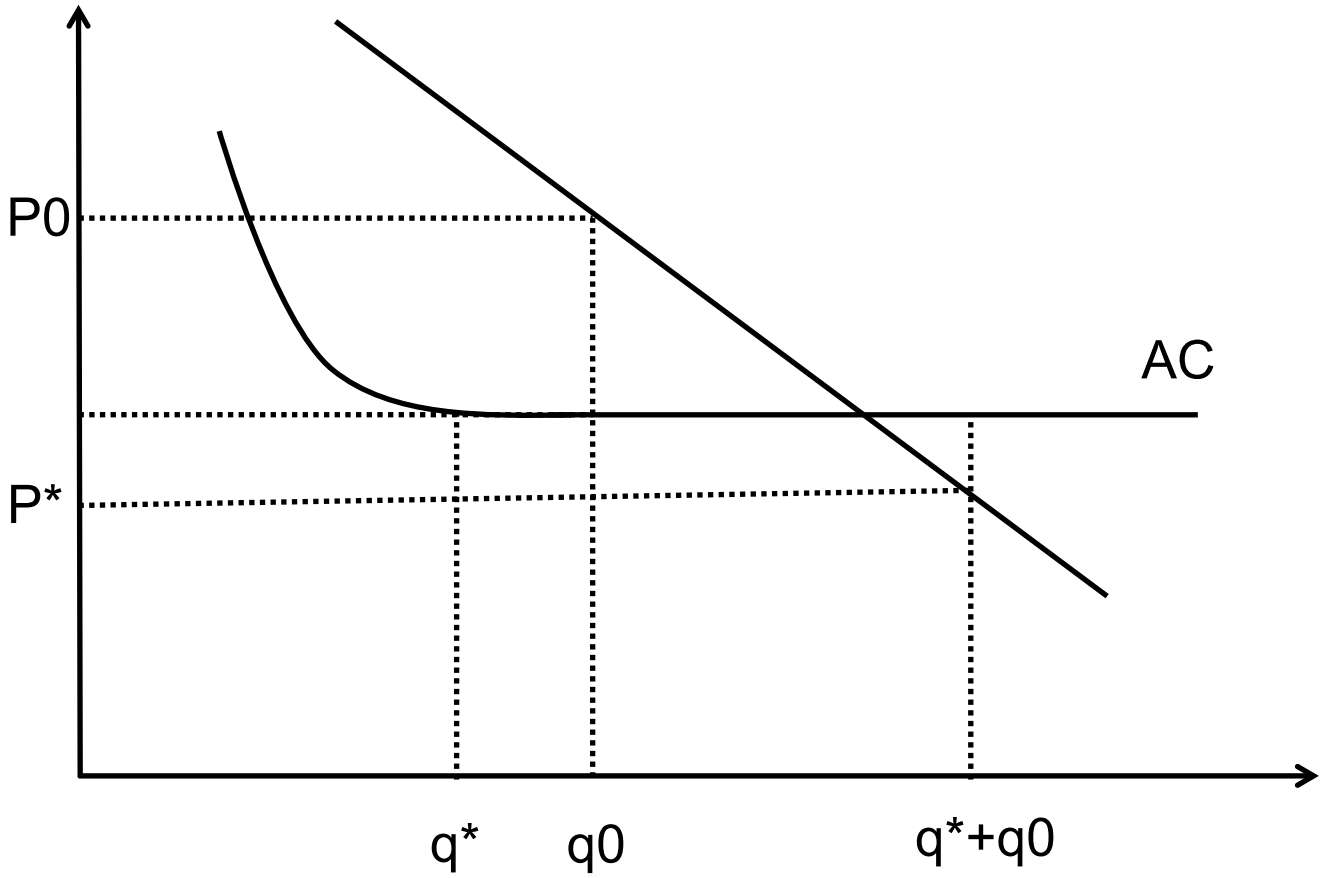
## barriers to entry – (controversial) notion

- Exs:
  - Government-created: franchise awarded, patents, taxi license,...
  - Scale economies
  - Capital cost requirements of entry
  - Absolute cost advantages of existing firms (better technology, control of input sources, learning curve)

- But:
  - Capital cost requirements of entry: eventually incumbent firms have to replace their plants and face same costs
  - Scale economies: not according to Stigler's definition

# Entry conditions

## contestability



# Entry conditions

## contestability

- Def: perfectly contestable market
  1. New firms face no disadvantage w. r. to existing firms (access to same technology, inputs, and information on demand)
  2. No sunk costs (all entry costs are recoverable, so that exit is costless)
  3. Entry lag (time firm is able to supply - time when firm's entry is known) < price adjustment lag for existing firms

- If a market is perfectly contestable, equilibrium is efficient (potential competition has the leading role)