Course outline I

- Introduction
- Game theory
- Price setting
  - monopoly
  - oligopoly
- Quantity setting
  - monopoly
  - oligopoly
- Process innovation

Homogeneous goods

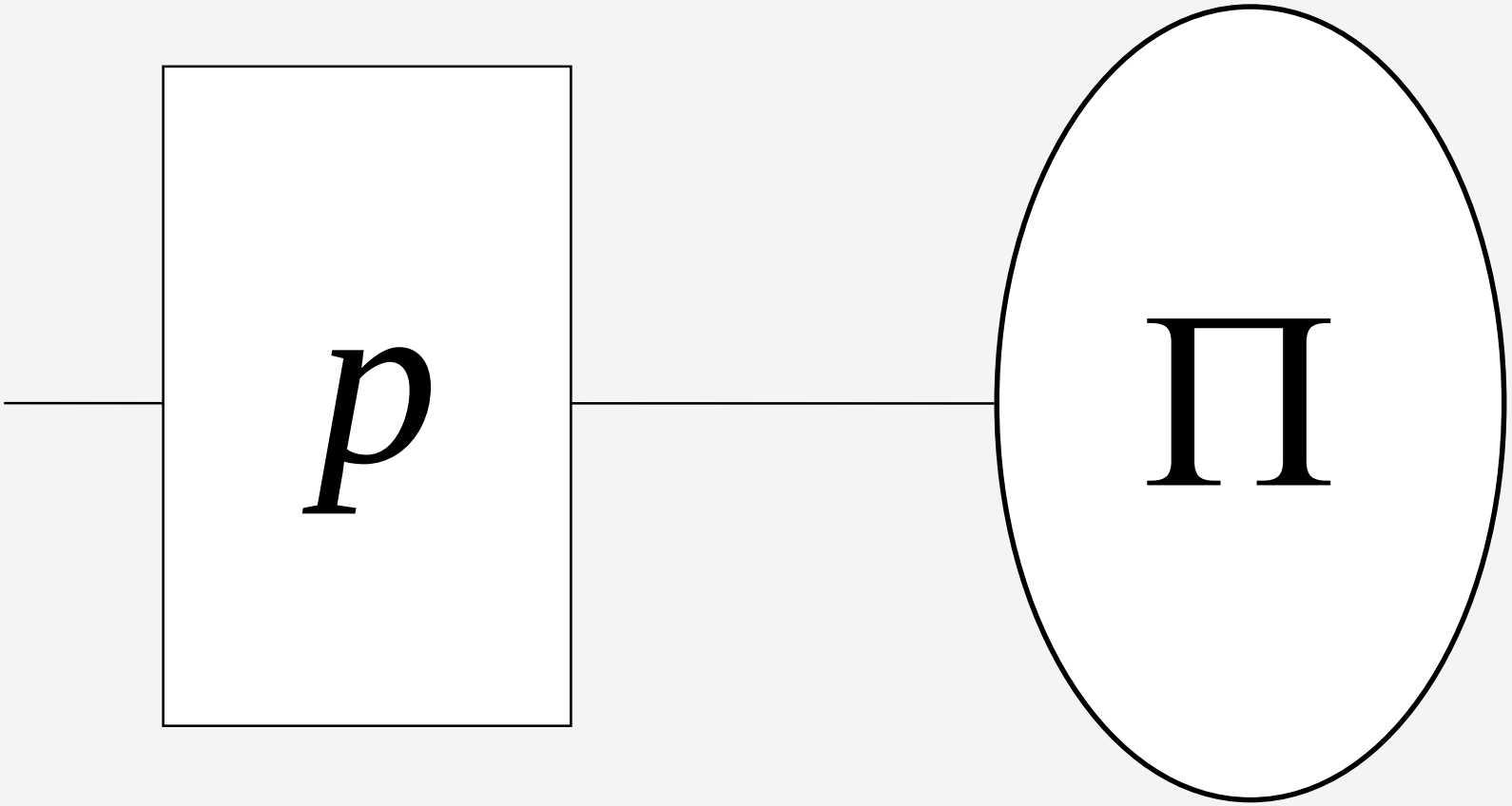
Monopoly (price setting)

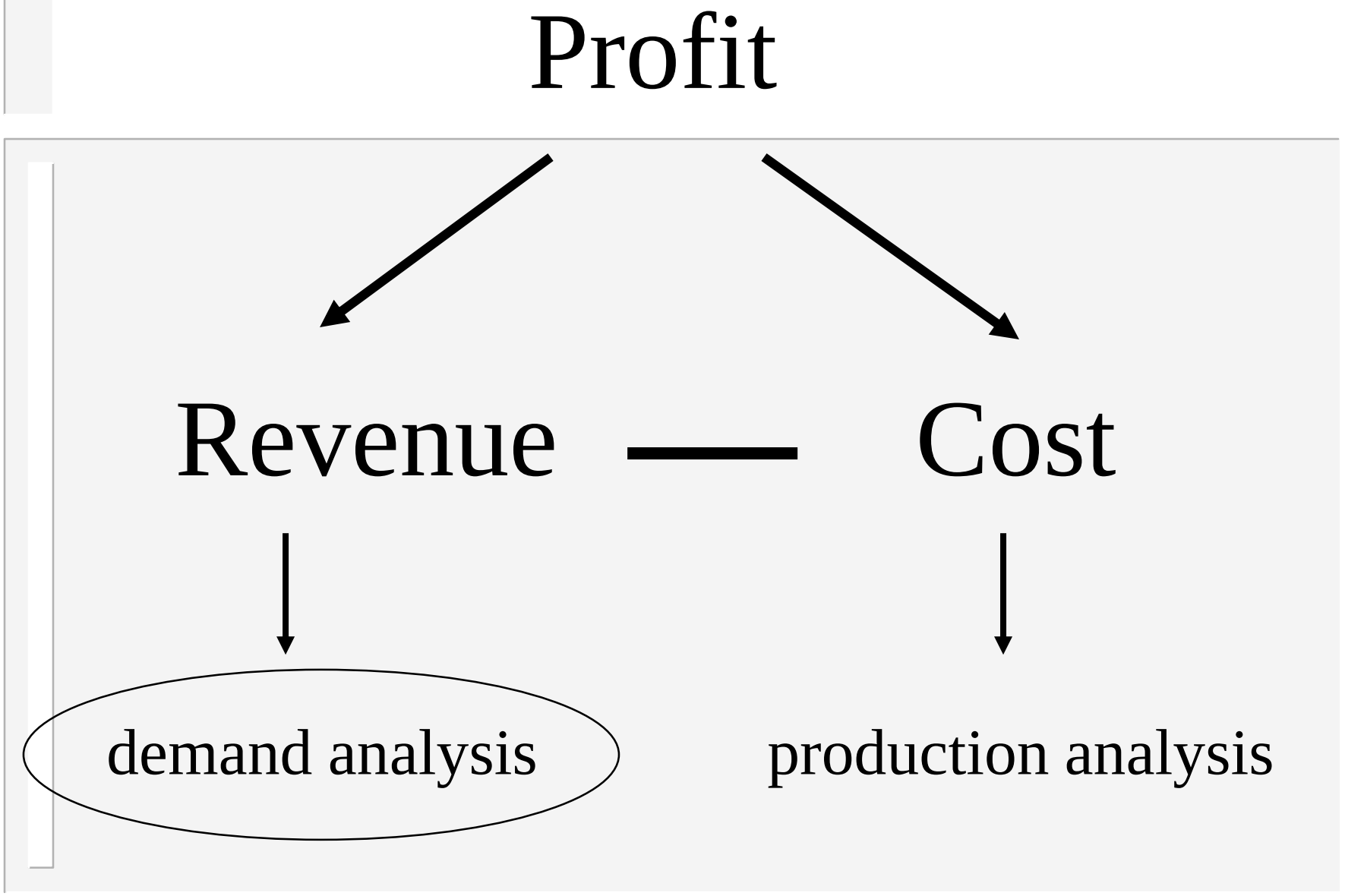
- Introduction
- Demand function
- Revenues, costs, profits
- Profit maximizing price
- Price discrimination
- Executive summary

Monopoly

- One firm only in a market
- Persistence of such a monopoly:
  - huge cost advantage
  - secret technology (Coca-Cola) or patent
  - government restrictions to entry (deliveries of letters in Germany)
- But what is a market?

Decision problem




Profit
Revenue
Cost
demand analysis
production analysis

The demand function: how many units of a good do consumers buy?

- price $X = X(p)$
- properties
- availability of substitutes
- quality
- information
- compatibility
- timely delivery
- ...

X=f(prices, qualities, ...)

Demand analysis for X=f(p, m, ...)

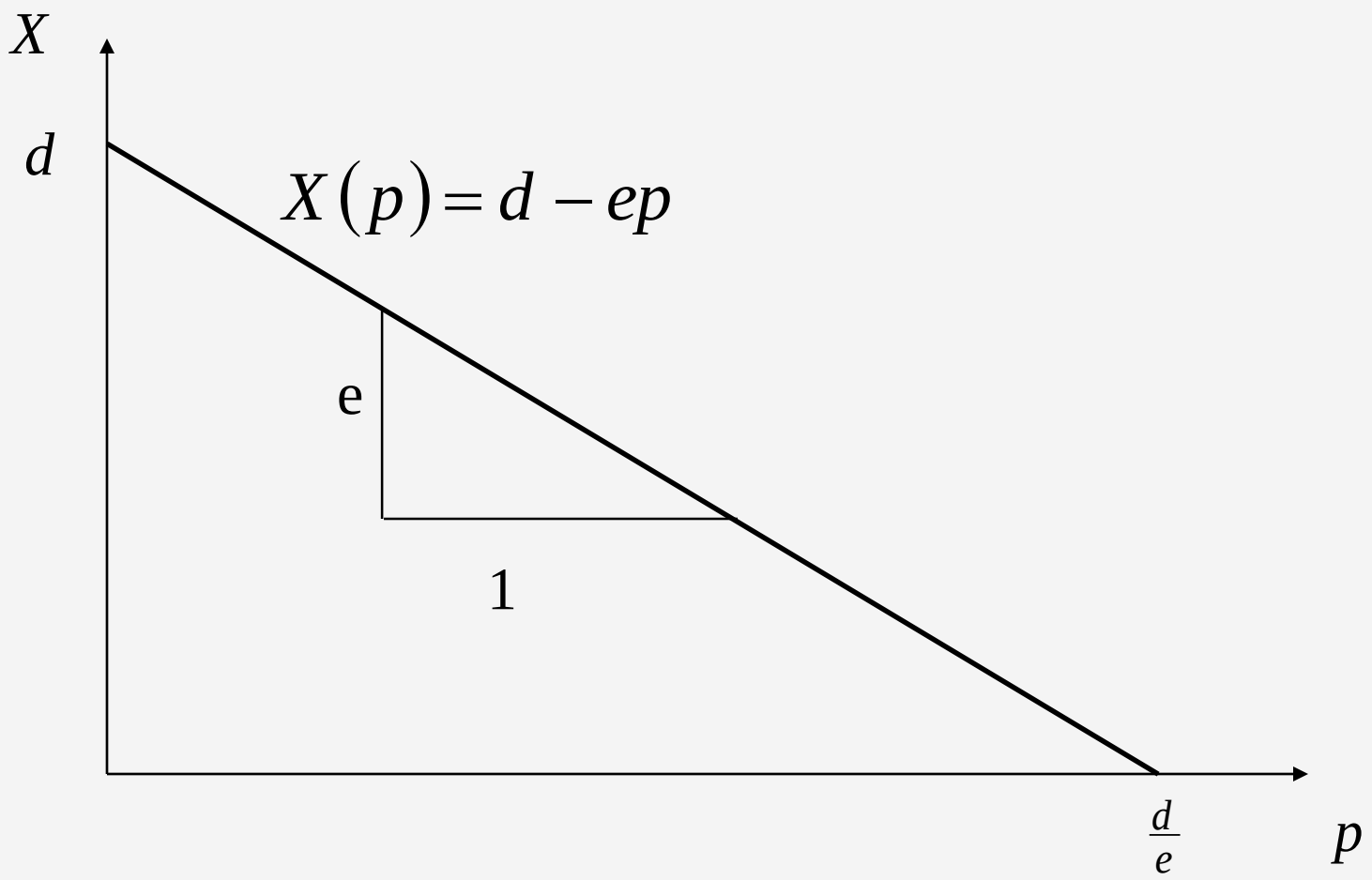
- Satiation quantity = f(0, m, ...)
- Prohibitive price = price p such that f(p, m, ...) =0
- Slope of demand curve dX/dp
- Price elasticity of demand

$$\varepsilon_{X,p} = \frac{\frac{dX}{X}}{\frac{dp}{p}} = \frac{dX}{dp}\frac{p}{X}$$

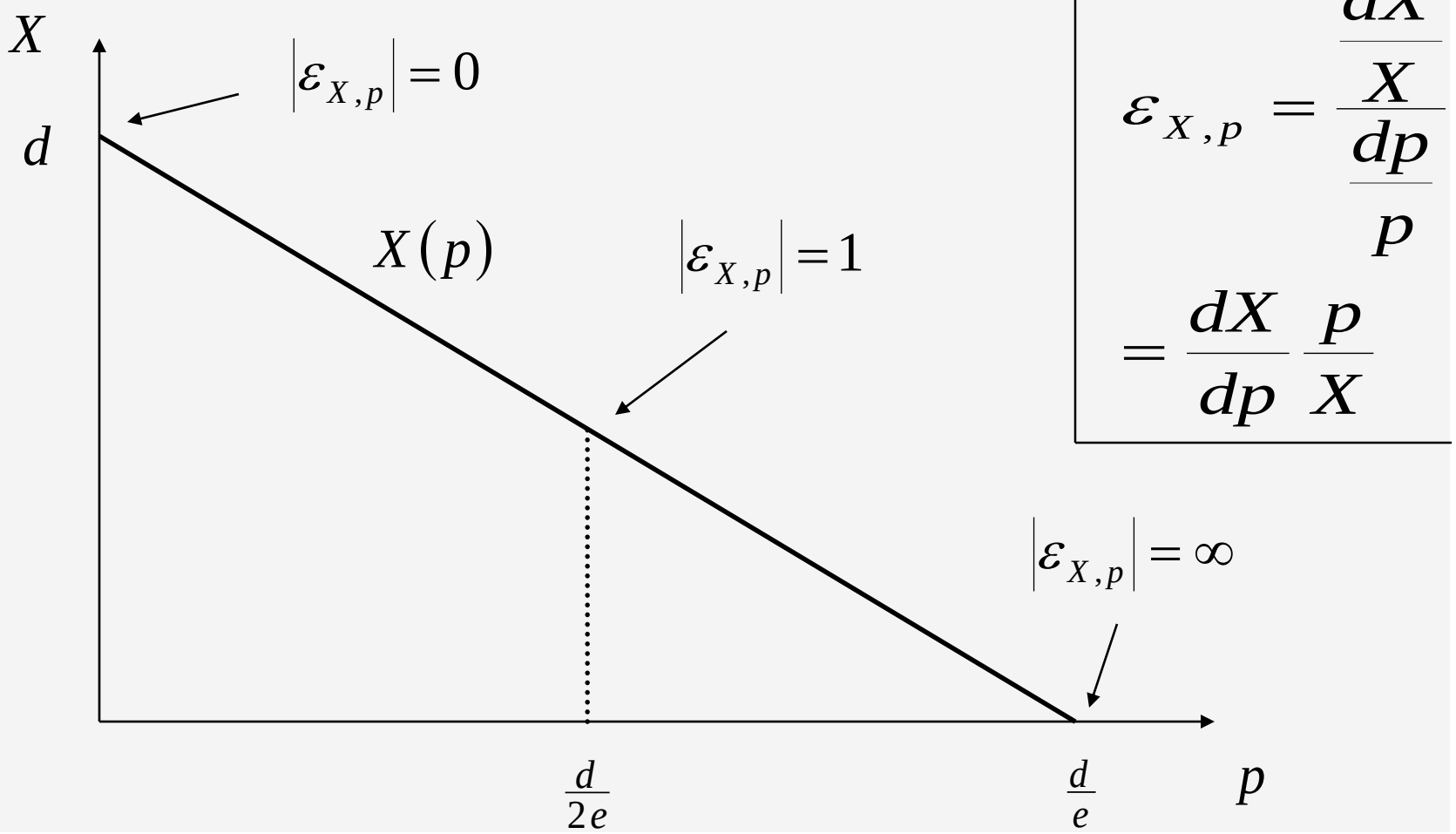
Demand analysis for X(p) = d - ep

- Satiation quantity:
- Prohibitive price:
- Slope of demand curve:
- Price elasticity of demand:

Demand analysis II



Demand analysis III



$$\varepsilon_{X,p} = \frac{\frac{dX}{X}}{\frac{dp}{p}} = \frac{dX}{dp}\frac{p}{X}$$

Revenue, costs and profit

- Revenue: $R(p) = pX(p)$
- Costs: $C(p) = C[X(p)]$
- Profit: $\Pi(p) = R(p) - C(p)$
  $= pX(p) - C[X(p)]$
- Linear case: $X(p) = d - ep,$
  $C(X(p)) = cX(p)$

Marginal revenue with respect to price

$$\frac{dR(p)}{dp} = X + p\frac{dX}{dp}$$

When a firm increases the price by one unit,

- revenue goes up by X (for every unit sold, the firm receives one Euro),
- but goes down by p·dX/dp (the price increase diminishes demand and revenue).

Marginal revenue w.r.t. price and price elasticity of demand I

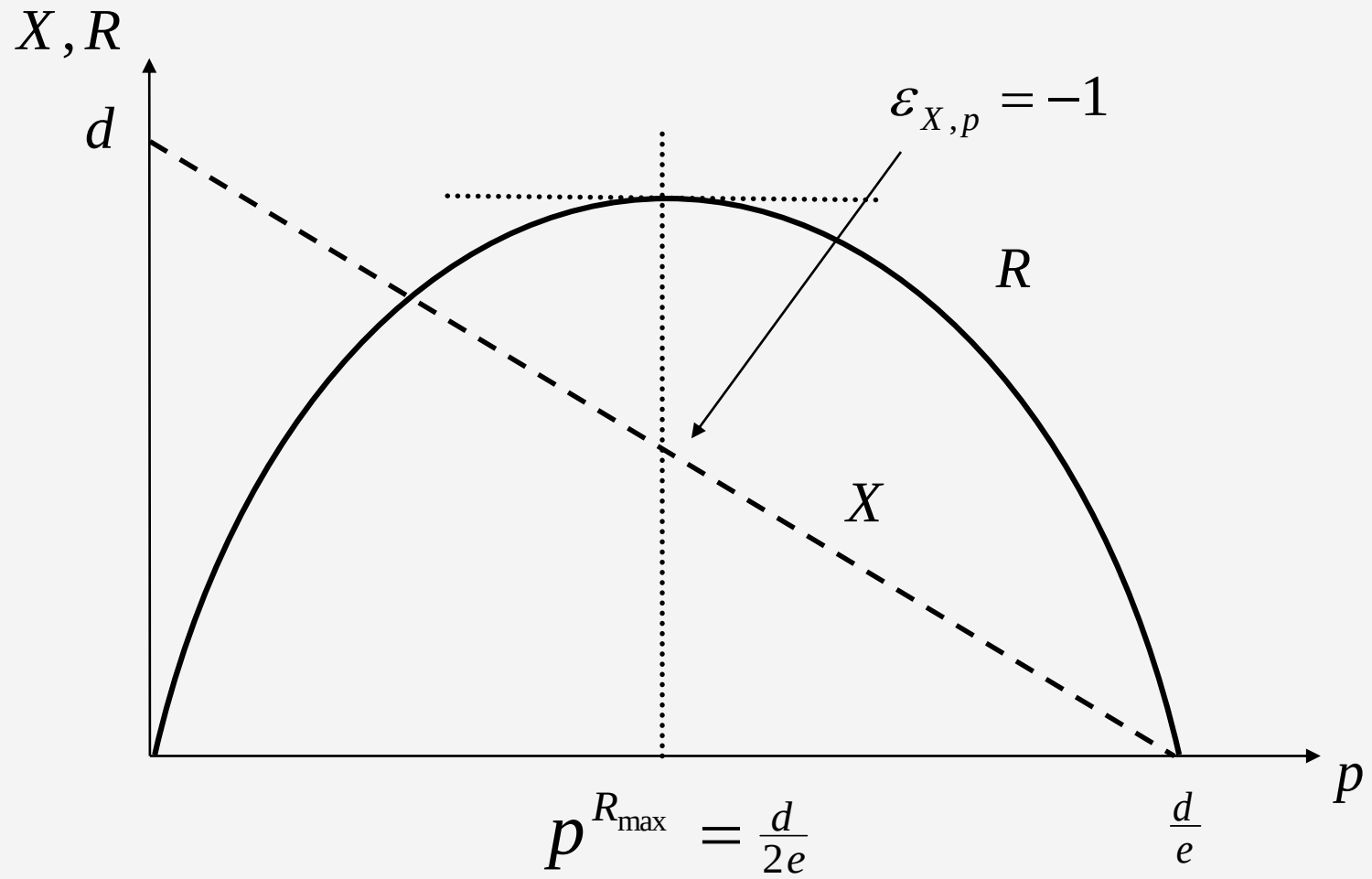
$$MR_p = \frac{dR}{dp} = X + p\frac{dX}{dp}$$

$$= X\left(1 + \frac{p}{X}\frac{dX}{dp}\right) = X\left(1 + \varepsilon_{X,p}\right)$$

" Amoroso - Robinson - Relation"

⇒ marginal revenue w.r.t. price is zero when a relative price increase is matched by a relative quantity decrease of equal magnitude

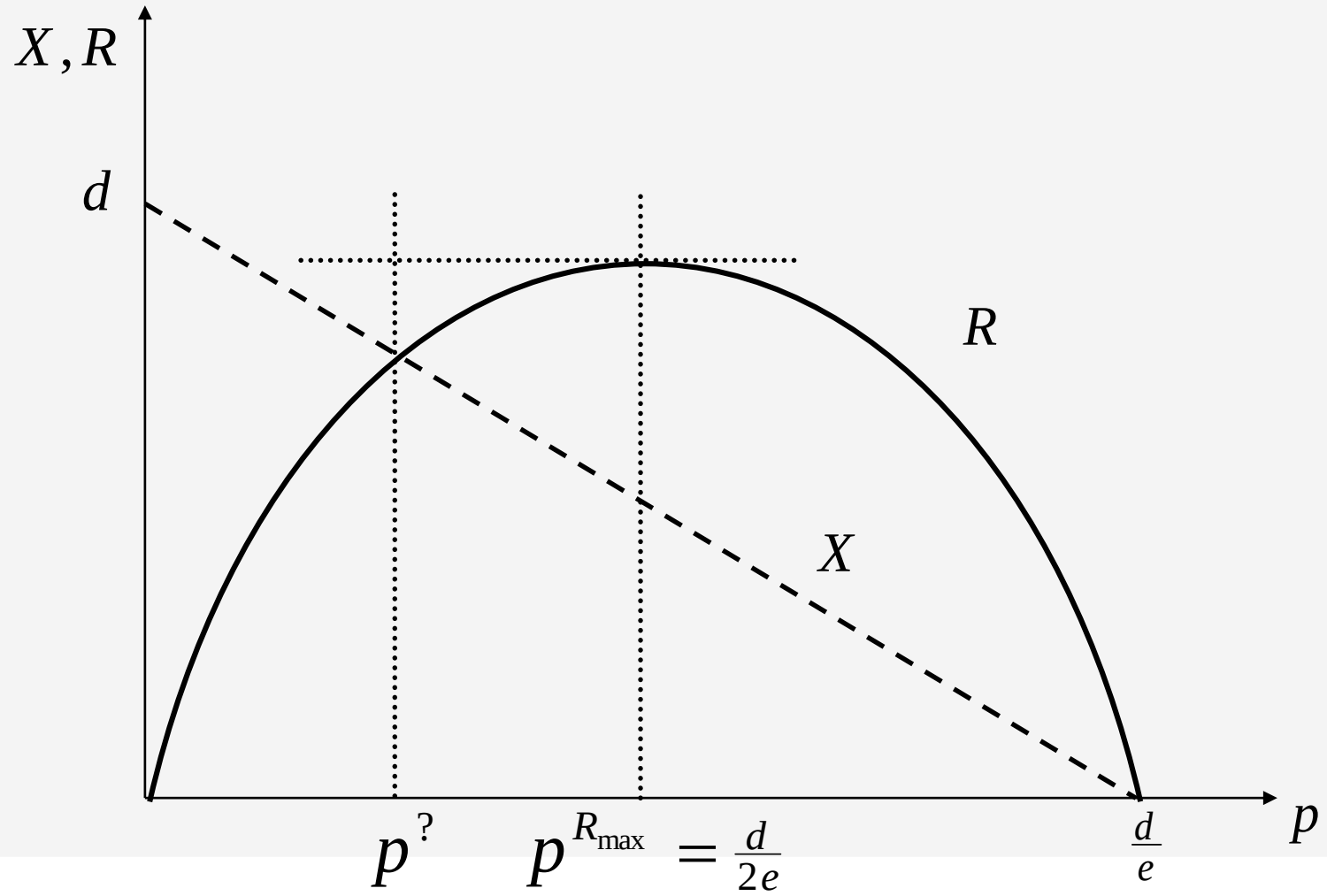
Marginal revenue w.r.t. price and price elasticity of demand II



Can a demand elasticity $0 > \varepsilon_{X,p} > -1$ be optimal?

- If the demand elasticity is between 0 and -1, a price (in relative terms) increase is followed by a smaller quantity decrease (in relative terms). Hence, revenue goes ... .
- Therefore, when the price increases, revenue ...
- Answer: No.

Exercise (units of measurement)

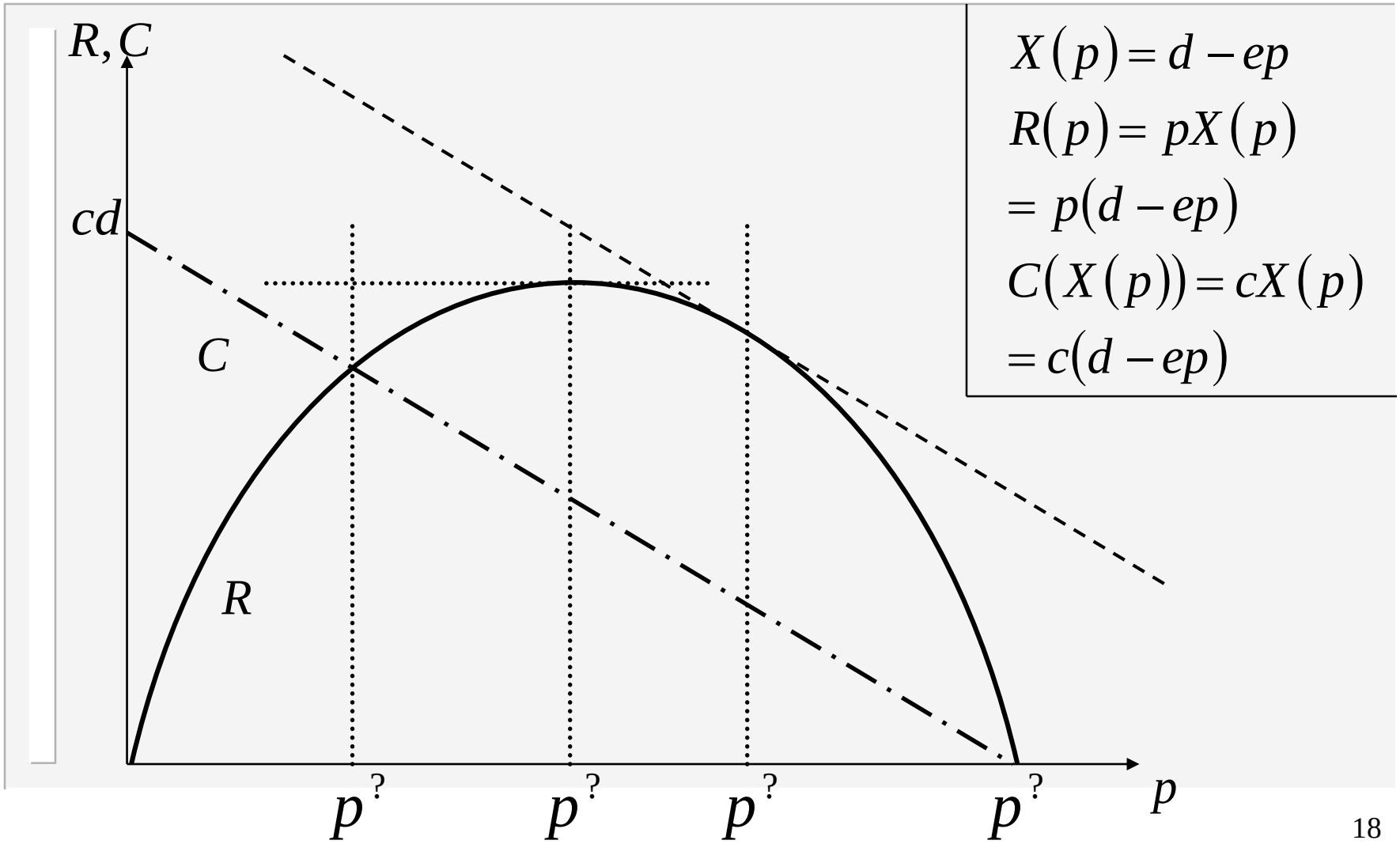


Solution (units of measurement)

- length: units of distance (e.g., kilometers)
- velocity: units of distance per unit of time (e.g. miles per hour)
- quantity X: units of quantity (e.g. pieces)
- price p: units of money per unit of quantity (e.g. € per piece)
- revenue R: units of money (e.g. Euros)

For comparisons, units of measurement have to be the same!

Exercise (revenue, costs)



$$X(p) = d - ep$$
$$R(p) = pX(p)$$
$$= p(d - ep)$$
$$C(X(p)) = cX(p)$$
$$= c(d - ep)$$

Marginal cost with respect to price

$$MC_p = \frac{dC[X(p)]}{dp} = \frac{\overset{+}{dC}}{dX}\frac{\overset{-}{dX}}{dp}$$

When a firm increases the price by one unit, the costs of production go down:

- the price increase diminishes demand,
- the demand decrease diminishes costs.

How to find the monopolist`s profit maximizing price

- Profit function: $\Pi(p) = R(p) - C(p)$
  $= pX(p) - C(X(p))$
- Setting the derivative of the profit function with respect to the price equal to 0:

$$\frac{d\Pi}{dp} = X + p\frac{dX}{dp} - \frac{dC}{dX}\frac{dX}{dp} \overset{!}{=} 0 \rightarrow p^M$$

Exercise (monopoly in the linear case)

Consider a monopoly selling at a single market. The demand and the cost function are given by $X(p) = d - ep$ and $C(X) = cX, c > 0$

a) Demand elasticity? Marginal-revenue function with respect to price?

b) Profit maximizing price?

c) How does an increase of unit costs influence the optimal price? (Consequence for tax on petrol?)

Parameters and variables

- exogenous parameters:

➔ describe the economic situation (input of economic models)
e.g. demand function

- endogenous variables:

➔ are the output of economic models (resulting from an equilibrium concept),
e.g. profit maximizing price

Equilibria and comparative statics

equilibria	comparative statics
= subjects have no reason to change their actions ▪ monopoly: ➔ profit maximizing price ▪ households: ➔ utility maximizing bundle ▪ markets: ➔ price which equalises supply and demand ▪ game theory: ➔ Nash equilibrium	▪ comparative: ➔ comparison of equilibria with different parameters ▪ static: ➔ no dynamics ➔ no adjustment processes

Exercise (monopoly with constant elasticity)

Consider a monopoly selling at a single market. The demand and the cost functions are given by $X(p) = ap^{\varepsilon}, \varepsilon < -1$ and $C(X) = cX, c > 0$.

a) Demand elasticity? Marginal-revenue function with respect to price?

b) Price charged with respect to ε?

c) What happens to the monopoly's price when ε increases? Interpret your result.

Price discrimination

- First degree price discrimination:

  Every consumer pays a different price which is equal to his or her willingness to pay.

- Second degree price discrimination:

  Prices differ according to the quantity demanded and sold (quantity rebate).

- Third degree price discrimination:

  Consumer groups (students, children, ...) are treated differently.

Exercise (third degree price discrimination)

- A monopolist faces two markets:
  $x_1(p_1)=100-p_1$
  $x_2(p_2)=100-2p_2$.
  Unit costs are constant at \$20.
- What are the profit-maximizing prices with and without third degree price discrimination?

(Intermediate Microeconomics; Hal R. Varian)

Exercises (inverse elasticities rule)

- Demand elasticities in two markets:

$$\varepsilon_1 = -2 \quad \text{and} \quad \varepsilon_2 = -4$$

- Suppose that a monopoly can price discriminate between the two markets.
- Prove the following statement:
  "The price in market 1 will be 50% higher than the price in market 2."

(Industrial Organization; Oz Shy)

Price discrimination

- According to GWB there is
  - abuse of the market-dominated position if different prices are charged without factual avowry.

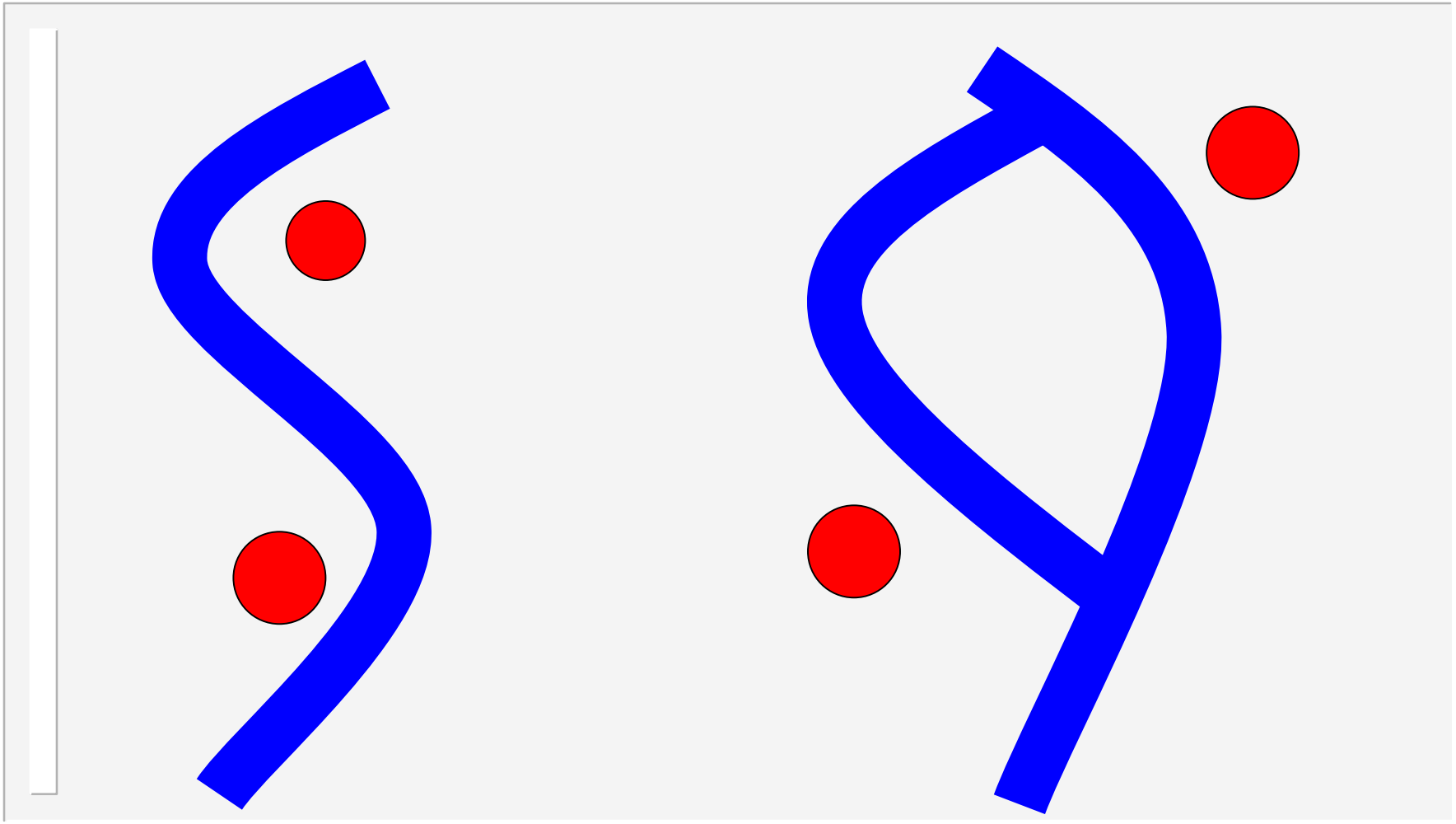
Modifications of the price rule

- Positive/negative carry-over-effects
- Temporal price discrimination
- Effects of experience/learning curves
- Information
- Uncertainty of demand
- Substitutes and complements

Complements and substitutes

- Goods are called complements if a price increase of one good decreases demand for the other (hardware and software, cars and gas, cinema and popcorn).
- Goods are called substitutes if a price increase of one good increases demand for the other (butter and margarine, petrol and train tickets).

A robber baron on the Rhine offers complements or substitutes



Executive summary I

- A profit-maximizing monopolist always sets the price in the elastic region of the demand curve.
- For linear demand, we have
  - The higher the marginal costs the higher the monopoly price and the lower monopoly quantity and profit.
  - Increasing the demand at any price (e.g. increasing *d* or decreasing *e*) increases monopoly price, quantity, and profit.

Executive summary II

- If a monopolist offers more than one good, he has to charge a higher/lower price for substitutes/complements than a single-product monopolist would do.
- A firm that offers durable goods should set a price which is above the optimal short-run price.
- In order to exhaust effects of experience and learning curves a price below the optimal short-run price should be charged.

Executive summary III - This is a firm‘s ideal world:

- There are no competitors in the output market and the firm uses price differentiation as perfect as possible.
- The firm is a monopsonist on the input markets and uses factor price discrimination.
- Entry is blockaded. Thus, the firm is not threatened by potential competitors.
- There is no threat of substitutes.
- Complements are available at high quality and low prices.