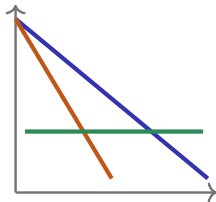


Imperfect Competition

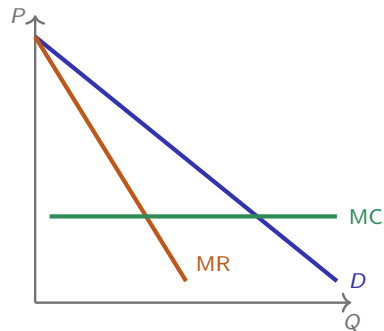
AP Microeconomics ■ Unit 4

AP Microeconomics



What we will cover

- 1 Market power & barriers
- 2 Monopoly
- 3 Price discrimination
- 4 Monopolistic competition
- 5 Oligopoly & game theory



1

Market power

Does a large factory prove market power?

A car maker offers a different design from its rivals. Buyers can still switch to other cars.

What evidence would you need?

Identify the product market, close substitutes and barriers preventing new firms from entering.



Scale can affect costs. Substitutes affect pricing power.

Does a large factory prove market power?

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What evidence would you need?

Identify the product market, close substitutes and barriers preventing new firms from entering.

Market power 市场势力 means some ability to choose price, subject to demand. Factory size alone does not establish it.



Scale can affect costs. Substitutes affect pricing power.

Selling another unit: why is MR below price?

Uniform pricing: every buyer pays the same price

Demand is $P = 110 - Q$. At $Q = 1$, charge \$109. At $Q = 2$, charge \$108 on *both* units. Find extra revenue from the second unit.

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$$TR_1 = P_1 Q_1 = 109(1) = \$109$$

$$TR_2 = P_2 Q_2 = 108(2) = \$216$$

$$MR = \Delta TR / \Delta Q = (216 - 109) / (2 - 1) = \$107$$

The new unit brings \$108, but the price cut loses \$1 on the first unit. Net extra revenue is \$107.

The market structure changes the firm's choices

Structure	Product and sellers	Entry
Perfect competition	Many; identical	Free
Monopolistic competition	Many; differentiated	Easy
Oligopoly	Few major sellers	Barriers
Monopoly	One; no close substitutes	Barriers

In an **imperfectly competitive** 不完全竞争 product market, firm demand slopes down. Under uniform pricing, $MR < P$.

Barriers to entry 进入壁垒, such as patents or control of a key resource, can protect profit. They cannot guarantee demand or profit.

2

Monopoly

One monopoly: choose quantity, then price

A **monopoly** 垄断 is one seller with no close substitutes, protected by entry barriers.

Try before the solution: one period, dollars and units

Demand $P = 110 - Q$; $MR = 110 - 2Q$; $MC = 20 + Q$.

Find the profit-maximizing quantity and the price buyers will pay. Which curve gives each answer?

For this model, rising MC crosses falling MR. First find $MR = MC$; then read price from demand at that quantity.

The monopoly cannot choose price and quantity freely

Quantity: compare extra revenue and cost

$$MR = MC$$

$$110 - 2Q = 20 + Q$$

$$Q_M = (110 - 20)/3$$

$$Q_M = 30 \text{ units}$$

Price: use buyers' demand

$$P_M = 110 - Q_M$$

$$P_M = 110 - 30$$

$$MC_M = 20 + Q_M = \$50$$

$$P_M = \$80 \text{ per unit}$$

At the chosen output, MR is \$50 and price is \$80. Reading price from MR would understate what buyers pay.

Profit needs ATC at the chosen quantity

Add the cost information

Same firm: $TC = 600 + 20Q + 0.5Q^2$; $ATC = 600/Q + 20 + 0.5Q$. Fixed cost is \$600. At $Q = 30$, $P = \$80$. Calculate economic profit.

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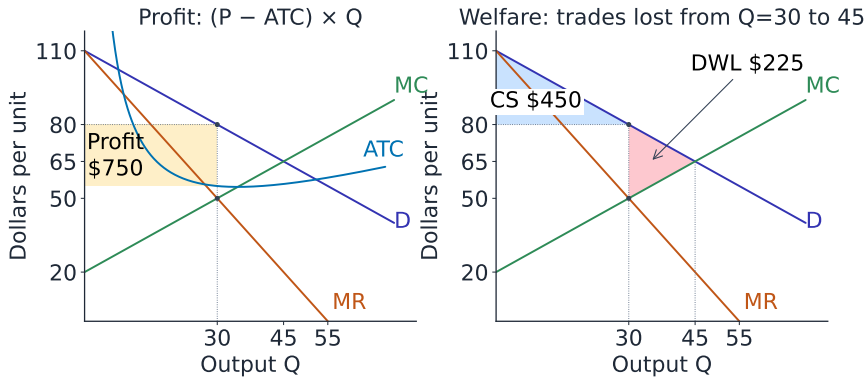
$$ATC = 600/Q + 20 + 0.5Q$$

$$ATC = 600/30 + 20 + 0.5(30) = \$55 \text{ per unit}$$

$$\pi = (P - ATC)Q = (80 - 55) \times 30 = \$750$$

$P - ATC = \$25$ is profit per unit. $P - MC = \$30$ is a different gap. Neither gap alone is total profit.

Profit and welfare: identify the separate areas



Left: profit uses ATC at $Q_M = 30$. Right: consumer surplus uses demand above $P = 80$; deadweight loss uses trades lost between 30 and 45.

Why are 15 worthwhile trades lost?

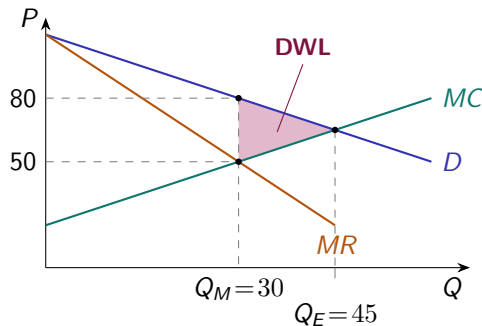
Assume no external costs or benefits: demand measures marginal benefit, MC marginal cost.
Efficient output ($P = MC$):

$$110 - Q = 20 + Q \Rightarrow Q_E = \frac{110 - 20}{2} = 45 \text{ units}$$

Lost gains from trade:

$$\begin{aligned} DWL &= \frac{1}{2}(Q_E - Q_M)(P_M - MC_M) \\ &= \frac{1}{2}(45 - 30)(80 - 50) \end{aligned}$$

$$DWL = \$225$$



Deadweight loss 无谓损失 is lost surplus on units 30–45: worth more to buyers than they cost to make, but never traded.

Consumer surplus, producer surplus and profit

Same model: $Q_M = 30$, $P_M = 80$, demand intercept 110, fixed cost 600.

$$CS = \frac{1}{2}(P_{\text{intercept}} - P_M)Q_M = \frac{1}{2}(110 - 80) \times 30 = \$450$$

$$VC = 20Q + 0.5Q^2 = 20(30) + 0.5(30)^2 = \$1,050$$

$$PS = TR - VC = 80(30) - 1,050 = \$1,350$$

$$\pi = PS - FC = 1,350 - 600 = \$750$$

Producer surplus subtracts variable cost. Profit subtracts *all* cost. Total surplus $CS + PS = \$1,800$; nobody receives the \$225 deadweight loss.

Can a protected monopoly make a loss?

Change only fixed cost

Raise fixed cost from \$600 to \$1,500. Demand, MR, MC and variable cost are unchanged. Does quantity change? Is profit still positive?

Can a protected monopoly make a loss?

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Quantity stays 30 and price stays \$80 because MR and MC do not change.

$$ATC = 1,500/Q + 20 + 0.5Q = 1,500/30 + 20 + 0.5(30) = \$85$$

$$\pi = (P - ATC)Q = (80 - 85) \times 30 = -\$150$$

Revenue \$2,400 still covers variable cost \$1,050. Operating contributes to unavoidable fixed cost; shutdown would lose \$1,500.

Revenue maximization is a different objective

Return to the original firm. Demand $P = 110 - Q$ and $MR = 110 - 2Q$.

Maximize total revenue

$$MR = 0$$

$$110 - 2Q = 0$$

$$Q_R = 55 \text{ units}$$

$$P_R = 110 - Q_R = \$55$$

Demand is **unit elastic** at the revenue maximum.

Profit maximization gave $Q_M = 30$, with positive MC and elastic demand.

If a patent expires and close substitutes enter, demand facing this firm becomes more elastic.

Label Q_M at $MR=MC$ and Q_R at $MR=0$. They answer different questions.

When is one supplier cheaper than two?

A **natural monopoly** 自然垄断 has falling long-run average cost across relevant market demand.

A separate utility model

$$TC = 1,200 + 20Q; MC = 20.$$

$$ATC = 1,200/Q + 20.$$

One supplier at $Q = 80$: $ATC = \$35$.

Two suppliers, each at $Q = 40$: each $ATC = \$50$.

Duplicate networks cost more in this model. A plant photograph alone cannot prove this condition.



Regulation: efficiency and covering costs

Utility demand $P = 100 - Q$, $MC = 20$, $ATC = 1,200/Q + 20$.

Pricing rule	Q	P	ATC	Profit
$MR=MC$	40	\$60	\$50	\$400
$P=MC$	80	\$20	\$35	-\$1,200
$P=ATC$	60	\$40	\$40	\$0

At efficient output 80, price cannot cover average cost: continuing supply needs funding for the \$1,200 loss.

Fair return at the larger-output demand-ATC intersection covers cost, including normal return, but output 60 is below efficient output 80.

Antitrust 反垄断 addresses competition. Natural-monopoly price regulation addresses a separate cost problem. $P=ATC$ does not mean minimum ATC.

3

Price discrimination

Different prices: discrimination or different costs?

Price discrimination 价格歧视: different prices for the same good, not explained by differences in supply cost.

Classify the offers; identify the evidence

A: a student pays less for the same cinema seat and service.

B: a premium ticket costs more because it includes a costly meal.

Check market power, separation by willingness to pay and limits on resale. A discount is not perfect knowledge of every buyer's valuation.

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A: a student pays less for the same cinema seat and service.

B: a premium ticket costs more because it includes a costly meal.

A can be price discrimination. B alone does not establish it: the service and cost differ. Student ID separates groups, and personal tickets restrict resale.

Check market power, separation by willingness to pay and limits on resale. A discount is not perfect knowledge of every buyer's valuation.

Perfect discrimination: who receives the surplus?

Original monopoly: $D : P = 110 - Q$, $MC = 20 + Q$, fixed cost \$600.

Predict before calculating

Each unit sells for its buyer's maximum willingness to pay. No price cut applies to earlier units. Find the final unit, its lowest price, and consumer surplus.

Perfect discrimination: who receives the surplus?

Original monopoly: $D : P = 110 - Q$, $MC = 20 + Q$, fixed cost \$600.

Predict before calculating

Each unit sells for its buyer's maximum willingness to pay. No price cut applies to earlier units. Find the final unit, its lowest price, and consumer surplus.

$$P = MC \Rightarrow 110 - Q = 20 + Q$$

$$Q_E = (110 - 20)/2 = 45 \text{ units}$$

$$P_{\text{lowest}} = 110 - Q_E = 110 - 45 = \$65$$

More efficient output does not mean buyer surplus

Original firm's outcome	Uniform price	Perfect discrimination
Output	30	45
Consumer surplus	\$450	\$0
Producer surplus	\$1,350	\$2,025
Economic profit	\$750	\$1,425
Deadweight loss	\$225	\$0

Each buyer pays their maximum willingness to pay. With no externalities, all worthwhile trades occur, but consumers keep no surplus.

Perfect discrimination removes the uniform-price deadweight loss. Producer surplus still differs from profit by fixed cost \$600.

4

Monopolistic competition

Entry changes demand for an existing restaurant

Monopolistic competition 垄断竞争: many firms, **differentiated** 差异化 products, easy entry and exit.

Explain the adjustment

A restaurant earns positive economic profit. New restaurants offer close substitutes. What happens to demand facing the original restaurant? What attracts the entrants?

Short-run profit, loss or zero profit are possible. In the long-run model, entry and exit remove economic profit, including losses.

Entry changes demand for an existing restaurant

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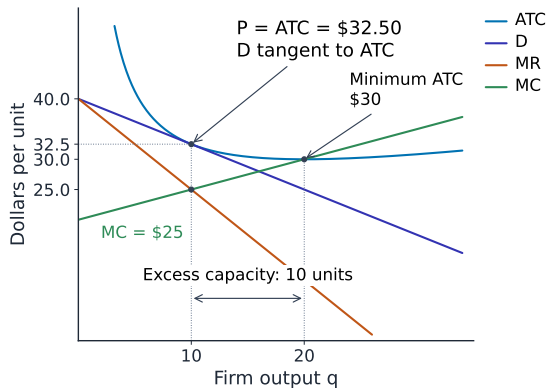
Explain the adjustment

A restaurant earns positive economic profit. New restaurants offer close substitutes. What happens to demand facing the original restaurant? What attracts the entrants?

Profit attracts entry. The original firm's demand decreases and tends to become more elastic as substitutes increase. With losses, exit increases demand for remaining firms.

Short-run profit, loss or zero profit are possible. In the long-run model, entry and exit remove economic profit, including losses.

Zero profit: demand touches ATC away from its minimum



At $q = 10$: $MR=MC=\$25$ and $P=ATC=\$32.50$. Minimum ATC occurs at $q = 20$. Read all three relationships separately.

Zero economic profit still leaves two efficiency gaps

Given the graph: output 10, price and ATC \$32.50, MC \$25; minimum ATC \$30 at output 20.

$$\pi = (P - ATC)q = (32.50 - 32.50) \times 10 = \$0$$

$$\text{Excess capacity} = q_{\min ATC} - q_{\text{actual}} = 20 - 10 = 10 \text{ units}$$

Excess capacity 过剩产能 means output below the quantity minimizing ATC; it need not mean unsold stock.

P exceeds MC, so output is allocatively inefficient with no externalities. ATC exceeds its minimum, so it is productively inefficient.

Zero economic profit includes normal return. Product variety is a benefit outside these simple cost-efficiency comparisons.

5

Oligopoly and game theory

Read each firm's incentive, holding its rival fixed

An **oligopoly** 寡头垄断 has few major sellers and barriers to entry. Firms are **interdependent** 相互依存.

Game 1: independent, simultaneous choices

Profits are in \$ millions. The first entry is A's profit; the second is B's. Both firms know the **payoff matrix** 收益矩阵; they do not cooperate.

	B: High	B: Low
A: High	(10, 10)	(4, 14)
A: Low	(14, 4)	(6, 6)

Does A prefer Low for *each* B choice? Check B separately. Can either firm gain by switching alone from (Low, Low)?

Game 1: prove dominance and equilibrium

A's comparisons

If B High: Low gives 14 rather than 10.

If B Low: Low gives 6 rather than 4.

Low is A's **dominant strategy** 优势策略:
better whatever B does.

At (Low, Low), either firm's unilateral switch cuts its own payoff from 6 to 4. Neither gains: a **Nash equilibrium** 纳什均衡.

B's comparisons

If A High: Low gives 14 rather than 10.

If A Low: Low gives 6 rather than 4.

Low is also B's dominant strategy.

Dominance compares a strategy across all rival choices. Nash checks unilateral switches at a particular outcome.

Why is the cooperative outcome unstable in this game?

	B: High	B: Low
A: High	(10, 10)	(4, 14)
A: Low	(14, 4)	(6, 6)

Payoffs (A, B), \$ millions. At the Nash outcome, each receives 6.

At (High, High), combined profit is $10 + 10 = 20$, above $6 + 6 = 12$.

But either firm can raise its own profit from 10 to 14 by switching alone.

This **prisoners' dilemma** 囚徒困境 explains an incentive to cheat when **colluding** 勾结 or forming **cartels** 卡特尔.

Game theory 博弈论 studies these interacting choices. The incentive to cheat does not prove that every real cartel immediately collapses.

Game 2: what if neither firm has a dominant strategy?

Same assumptions and payoff order (A, B), in \$ millions. New illustrative choices and payoffs:

	B: Reliability	B: Power
A: Safety	(12, 18)	(24, 25)
A: Comfort	(22, 30)	(20, 15)

Find A's best response to each B choice. Find B's best response to each A choice. Then check each cell for profitable unilateral switches.

A Nash equilibrium can exist without a dominant strategy. Do not assume every matrix is a prisoners' dilemma.

Game 2: two equilibria, no dominant strategy

A's best response

B Reliability: Comfort, $22 > 12$.

B Power: Safety, $24 > 20$.

A's choice changes with B's: no dominant strategy.

Nash: Safety, Power. A switching gets 20 instead of 24; B switching gets 18 instead of 25.

Nash: Comfort, Reliability. A switching gets 12 instead of 22; B switching gets 15 instead of 30.

B's best response

A Safety: Power, $25 > 18$.

A Comfort: Reliability, $30 > 15$.

B's choice changes with A's: no dominant strategy.

A penalty changes the matrix before the equilibrium

Change only B's payoff from choosing Power

Subtract \$10 million from B in *both* Power cells. Keep A's payoffs and the Reliability column unchanged. Find the new equilibrium.

	B: Reliability	B: Power
A: Safety	(12, 18)	(24, 15)
A: Comfort	(22, 30)	(20, 5)

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Change only B's payoff from choosing Power

Subtract \$10 million from B in *both* Power cells. Keep A's payoffs and the Reliability column unchanged. Find the new equilibrium.

	B: Reliability	B: Power
A: Safety	(12, 18)	(24, 15)
A: Comfort	(22, 30)	(20, 5)

B prefers Reliability: $18 > 15$ with Safety; $30 > 5$ with Comfort. A's best response is Comfort. Unique Nash: (Comfort, Reliability), profits (22, 30).

How large must the penalty be?

Let t be the penalty on B's Power choice in each row, in \$ millions. For Reliability to be *strictly* dominant:

$$18 > 25 - t \quad \Rightarrow \quad t > 7$$

$$30 > 15 - t \quad \Rightarrow \quad t > -15$$

A nonnegative penalty must exceed \$7 million. At exactly 7, B is indifferent in the Safety row. With whole millions, 8 is the smallest sufficient penalty.

A merger maximizing combined profit in the *original* Game 2 chooses Comfort, Reliability: $22 + 30 = \$52$ million. Other totals: 30, 49, 35.

Use the stated table and objective. Joint-profit maximization and individual best responses are different decisions.

Exam tips

Transfer the worked example to a blank graph

Original model: $P = 110 - Q$, $MR = 110 - 2Q$, $MC = 20 + Q$, $ATC = 600/Q + 20 + 0.5Q$. Use dollars per unit and units per period on the axes.

- 1 Draw and label D, MR, MC and ATC. Make MC cross ATC at its minimum.
- 2 Find $MR=MC$; mark quantity, then read price and ATC at that same quantity.
- 3 Shade profit, consumer surplus and deadweight loss as separate areas. Label the efficient quantity at $D=MC$.
- 4 Mark revenue-maximizing output at $MR=0$. If pricing becomes perfect discrimination, identify the final unit and its lowest price.

6

Recap

Check yourself: defend each answer

- 1 Original monopoly: $P = 80$, $ATC = 55$, $MC = 50$, $Q = 30$. Calculate profit. Why is $(P - MC)Q$ wrong?
- 2 Long-run monopolistic competition: $P = ATC = 32.50$, $MC = 25$, output 10, minimum-ATC output 20. Is it efficient?
- 3 Original Game 2: is (Safety, Reliability) Nash? Give one profitable unilateral switch.

Attempt first. Use the correct cost, the correct output and the deciding player's own payoff.

Check yourself

- 1. Profit:** $\pi = (P - ATC)Q = (80 - 55)30 = \750 . MC measures the next unit's cost; ATC measures cost per unit across all 30.
- 2. Efficiency:** zero economic profit, but $P > MC$ and output is below minimum-ATC output. Neither allocative nor productive efficiency in this model. Excess capacity $20 - 10 = 10$ units.
- 3. Game 2:** not Nash. With B fixed at Reliability, A can switch from Safety to Comfort and raise profit from 12 to 22. B could also gain by switching to Power, from 18 to 25.