Opportunity cost

11 principles:

1. Make choices based off scarcity
2. Opportunity costs are the true costs
3. Think on the margin
4. People respond to incentives to better themselves
5. There are gains from trade through specialization
6. Market is constantly shifting towards EQ
7. Resources should be allocated efficiently
8. Market is usually efficient. If it isn't, gov't can step in to improve social welfare
9. Your spending is another person's income
10. If spending surpasses production capacity, gov't policy can change spending
11. Increase in economic potential leads to growth over time

Surplus = benefits - costs

IGNORE SUNK COSTS

Take action only if benefits ≥ costs

MB ≥ MC → stop at MB = MC

OC → $ Value of NEXT BEST ALTERNATIVE

OC = Explicit cost + Implicit cost

Explicit cost: price you actually pay

Implicit cost: costs relevant to decision making but hidden from accountant

Value-Price

$MC(N) = Cost(N) - Cost(N-1)$

$MB(N) = Benefit(N) - Benefit(N-1)$

Accounting profit = Revenue - Explicit Cost

WTP = Benefits - Implicit

≥ Price (Explicit cost)

Economic profit = Revenue - OC

= Revenue - (Explicit + Implicit)

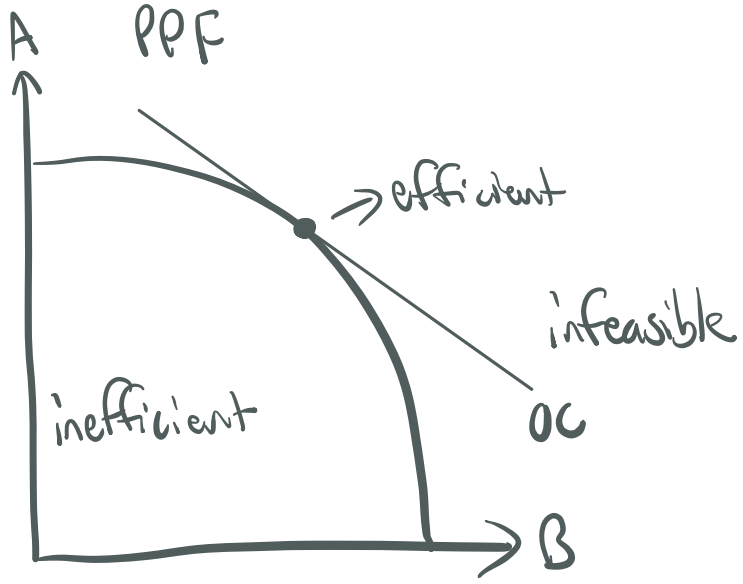
= (Revenue - Explicit) - Implicit

= Accounting Profit - Implicit

Benefits ≥ OC → Buy only if B ≥ OC

Always choose the lowest OC

Gains from trade



Slope of tangent of PPF = OC

$\frac{d}{dx}(PPF) = OC$

- Bowed out curve
  - ↳ Increasing OC

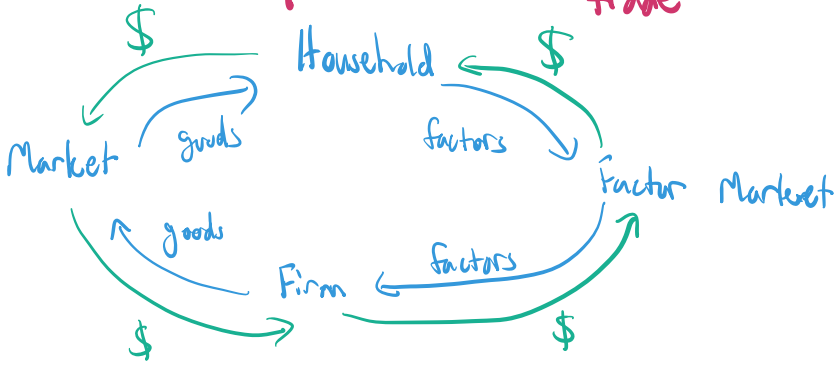
$OC_B = \frac{A}{B}$

Specialize in **lower OC** → Comparative advantage

Absolute advantage - producing more physically

$OC_{trade} = \frac{\text{give up}}{\text{get}}$

Trade only if $OC_{trade} < OC_{self\text{-}produce}$



Failures

Pauper - affect QOL

Sweatshop - low wages

Exchange rate for x:

$OC_x^b \leq E \leq OC_x^A$

Positive - How it actually works

Normative - How it should work

Start with person with lowest OC for joint PPF

Supply & Demand

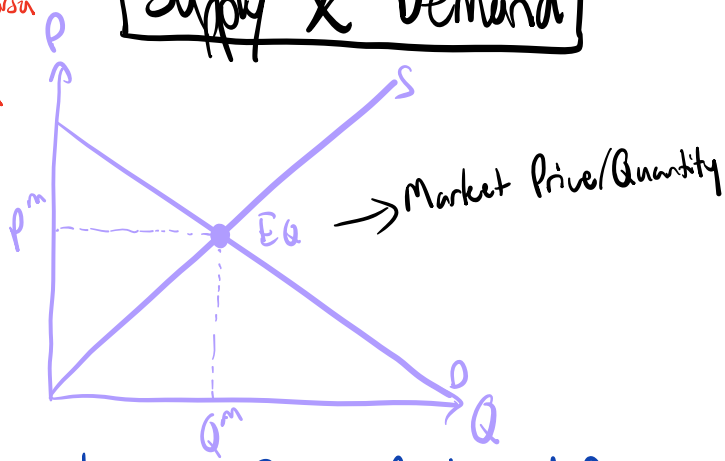
Law of Demand - As price ↑, quantity demanded ↓ and vice versa

Law of Supply - As price ↑, quantity supplied ↑ and vice versa

All else held equal

Demand/Supply ↑, shift →

Demand/Supply ↓, shift ←



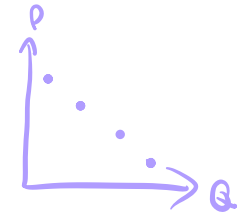
Shift along - ΔP

Shift off - ΔQ^D / ΔQ^S

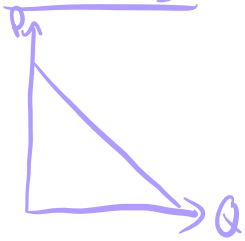
Normal good: Income ↑, demand ↑

Inferior good: Income ↑, demand ↓

Discrete:



Continuous:



Demand: P = MWTP for last unit

Supply: P = MC for last unit

Sell if MB ≥ MC

Factors that affect Demand	Factors that affect Supply
① Price of other goods	① Price of other goods
② Tastes	② Price of inputs
③ Expectations for future	③ Expectations for the future
④ Consumer income	④ Technology
⑤ No. of consumers	⑤ No. of producers

Always convert to $Q(p) = a + bP$

Always move towards EQ

Market supply/demand = $\sum_{i=1}^{n} Q_i(p)$

Substitutes: P_{sub} ↑, $Q^D_{original}$ ↑

$Q^S_{original}$ ↓

Complements: P_{comm} ↑, $Q^D_{original}$ ↓

, $Q^S_{original}$ ↑

Demand ↓, Supply ↑, EQ price ↓, EQ quantity depends

Demand ↑, Supply ↓, EQ price ↑, EQ quantity depends

Demand ↑, Supply ↑, EQ quantity ↑, EQ price depends

Demand ↓, Supply ↓, EQ quantity ↓, EQ price depends

If MP > EQ, surplus leads to price downshift

If MP < EQ, shortage leads to price upshift

Elasticity

$$\text{Elasticity} = \frac{\%\Delta Q}{\%\Delta P}$$

$$\%\Delta Q = \frac{\Delta Q}{Q}$$

$$\%\Delta P = \frac{\Delta P}{P}$$

Usually, P and Q^D move oppositely → When P⊕, Q^D⊖

$$\varepsilon_D = \left|\frac{\%\Delta Q^D}{\%\Delta P}\right|$$

Midpoint method:

$$\varepsilon_D = \left|\frac{\%\Delta Q^D}{\%\Delta Q^S}\right| \quad \%\Delta Q^D = \frac{\Delta Q^D}{\text{avg } Q^D} \quad \%\Delta P = \frac{\Delta P}{\text{avg } P}$$

$$= \left|\frac{\frac{Q_2^D - Q_1^D}{\frac{Q_2^D + Q_1^D}{2}}}{\frac{P_2 - P_1}{\frac{P_2 + P_1}{2}}}\right|$$

Revenue = $P \cdot Q_{sold}$

= Expenditure ≠ Profit = Rev. − Costs

Point elasticity

$$\varepsilon_D = \left|\frac{\%\Delta Q^D}{\%\Delta P}\right|$$

$$= \left|\frac{\Delta Q^D}{\Delta P} \cdot \frac{P}{Q}\right|$$

$P = a + b \cdot Q^D$, slope $\left(\frac{\Delta P}{\Delta Q^D}\right)$

$$= \left|\frac{1}{b} \cdot \frac{P}{Q}\right|$$

Inelastic – if P↑, revenue↑ ⇒ price effect > quantity effect

Elastic – if P↑, revenue↓ ⇒ price effect < quantity effect

Unit-elastic – ΔP doesn't change revenue ⇒ price effect = quantity effect

Elastic if $|\%\Delta Q| > |\%\Delta P|$, $|\varepsilon| > 1$

Inelastic for $|\%\Delta Q| < |\%\Delta P|$, $|\varepsilon| < 1$

Unit elastic if $|\%\Delta Q| = |\%\Delta P|$, $|\varepsilon| = 1$

Perfectly elastic if $|\varepsilon| = 0$

Perfectly inelastic if $|\varepsilon| = \infty$

$$\text{Income elasticity} = \frac{\%\Delta Q}{\%\Delta I}$$

Normal good $\varepsilon_I > 0$

Inferior good $\varepsilon_I < 0$

} Sign matters

Income elastic → $\varepsilon_I > 1$

" inelastic → $0 < \varepsilon_I < 1$

" unit-elastic → $\varepsilon_I = 1$

$$\text{Cross-price elasticity} = \frac{\%\Delta Q_A^D}{\%\Delta P_B}$$

Positive when A and B are substitutes

Negative when A and B are complements

Elasticity changes along a curve

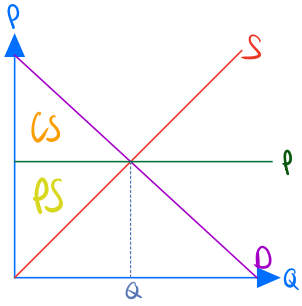
Surplus

Consumer surplus = WTP − $ Price

Market consumer surplus = $\sum CS$

Producer surplus = $Price − MC

Market producer surplus = $\sum PS$



Total surplus = CS + PS

Transaction takes place when

$MWTP \geq P \geq MC$

Reallocating good to someone with higher MWTP increases surplus

Reallocating good to someone with lower MC increases surplus

If extra unit has MWTP > MC producing it, $\sum$ Surplus ↑

Trade all goods where MWTP > MC and not any others

No externalities

Efficient ≠ fair

↳ Maximizes $\sum$ Surplus

$\sum$ Surplus is maximized at Equilibrium

Market failure happens when

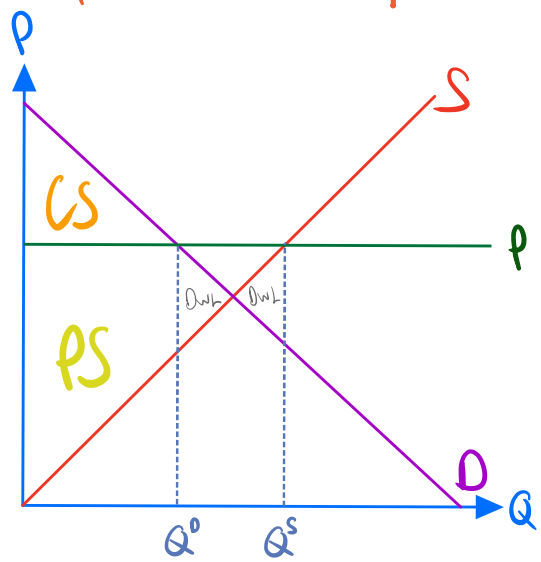
- Inefficient trade
- Inaccuracy of price signals
- Assumptions of perfectly competive market don't hold

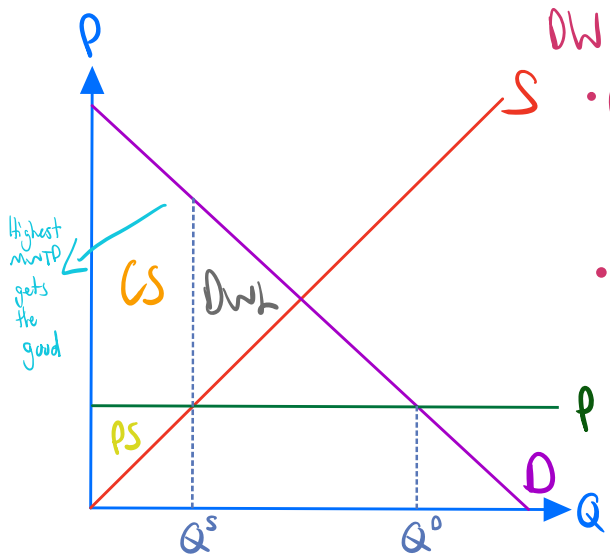
$$DWL = \sum S_{efficient} - \sum S_{market}$$

Focus on Quantity for DWL

DWL happens because:

- Quantity traded too low
- Quantity traded too high





Market power, externalities, public goods are goods for inefficient allocation

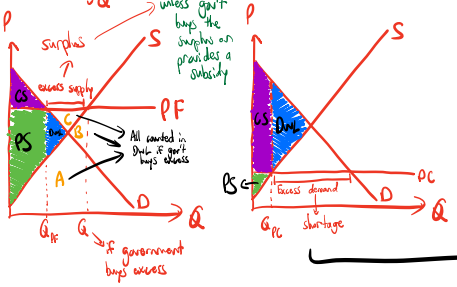
Equity ↑, Efficiency ↓

Tax & Price Controls

Interfere with the market if want: • change in distribution of surplus
• encourage/discourage consumption

Price Floor

$P_F > P_{EQ}$



Price ceiling

$P_C < P_{EQ}$

→ Both have additional sources of DWL

$Q < Q_{EQ} \Rightarrow TS \downarrow$

↳ Leads to illegal activity

↳ Inefficient allocation of sales

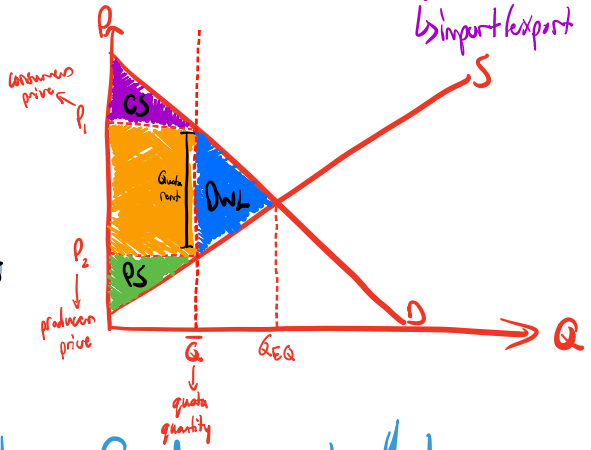
↓

excess supply / demand

Quotas

↳ Quantity traded can not legally be higher than $\bar{Q}$

↳ import/export restrictions



Excise tax - $ amount / unit purchased

↳ Distortionary tax: ΔMB vs $\Delta MC \Rightarrow \Delta Q$

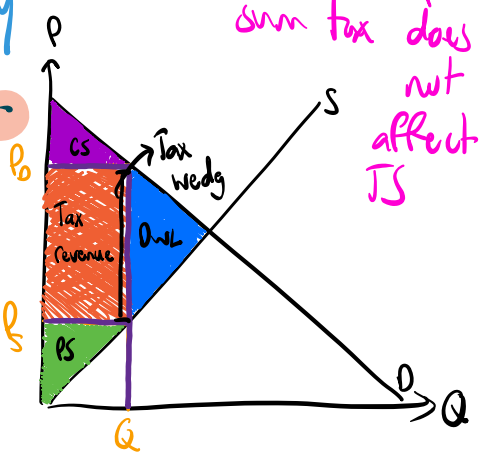
$P_D = P_S + t$

Lump sum tax - fixed amount that doesn't depend on quantity

↳ Regressive

→ Tax rev. from lump sum tax does not affect TS

Market price → determined by who pays tax at checkout



Buyer pays → $P = P_S$ → $P_D = P + t$

Seller pays → $P = P_D$ → $P - t = P_S + t$

$TS = CS + PS + \text{Tax revenue}$ → depends on ε_D and ε_S

Whoever pays tax on paper does not affect who bears tax burden

Statuary incidence: Who pays at checkout? → determined by gov't

Economic incidence: Who effectively pays the tax → determined by market

$P_D \Rightarrow \Delta P$ for consumer $= P_D - P_{EQ}$

$P_S \Rightarrow \Delta P$ for producer $= P_{EQ} - P_S$

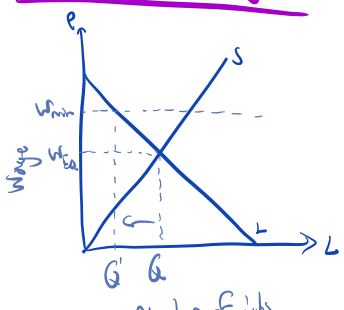
★ Who pays depends on relative elasticities → less elastic gets tax burden

If tax ↑, revenue will increase if the revenue from the new units can negate the revenue lost from the old units

$\varepsilon \uparrow \Rightarrow DWL \uparrow$

$\text{Tax revenue} = t \cdot Q$

Minimum wage



Minimum wage → price floor

↳ As W_{min} increases, number of jobs lost depends on ε_D of labour

↓

less jobs lost if $|\varepsilon_D| < 1$

IF $P_D > P_S \Rightarrow DWL$

Firm costs

Profits = Revenue − Costs
= P × Q − OC

Marginal cost → extra cost of Q^{th} bit

Cost categories directly affect

Total Cost
- Fixed ← does not change as Q^s ↑ or ↓
- Variable → changes as Q^s changes
  - ↳ Cost of labour
- ↳ Avg. costs → useful for quick comparisons, especially on graphs

Fixed input: · Quantity fixed
· Can't ↑ or ↓

Variable input: Firm can hire/buy more or less of input

$TC = FC + VC$
↳ pay off FC

Long run → all inputs are variable
Short run → at least one input is fixed

Average fixed cost (AFC) $= \frac{FC}{q}$

Average variable cost (AVC) $= \frac{VC}{q}$

Average total cost (ATC) $= \frac{TC}{q}$

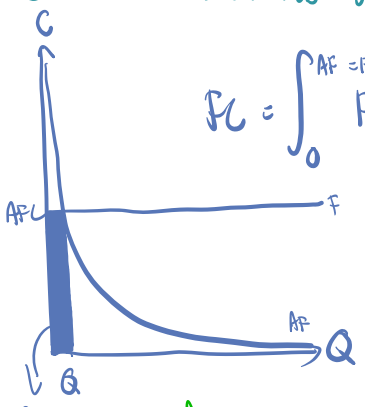
$VC = \sum MC$

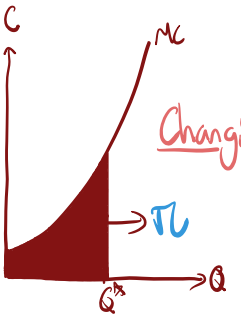
$= AFC + AVC$

Marginal Cost (MC) $= \frac{\Delta TC}{\Delta q}$

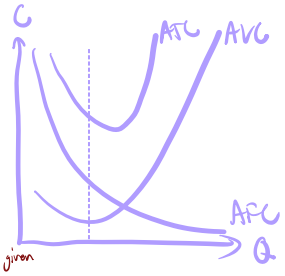
$MC = TC_{(q)} - TC_{(q-1)}$
$= FC + VC_{(q)} - FC - VC_{(q-1)}$
$= VC_{(q)} - VC_{(q-1)}$

$FC = \int_0^{AF = FC} F\,dq$





$TC = \int_0^{\bar{q}} MC\,dq \rightarrow VC + C^{\text{fixed cost}}$
SR, $VC = \int_0^{q} MC\,dq$
LR, $TC = \int_0^{q} MC\,dq$ but FC is given



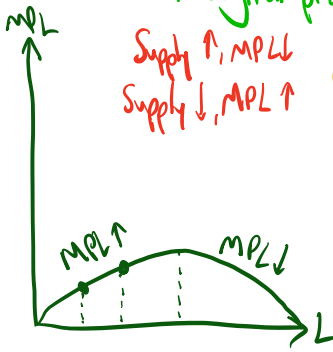
Changing costs: ① Δ input prices
② Difference in technology
③ Which inputs can be changed

Marginal product of labour $= \frac{\Delta q}{\Delta L} = \frac{\text{Wage}}{MC}$

- MPL ↑ ⇒ MC ↓
- MPL ↓ ⇒ MC ↑

$\frac{1}{MPL}$ = How many extra workers needed for an extra unit of output

SR MC depends on MPL
LR returns to scale



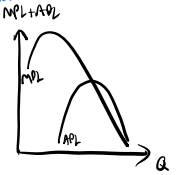
Supply ↑, MPL ↓
Supply ↓, MPL ↑

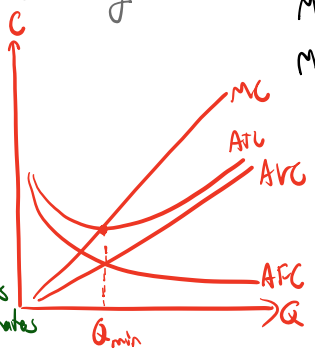
Diminishing return to input: input ↑ MPL ↓
↳ More/less producers so it costs less/more to produce something

Increasing return to input: input ↑ MPL ↑

Average product of labour $= \frac{\sum q}{\sum L}$

MPL > APL, APL ↑
MPL < APL, APL ↓





MC < ATC when $Q < Q_{min}$, ATC ↓
MC > ATC when $Q > Q_{min}$, ATC ↑
MC = ATC when $Q = Q_{min}$

Think GPA

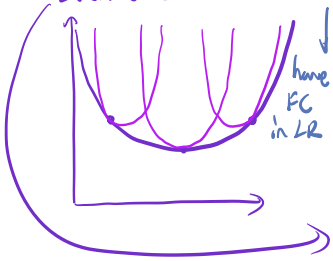
Spreading effect: As output ↑, AFC ↓
↳ Greater quantity over with FC is spread
↳ Strong at low inputs

Diminishing returns effect: As output ↑, AVC ↑
↳ More variable input needed at larger output
↳ Strong at high inputs

If AFC > AVC, spreading effect dominates
If AFC < AVC, diminishing returns effect dominates

Choose FC that minimizes its ATC

LRATC is lower than short run
↳ have FC in LR



Increasing returns to scale enlarges firms
Decreasing returns to scale reduces firms
↑ monopoly

Increasing returns to scale → LRATC ↓ as output ↑
Decreasing returns to scale → LRATC ↑ as output ↑
Constant returns to scale → ΔLRATC = 0 as output ↑

Perfect competition

Economic profit in perfectly competitive market = 0 at EQ

Demand is more elastic in long-run in Perfect competition

↳ Assume perfectly elastic → a P_{mkt}

In perfect competition, P = Avg. R = MR

Free entry & Exit

Use TC (VC+FC) to calculate profit, even in the SR

Profits = P.Q − OC

↳ Avg. Revenue = $\frac{P.Q}{Q}$ = P

Marginal Revenue = ΔTR = PQ − P(Q−1)
= PQ − PQ + P
= P

firms are price takers.

Choose Q based on P ≥ MC

↳ Verify by making sure P ≥ AVC → SR
≥ ATC → LR

Zero economic profits → Revenue maximisation

LR

$P = ATC_{min} = MC$

operate at minimum (break even price)

need $P = ATC_{min}$ for last firm to enter

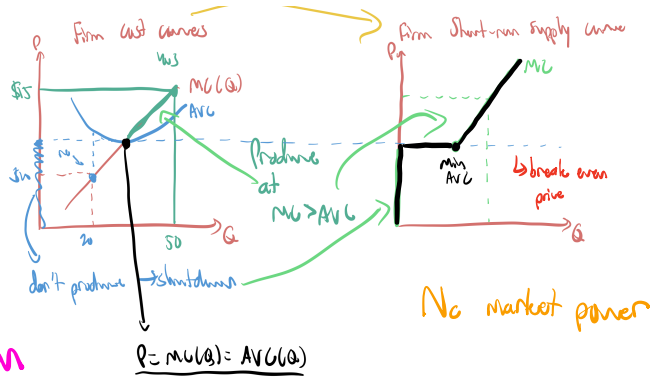
Market supply is perfectly elastic

SR → IF P < AVC, produce q = 0 (MR/Avg R)
↳ Still exist
↳ FC is a sunk cost
→ $P_{min} = AVC_{min}$
P > MC

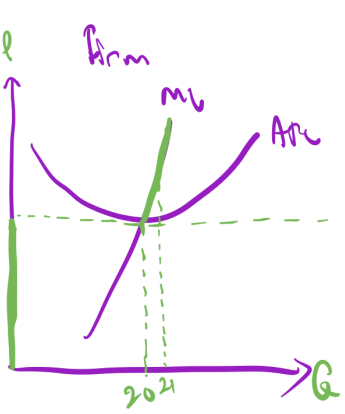
No entry or exit
↳ fixed number of firms

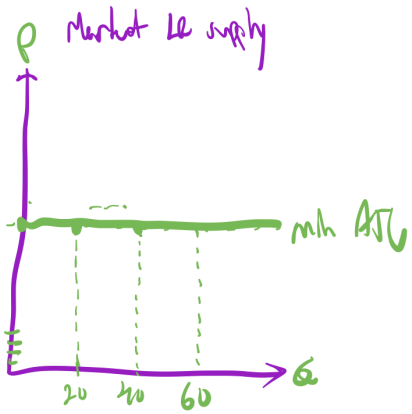
LR → IF P < ATC, shut down firm → $P_{min} = ATC_{min}$
↳ exit market
↳ See if FC can be payed off in LR

Think about entry/exit
↳ Variable number of firms



No market power





Monopoly

sometimes price discriminate
↳ capture CS and very little DWL exists

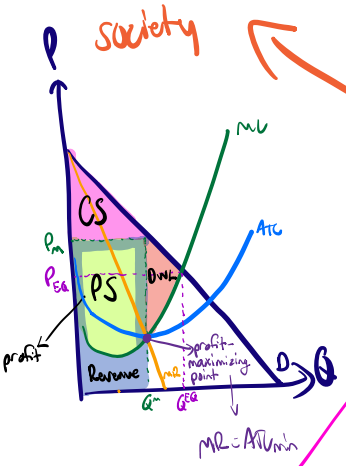
stifle innovation

net losses to society

only produce elastically since QE > PE

MR = QE + PE → Revenue ↑ if P↓ since [maximize profit]

↳ can increase quantity without having to decrease price too much



Monopolists have market power

↳ only one firm
↳ no substitutes

Firm demand = Market demand

producer captures CS as profit → creates DWL

charge same price for every unit sold → creates DWL

Demand = $P_{(Q)} = A - BQ$

Revenue = $R = P_{(Q)} \cdot Q = AQ - BQ^2$

MR = $\frac{dR}{dQ} = A - 2BQ$

⇓

MR is twice as steep as demand

choose quantity

Break up monopoly

① Public ownership
↳ Product supplied by government to protect consumer interests
↳ Can set price based on efficiency rather than profit maximization
↳ firm less willing to keep costs low
↳ often serve political needs

② Regulation
↳ Price ceiling
↳ Still produce as long as P ≥ MC and total breaks even
↳ Incentive to produce more since output no longer affects price
↓
Ignore MR curve → Set P = Mkt. demand

Monopsony → One buyer has market power
↓
Drive through hiring less workers and low wages → too little output
ie! App Store → can only buy apps through App Store
↓
largest network → more dominant → market power
Stifle innovation

High barriers to entry

① Control over a scarce input
↳ Prevent other firms from entering

② Increasing returns to scale
↳ ATC ↓ as output ↑ → since FC is being spread, AFC ↓ so ATC ↓ as Q ↑ (due to spreading effect since monopolists produce less quantity)
↓ mass production → dominant firms buy the smaller ones
↓ Increasing returns to scale
creates natural monopoly → spread over a large Q, so a large firm mass produces
↳ Since very large FC so ATC is less if 1 firm produces

③ Technological superiority
tech is an FC
↳ not typically a barrier in LR since firms can pay off FC in LR
↳ In SR, creates temporary monopoly since producing faster = producing more

④ Network externality
↳ Value of a product is higher to an individual if greater number of others use it
↳ Larger network = more customers
ie! WeChat
Must many → sell at a loss → gain bigger fanbase → monopoly

⑤ Government-created barriers
↳ Patents & Copyrights
↳ Temporary monopoly

Average cost pricing → P = ATC → societal gain → 0 profit and can break even
Marginal cost pricing → P = MC → requires gov't subsidy to cover FC

Price discrimination and Game theory

Prisoner's dilemma → NE is inefficient outcome

Strategic decision → outcome & action depends on what other people do

↓

interdependence

Strategic situation → result of A's actions varies depending on B's

↓

doesn't exist if both firms have strictly dominant strategies

extract CS → from higher WTP

get new customers → more CS, PS → from lower WTP

Price discrimination – setting a different price for people with varying WTPs

more mutually beneficial transactions

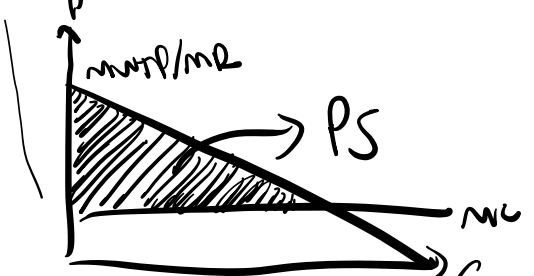
Perfect price discrimination

- Ability to price every consumer their unique WTP's

PE = 0

TS = PS

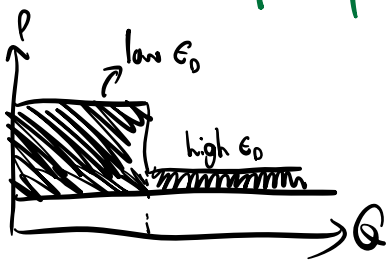
MWTP = MR



- Consumers don't like PPD since CS = 0

3 conditions for PD

1. Firm has to have market power
   - Can raise prices without losing customers
   - In PC, producers are Price Takers
2. Firm has info on consumer's WTP and is able to target them with specific prices
3. Firm needs ability to prevent arbitrage
   - resale of product
     - buy low, sell high



Group pricing

- separate consumers into different groups
  - different ϵ_D
    - have info on consumers and can separate them
  - Has to be so that consumers can't pretend to be part of a different group
- Same P within group
  Different P between groups
- Q determined by MR = MC ⇒ P

Second degree price discrimination

- Unable to distinguish people with different WTP's
  - consumers revealed by their choices
  - Consumers are identical to the firm
- Lower WTP = willing to wait
- Combine lower prices with a hurdle
  - higher MWTP consumers can't pretend to have lower
  - Q discounts
  - Bundling
  - 2-part tariffs
    - entry + per-unit fees
      - → P = MC
      - → CS @ per-unit fee

Oligopoly

4 factors that make it hard to coordinate on high prices

1. Less concentrated industry
   - Gain profit if deviate
2. Complex products and pricing schemes
3. Difference in interests
4. Bargaining power of buyers → often large firms

→ have market power

→ consider duopolies

→ whoever blows the whistle first avoids persecution in a cartel

Oligopoly: less firms producing similar product

Choose Q

Choose P

Cournot Competition ⟷ different results ⟷ **Bertrand Competition**

Cournot Competition

P_{mkt} determined by $\sum Q$ in the market

↳ Interdependence

↓

Firm A's profits depend on Q_B and vice versa

Game theory finds → Nash EQ

best optimal strategies

Undergo Cournot Competition when there are capacity constraints → have to plan ahead

Can't reach PC outcome since collusion

Collusion

- Treated oligopoly as a monopoly
- Limits Q → more profits → cartel
- Yet there is still incentive to cheat → firms act in self-interest
  - $MR^{di} < MR^{mono}$
  - Use Game Theory to determine this

Continuous → undercutting

Prisoner's Dilemma is Monopoly outcome

↳ For oligopoly chose NE

Causes Bertrand to reach PC

Bertrand Competition

Product differentiation

Q^{mkt} for lowest price firm determined by market demand

↳ Interdependence

↓

Firm A's profits depend on P_B and vice versa

- Happens when there are no constraints

IF Firm A choose P_A, Firm B's best choice is to choose $P_A - 0.01$

↳ Enough to steal all demand

Nash EQ is when $P = MC$

for each firm → same as PC

Won't produce below MC since 0 profits > negative profits

$Q^m < Q^o < Q^{pc}$

Externality

Positive externality → ↑ if consumption, ↓ if production

Negative externality → ↑ if production, ↓ if consumption

Social ≠ private

Externality ↴

MSB/MSC = MPB/MPC + MEB/MEC

Efficient

MSB = MSC

Market

MPB = MPC

TS_{mkt}

CS + PS + Ext.

TS_{mkt} with a subsidy/tax

CS + PS + Ext. + Gov't R = TS_{eff}

negative tax → encourages buyers to buy more or producers to produce more

DWL = 0

Internalize externalities

① Social norms

↳ Increase cost of actions OR social recognition increase the benefits of actions

② Bargaining

↳ Coase theorem: If we enforce clear property rights, then the externality problem can be solved through bargaining

③ Pigouvian tax/subsidy

↳ DWL = 0

④ Cap and trade

↳ Regulate amount of externality by issuing permits

↳ Allowing trade of permits to those with the highest MWTP

Technology spillovers

↳ Unintentional technological benefits to firms that come from the research and developmental efforts of the firms