The Firm & The Industry

We go from the individual firm to the industry. The supply side differs from the demand side: firms appear and disappear in response to profitability. The number of firms determines the nature of the market and so the equilibrium price and quantity.

1. From a single price-taking firm, **industry supply** curve can be obtained by the horizontal summation of individual firm's supply curves, in the short run. (H&H Ch. 7.1)
2. In the long run, two complications: (1) the **factor-price effect**, and (2) the **entry and exit** of firms from the industry. (H&H Ch. 7.1)
3. The **price elasticity of supply** measures the percentage change in quantity following a 1%-change in output price. (H&H Ch. 7.1)
4. The conditions for **perfect competition**, and for **pure competition** (no barriers to entry or exit).
5. A single seller: **pure monopoly**. (H&H Ch. 8.1)
6. **Monopolistic competition**: several firms selling goods which are close, but not perfect, substitutes. Long-run profits are zero. (H&H Ch. 9.2)
7. **Price discrimination** and the segmentation of markets. The mark-up with market power. **Consumer's surplus,** and how to capture it. (H&H Ch. 7.3, 8.4)
8. **Producer's surplus** and **economic rent**. (H&H Ch. 7.3) (Revision)

The single price-taking firm interacts with the rest of the world through markets, taking prices P and w_i as given:

the market for output $y^D(P)$
the markets for inputs $z_i^S(w_i)$

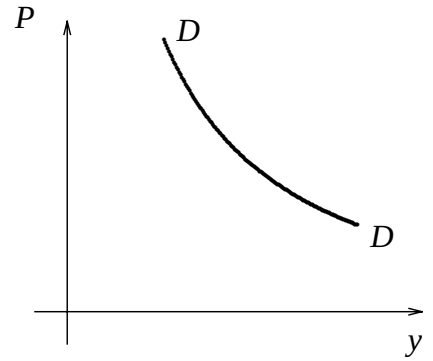
that is, the firm decides how much output y^* to produce and sell, and how much of each input z_i^* to buy in order to maximize profit, given —

- the demand for output $y^D(P)$
- the supply curves for inputs $z_i^S(w_i)$

(For a price-taking firm these are horizontal.)

Two directions in possible analysis:

1. The firm has **market power** and can influence the price P it receives for output by altering its level of production & sales, in which case *the firm's demand curve is not horizontal*.



By altering the amount y^S it offers for sale, the firm can affect the price it sells at, so long as it faces a downwards-sloping demand curve,

and $\frac{\partial P}{\partial y^D} < 0$ is evidence of *market power*.

(downwards sloping
firm's demand curve)

When this happens, we say there is
imperfect competition,

and speak of these (definitions)
monopoly one seller,
monopsony one buyer,
oligopoly a few sellers.
(strategic behaviour)
(→ game theory!)

We consider this below (next lectures).

2. We can aggregate across a large number of small (price-taking) firms to obtain the

   - **industry supply of output**, and
   - **industry demand for inputs** (e.g. labour).

   (We assume that each firm produces identical output goods.)

We shall answer these questions:

Q: at marketing-clearing equilibrium ($S = D$):

- what is the price of output? P
- what are the prices of inputs? w_i
- what are the quantities of outputs & inputs traded? y, z_i

and are these equilibria stable? That is, will prices and quantities adjust to a **market-clearing equilibrium**, where supply = demand?

1. Supply and Short-Run Response

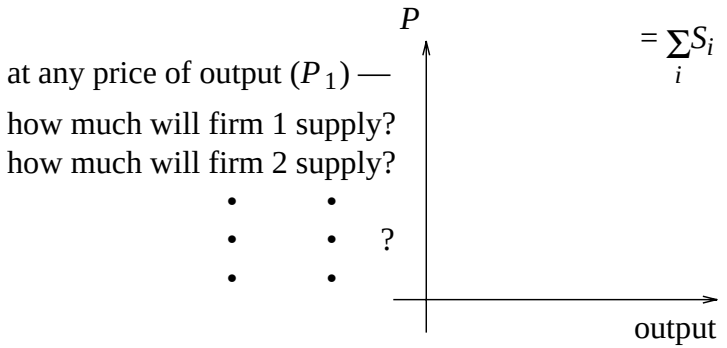
(H&H Ch. 7.1)

1. When $P < P_V$ (where $P_V \equiv \min(AVC)$),
   then $y^* = 0$ because $TR < VC$, and profit < 0.

   When $P > P_V$,
   then $TR > VC$ and short-run $\pi > 0$ and π maximum
   with y^*: $MC(y^*) = P$.
   (so long as increasing MC)

2. The price-taking *firm's* supply curve is its MC curve above breakeven ($\pi = 0$). The **industry supply curve** or **market supply** is obtained by

   horizontally adding all supply curves of individual firms:



   The summation is similar to the summation of individual consumer demand curves to obtain the *market demand curves* (see above)

   but not exactly: there are *complications*:

2. Two complications in deriving the market supply curve from the individual firms' supply curves:

Long-run Responses:

1. *the number of firms is not fixed in the long run*, but will adjust in response to profitability,

   ∴ the number is responsive to output price *P* and profits

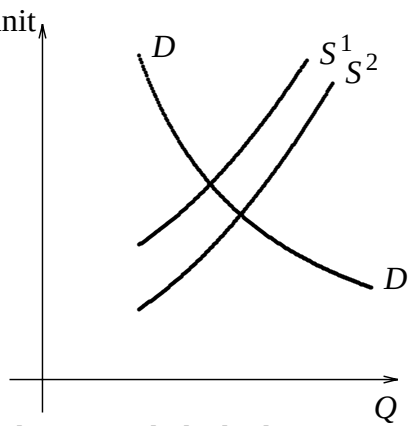
   – if a firm sees an opportunity for increased profit in a new market, it may enter,

   – if a firm is suffering low or negative profits in a market, it must eventually leave the market.

∴

As price *P* rises, firms enter,	cet. par.,
as price *P* falls, firms leave,	cet. par.

The effect of an increase in supply (due to more firms) is to bid down the price, and reduce the profit of the marginal firm to zero, i.e. no more incentive for entry or exit.



The **marginal firm** is the one with the highest average costs of production but positive profit still.

>> Include H&H Fig 7.1, 7.2, 7.3 <<

2. (Second complication) **The Factor-Price Effect**.

   As the *price of output P rises* (say, cars) this may well have an effect on other markets (for example, labour or other markets in which *cars are an input* to production)

   An increase in price of output P may thus

   - result in *increased costs of production* for the firms,
   - & result in a shift upwards in their supply curves.

   ∴ the **effective industry supply curve** tends to be steeper (less elastic) than the aggregate of firms' supply curves.

In conclusion:

- the short-run supply curve of a competitive (or price-taking) firm is identical to its *MC* curve (above min *AVC*),
- the short-run supply curve of a competitive industry is the horizontal sum of firms' supply curves, adjusted for the factor-price effect,
- in the long run, the number of firms will change as marginal firms (in cost terms, $LRAC = P,\ \therefore \pi = 0$) enter or leave in response to positive or negative profit opportunities.

>> Include H&H Fig 7.4 <<

3. Price Elasticity of Supply:

Let κ denote the price elasticity of supply:

$$\text{industry } \kappa \equiv \frac{\Delta Q^S / Q^S}{\Delta P / P} \text{ (arc)}$$

$$\equiv \frac{\partial Q^S}{\partial P} \frac{P}{Q} \text{ (point)}$$

for a firm,

$$\kappa_i = \frac{\partial Q_i^S}{\partial P} \frac{P}{Q_i} \text{ (point)}$$

κ_i +ve

Defn. The price elasticity of supply is the % change in output offered in response to a 1% increase in price of output.

But for the *industry*, $\kappa \le \sum_{i=1}^{n} s_i \kappa_i$, (note the inequality)

where $s_i = \dfrac{Q_i^S}{\Sigma Q_i^S}$ is the market share

and κ_i is the price elasticity of supply of firm *i*.

(The inequality is because of a time period for adjustment, and entry or exit of firms, and the factor-price effect.)

4. Pure Competition

A **perfectly competitive market** satisfies the following three conditions:

1. numerous buyers
   numerous sellers $\Rightarrow$ *price takers*

   $\therefore$ there is *no* market power for an individual buyer or seller to affect the market price.

2. A homogenous good & identical buyers (or arm's length deals)
   $\therefore$ *no price discrimination*.

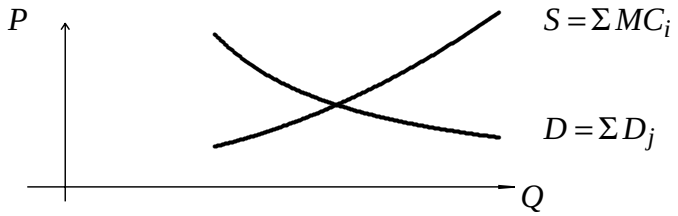
3. Perfect information of all offers to buy & sell
   $\therefore \rightarrow$ *there is one equilibrium price:* $S(P) = D(P)$.

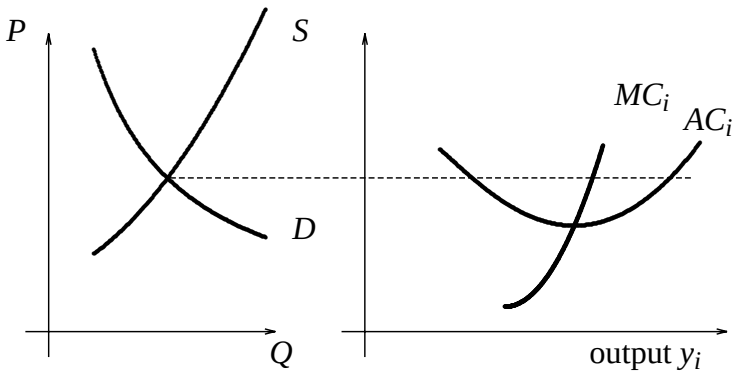
+ 4. An additional condition $\Rightarrow$ **pure competition**: there are no barriers to entry or exit
   $\therefore$ *zero long-run profit at the margin.*

1, 2, 3 $\Rightarrow$
- individual consumers face *horizontal supply curves*
- individual firms face *horizontal supply curves* (inputs)
- individual firms face *horizontal demand curves* (outputs)

where | price: market supply = market demand |

$\therefore$ price = marginal cost to producers
= marginal value for consumers





Short run:

$P > SRAC \therefore$ profit is positive

Long-run equilibrium when:

$P = LRMC =$ min $LRAC$
and profit is zero.

In the diagrams (Smith 8-5, 8-6):

quantity A_2 is less than A_1
competitive price P_{A_2} is less than P_{A_1}.

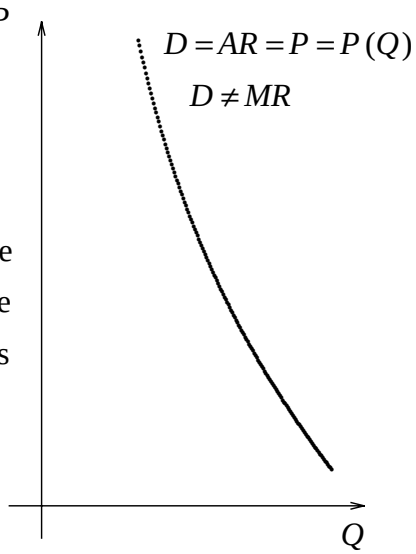
For the price-taking firm:

- $MR \equiv P = MC$,
- rising marginal costs MC, and
- non-negative profits π.
- For the *marginal* firm, profits are zero ($\pi = 0$).

Although the industry demand curve is downwards sloping, the firm sees only a horizontal demand curve.

<<Smith Figs 8-5, 8-6 >>

5. Pure Monopoly



The single seller (monopoly) faces a downward-sloping demand curve—it possesses *market power*, and can choose any combination (P, Q) on the demand curve to maximize its profit π. But choose Q to maximise profit π.

$$\pi = TR(Q) - TC(Q)$$

$$\max_Q \pi \Rightarrow \frac{d\pi}{dQ} = 0 = \frac{dTR}{dQ} - \frac{dTC}{dQ}$$

$$\therefore \; MR(Q^*) = MC(Q^*) \text{ for } \pi \text{ max.}$$

$$\rightarrow Q^* \rightarrow P^*$$

Marginal Revenue $MR \equiv \frac{d(P \times Q)}{dQ}$

$$= P \times (1 + \frac{1}{\eta^P})$$

$\leq P$, (i.e., market power).

because the price elasticity of demand η^P is negative.

$$\therefore \; P \geq MC \text{ with market power}$$

For a *competitive, price-taking* (PT) firm, by definition,

the demand curve is horizontal ($|\eta^P| = \infty$)

$$\therefore \quad \frac{dP}{dQ} = 0$$

$$\therefore \quad MR = P$$

Hence π is max. at Q^*: Price = Marginal Cost (Q*)

For a firm with *market power*,

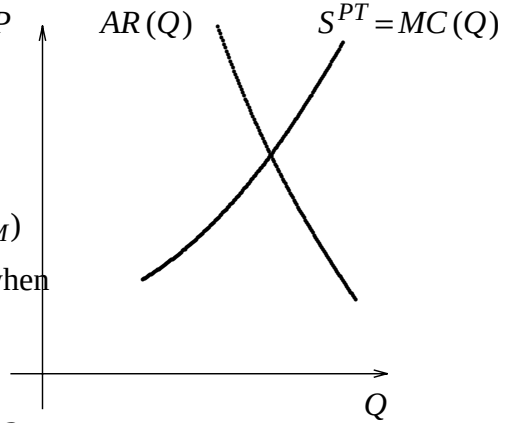
the demand curve slopes down & $\frac{dP}{dQ} < 0$

$$\therefore \; MR \neq P$$

$$MR(Q) = P \times (1 + \frac{Q}{P} \frac{dP}{dQ})$$

$$\boxed{MR(Q) = AR \times (1 + \frac{1}{\eta^P})}$$

$$\text{i.e. } MR(Q) \leq AR = P \times Q/Q = P$$



Remember:

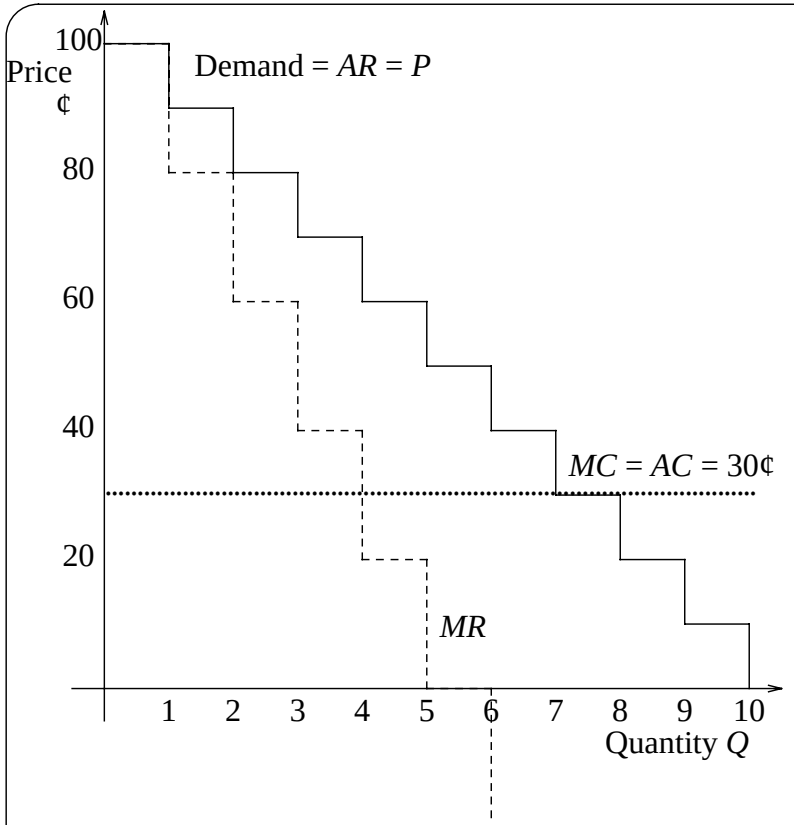
$\because \eta^P \leq 0$

Q_M^* is the output:

$MR(Q_M^*) = MC(Q_M^*)$

Not P_C^{PT} and Q_C^{PT} when Supply = Demand

Where is $MR(Q)$?



$$TR = P \times Q, \qquad P = P(Q)$$

$$\Delta TR = P \times \Delta Q + \Delta P \times Q$$

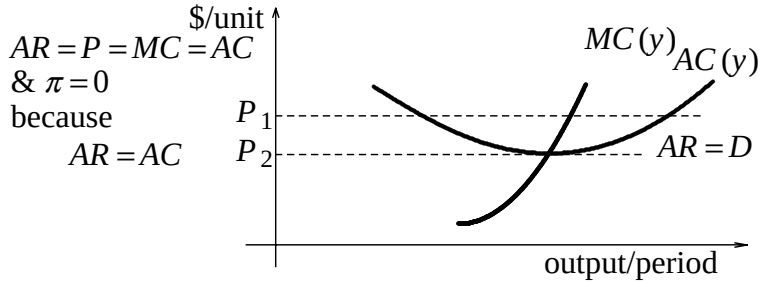
$$MR \equiv \frac{\partial TR}{\partial Q} = \frac{\partial P(Q)}{\partial Q} Q + P$$

Q: At what quantity is Revenue maximised?

In the long run · · ·

(· · · *we're all dead* – J.M. Keynes)

Competitive market:



so: for the *marginal* firm, **profit is zero**, having been competed away by new entrants.

Long-run equilibrium when:

$P = LRMC = \min LRAC$

and economic profit is zero.

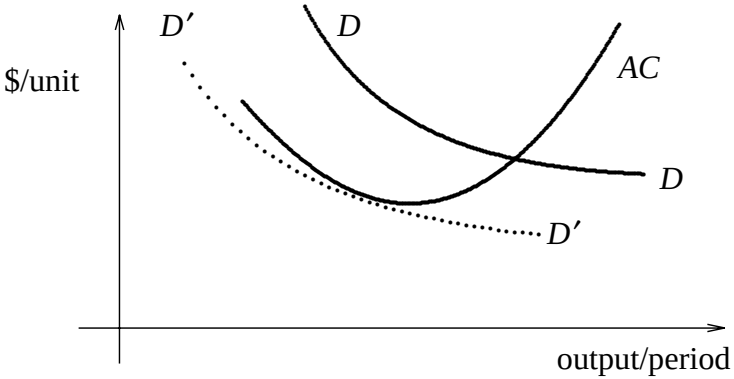
The positive profits attract new entrants, whose output in aggregate reduces the price at which supply equals demand, until profits disappear (at least at the margin).

To attain a competitive advantage, firms want to secure a market position that protects from imitation and entry.

6. Monopolistic Competition:

For a firm (a monopoly ?) with **market power** (i.e. facing a downwards-sloping demand curve) with other firms selling **close substitutes**, there is competition as firms change the prices of the close substitutes, which results in a shift to the left in the demand curve that our firm faces.

→ *Monopolistic Competition*



Conditions for Monopolistic Competition:

1. firms compete by selling differentiated (such as branded) products; substitutes but not perfect substitutes; so they have some market power;
2. free entry and exit; no barriers;
3. firms do not behave strategically, they assume their competitors' actions fixed;
4. buyers are price takers; no bargaining.

Summary:

1. Prices of substitutes affect the demand curve, downwards-sloping. (imperfect substitutes)

2. Assume that each firm takes others' actions constant & then *sets sales* (Q^*_{SR}) so that
   $$MR(Q^*_{SR}) = MC(Q^*_{SR}) \quad (SR \Rightarrow \text{Short Run})$$
   to maximize its profit ($Q^*_{SR} \rightarrow P^*$).

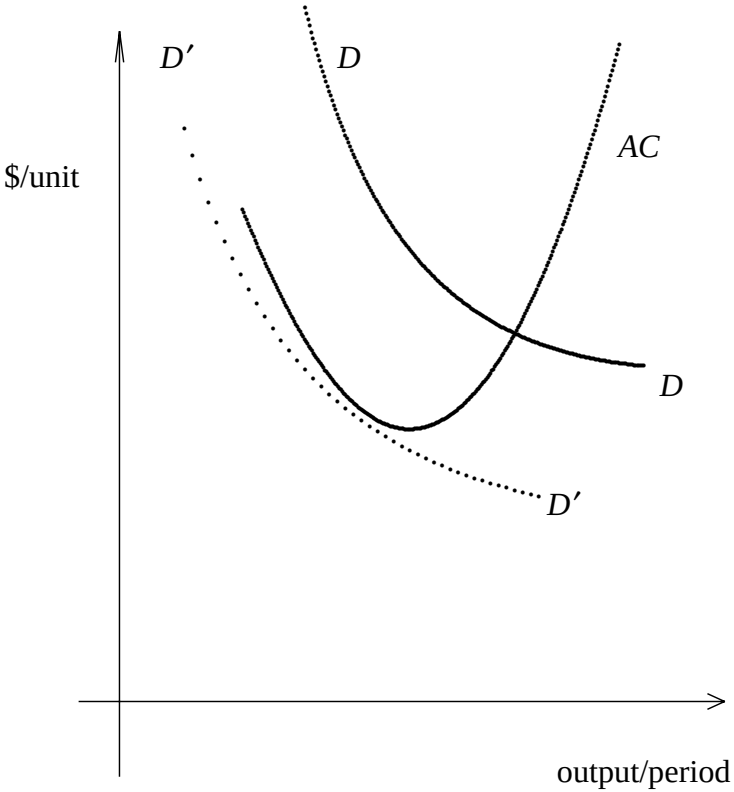
3. In general, $P^* > AC(Q^*)$ for each firm, so that profit π is positive in the short run.
   ⇒ attractive for new firms to produce close substitutes in the long run.

4. In the medium-to-long run, new entrants invest, and the original firms' demand curves move to the left, as their *market share* falls.

5. In the long run (*LR*), all profits will be bidded away for the marginal firm, with
   $$AR = D \equiv P = AC \qquad \therefore \ \pi = 0$$
   and maximum profit point on demand curve
   (i.e. output Q^*_{LR}: $MR(Q^*_{LR}) = MC(Q^*_{LR})$)

∴ the demand curve must be tangent to the *AC* curve at the price & output chosen. (*LR*: long run)

(See the T-shirt case.)

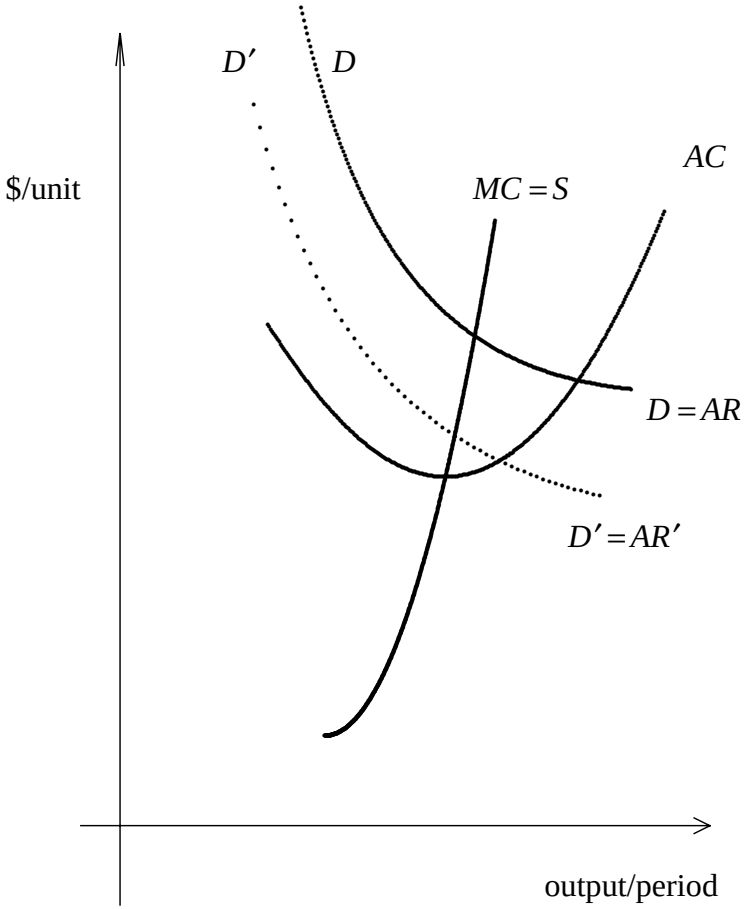


Monopolistic Competition

Long-run equilibrium at the margin.

(Remember:
average profit = average revenue – average cost.)

There will be excess capacity:
firms will not operate at minimum AC, and so they could reduce AC by increasing output.
Why don't they?



Competitive Pricing
and
Monopoly Pricing

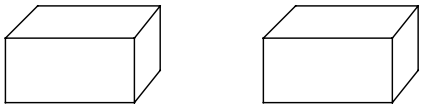
Assume: *Many Buyers*

	Number of Sellers		
	One	A Few	Many
Homogenous Product	Pure Monopoly	Homogeneous Oligopoly	Pure Competition
Differentiated Product	Pure Monopoly	Differentiated Oligopoly	Monopolistic Competition

Market Structure

(One buyer, many sellers: *monopsony*.)

"I think it's wrong only one company makes the game Monopoly"
— US humorist, Steve Wright

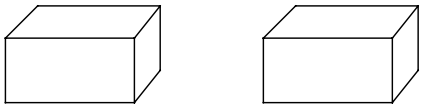


HOMOGENEOUS
or
DIFFERENTIATED?

Degree of Substitutability?

- Physical Attributes
- Ancillary Services
- Geographical Location
- Subjective Image

Same seller, but ...



Unequal markups:

$$\frac{P_1}{MC_1} \neq \frac{P_2}{MC_2} > 1$$

$\Rightarrow$ *PRICE DISCRIMINATION!*

across customers 1, 2

Perhaps because of:

Different Customers (e.g. young, old, sex)

- Different Time
- Different Place
- Different Appearance

(Note:

$\frac{P}{MC} > 1$ implies *market power*. Why?)

7. Price Discrimination

When a company which possesses some market power charges its consumers *different prices for essentially the same product*.

With market-power, the profit-maximization output y^* is given by:

$$MR(y^*) = MC(y^*)$$

but since (with uniform pricing):

$$P = D = AR > MR$$

it is *not* the case that $P = MC$.

Instead,

$$P > MC$$

$$P = \frac{MC}{1 - \frac{1}{|\eta^P|}} \text{ (see above)}$$

$$\therefore \quad \frac{P}{MC} = \frac{1}{1 - \frac{1}{|\eta^P|}} > 100\%$$

when elastic: $|\eta_P| > 1$

= the *mark-up* (or $P/MC - 1$).

The monopolist would like to *segment the market* according to the price elasticity of demand η^P and charge higher prices for those consumers with lower elasticities of demand.

Similarly: Taxes: on items with lower η? Which?

Price Discrimination can take three broad forms:

1. *First-Degree Price Discrimination*

   To capture all the consumers' surplus, the firm with market power would like to charge each of its customers the maximum price that customer is willing to pay for each unit sold. *Perfect price discrimination.*

2. *Second-Degree Price Discrimination*

   In some markets (water, electricity, etc.) each consumer buys many units of the good over any given period, and the consumer's demand falls with the number of units bought.

   In this situation, a firm can discriminate according to quantity bought. *Multi-part pricing* or *declining block pricing*, where the price for later blocks bought is lower than the price for the earlier blocks.

3. *Third-Degree Price Discrimination*

   The firm *segments the market* into two or more groups with separate demand curves for each group, and charges the members of each group the same price, but members of different groups different prices.

   This is the most common version of price discrimination (haircuts, airfares, generic brands, student and pensioner discounts).

   For the groups, total output must be divided between groups to equalise their marginal revenues (otherwise firms are not maximising profits).

Total output must be such that marginal cost equals marginal revenue across all groups (otherwise the firms are not maximising profits). Total output is determined by horizontally summing the marginal revenues of all groups and equating this sum with the marginal cost of total production.

Remember that the mark-up formula gives:

$$MR = P\left(1 + \frac{1}{\eta}\right),\ \eta < 0$$

and $MR_1 = MR_2$ implies that the ratio of prices in two segments is

$$\frac{P_1}{P_2} = \frac{(1 + 1/\eta_2)}{(1 + 1/\eta_1)}$$

so the higher price is charged to the consumers with the lower demand elasticity, as expected.

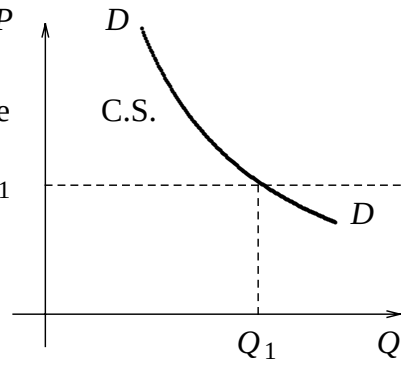
4. *The Two-Part Tariff*

   Another way of extracting consumer surplus:

   - charge an up-front fee T (for membership or entrance or connection or a "monthly service fee") and then
   - charge a further per-unit price P for usage (for use or rides or phone calls or water litres).

   How to set the connect/entry fee T and the usage fee P? For a single consumer: let $P = MC$ and T equal the entire consumer surplus.

8. Consumers' Surplus



Remember: each point on the demand curve gives the *highest uniform price* at which consumers are willing to buy the corresponding quantity of output.

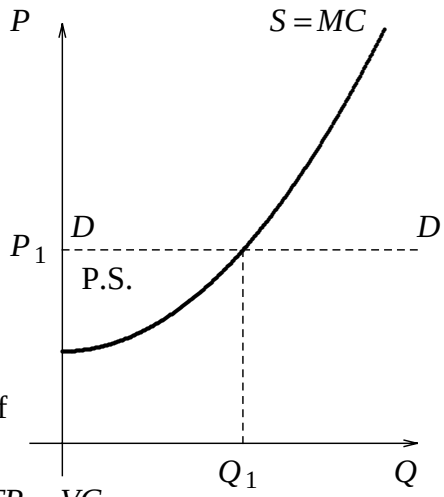
At price P_1 there exist some consumers (represented by the demand curve to the left) whose *net willingness to pay* is still positive.

At price P_1 they gain *consumers' surplus*, which (if their expenditure is a small fraction of their total expenditure, so that there are no income effects with the price change) equals the area above the price and below the demand curve.

So consumers' surplus is a willingness to pay over and above the uniform price (at uniform pricing or general pricing).

A monopolist might like to segment the market and *price discriminate* to increase his or her *producers' surplus* at the expense of consumers' surplus.

8.1 Producers' Surplus and Economic Rent



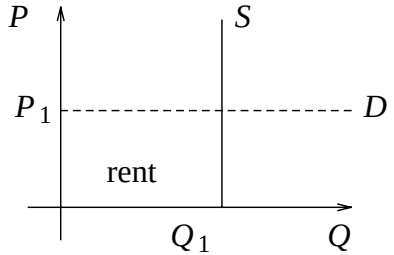
Each point on the supply curve (the *MC* curve for price-taking firms) gives the *lowest uniform price* which suppliers are willing to sell the corresponding quantity of output.

The firm's view: P.S. = $TR - VC$

$\therefore\ \pi$ = P.S. – FC

At price P_1 there exist some producers (represented by the supply curve to the left) who would sell at prices below P_1: their *net willingness to sell* at P_1 is still positive.

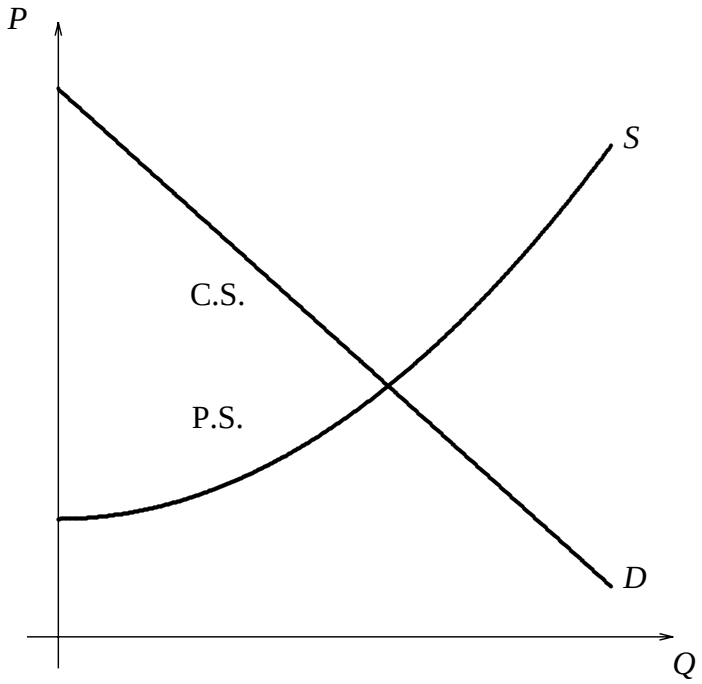
At price P_1 they gain *producers' surplus*, or *economic rent*: a return to producers over and above the minimum necessary to induce them to supply Q_1 in aggregate. P.S. equals the area below the (uniform) price and above the supply (*MC*) curve.



In the long run, monopolistic-competition equilibrium

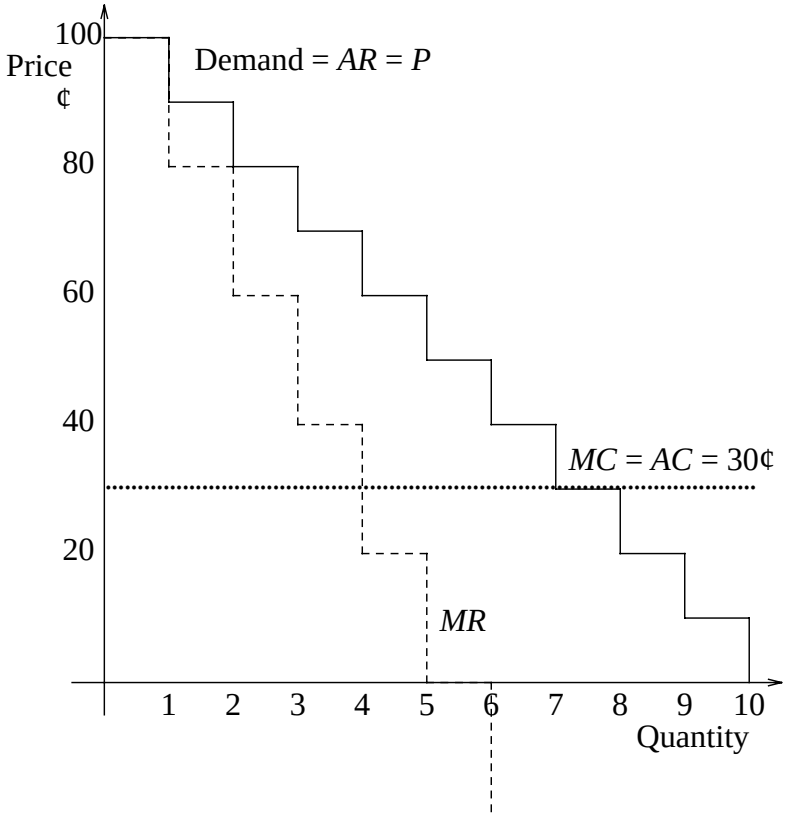
there will be *excess capacity*,

i.e. firms will *not* operate at the *minimum efficient scale* (y', which results in the minimum AC), and so they could reduce AC by increasing output.



(1) Price	(2) Quantity Demanded	(3) Consumer's Total Willingness To Pay	(4) Total Revenue (with perfect price disc.) (1) × (2)	(5) Marginal Revenue (with perfect price disc.) Δ (4)	(6) Profit with $AC=MC=0.3$ $\pi = TR - TC$ (4)–[(2)×0.30]
$1.00	1	$1.00	$1.00		$0.70
0.90	2	1.90	1.90	0.90	1.30
0.80	3	2.70	2.70	0.80	1.80
0.70	4	3.40	3.40	0.70	2.20
0.60	5	4.00	4.00	0.60	2.50
0.50	6	4.50	4.50	0.50	2.70
0.40	7	4.90	4.90	0.40	2.80
0.30	8	5.20	5.20	0.30	2.80
0.20	9	5.40	5.40	0.20	2.70
0.10	10	5.50	5.50	0.10	2.50

$MC = AC \Rightarrow$ constant cost firm



$$TR = P \times Q, \qquad P = P(Q)$$

$$\Delta TR = P \times \Delta Q + \Delta P \times Q$$

$$MR \equiv \frac{\partial TR}{\partial Q} = \frac{\partial P(Q)}{\partial Q} Q + P$$

Monopoly $P_M =$

$MR(Q_M^*) = MC(Q_M^*), \therefore Q_M^* =$

$\pi_M =$

Competitive $P_C =$

$Q_C^* =$

$\pi_C =$

9. Summary

In this section, we have considered:

1. How *industry supply curves* are derived from those of individual firms, and the *complications* of achieving this, in the short run and the long.
2. The differences between *pure* and *perfect competition*, at one extreme, and
3. The use of *market power* by a *profit-maximising monopolist*, at the other extreme.
4. What the *long-run equilibrium condition* of zero profits for the *marginal firm* means when firms face horizontal demand curves (no market power) or downwards-sloping demand curves (with market power) in the case of *monopolistic competition.*
5. How and why firms with market power might *segment the market* and *price discriminate* in order to capture more of *consumers' surplus* and so increase their profits.
6. Three types of *price discrimination*: perfect price discrimination, block price discrimination (declining), segmenting the market. Two-part tariff: a connect charge plus a usage charge.
7. The meaning of *economic rent*, and the relationship between *producers' surplus* and profit.