Economics for Competition Lawyers

Outline of subject:

Lecture	*Topic*
1.	Primer: Modelling & Economic Concepts
2.	Industry Analysis: Porter’s Five Forces
3.	Market Structure & Competition
4.	Strategic Commitment & Competition
5.	The Dynamics of Pricing Rivalry
6.	Entry & Exit
7.	Mergers & Acquisitions

Introduction

- A course for competition lawyers about economics and corporate strategy.
- Focus on how firms behave, by looking at what managers learn to do in order to maximise profits and survive.
- Also discuss the social costs and benefits of different market structures.
- To obtain benchmarks for policy.

Six topics for discussion:

1. Modelling
2. Costs
3. Demand, Prices, and Revenues
4. Price and Output Determination
5. Perfectly Competitive Markets
6. Game Theory and Strategic Interactions

Modelling

What is a model?
What is a good model?

A simplified picture of a part of the real world.
Has some of the real world's attributes, but not all.
A picture simpler than reality.

We construct models in order to explain and understand.

Three Rules for Model Building:

- Think "process".
- Develop interesting implications.
- Look for generality.

Judge models using: truth, beauty, justice.

Interplay between the real world, world of æsthetics, world of ethics, and the model world.

Prices, Costs, and Values → Profits

We use verbal, graphical, and algebraic models of how consumers, firms, and markets work.

We assume rationality: that economic actors (consumers and firms) will not consistently behave in their worst interests.

Not a predictive model of how individuals act, but robust in aggregate.

1. Primer: Economic Concepts

1.1 Costs

Profit = Sales Revenue – Costs

Four cost topics:

1. Cost Functions
   — Total Costs *TC*
   — Fixed *FC* and Variable Costs *VC*
   — Average *AC* and Marginal Costs *MC*
2. Economic versus Accounting Costs
   — Opportunity Costs
3. Short-run and Long-run Costs
   — before and after commitment to plant size
4. Sunk Costs
   — recoverable or not?

1.1.1 Cost Functions

1.1.1.1 Total Cost Function:

The Income Statement and the Costs of Goods Manufactured Statement:
both retrospective, objective, and verifiable.

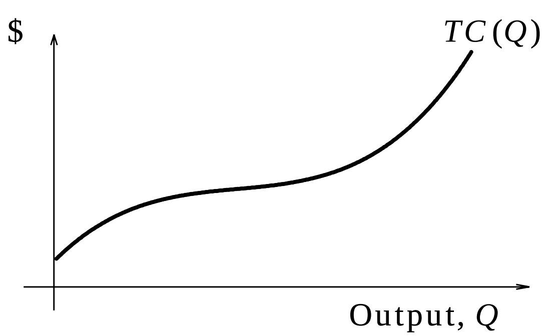
A price fall will stimulate sales,
but higher output will raise Total Costs.
By how much?

Profitable?

Total Cost Function:
for each level of output per period,
a unique level of total cost.

"unique": assume that *the firm produces at the most efficient means possible*, given its technological capabilities.

∴ "efficiency" implies: total costs always rise with output because more *input factors of production* (labour, machinery, materials) necessary.



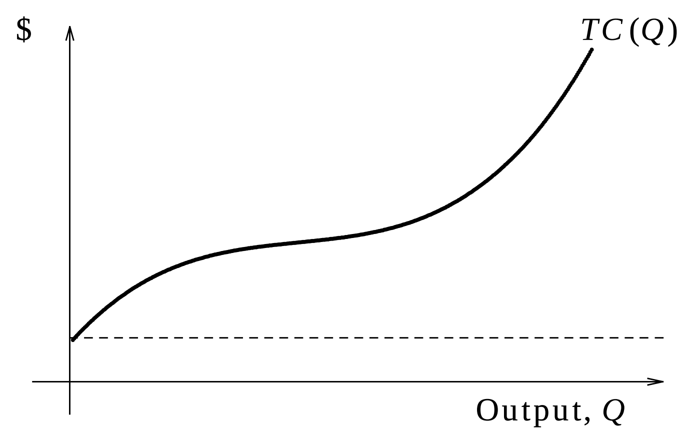
1.1.1.2 Fixed and Variable Costs:

Variable Costs VC (direct labour and commissions)
increase as output increases.

Fixed Costs FC (general & admin. expenses, rates)
remain constant as output increases.

Three points:

1. Fuzzy dividing line:
   some costs contain both fixed and variable elements, and
   semi-fixed costs (delivery trucks).
2. "fixed": invariable to firm's output per period but could be affected by other decisions.
3. Time horizon:
   in the long run, almost all expenses variable
   e.g. restaurant



1.1.1.3 Average and Marginal Costs:

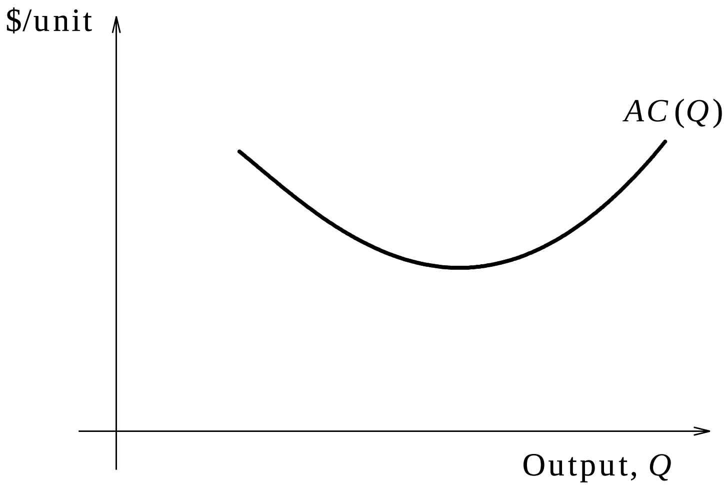
Average Costs AC: how do the firm's average or per-unit costs vary with the amount of output it produces?

Constant *AC*: *constant returns to scale*, CRTS

Falling *AC*: *economies of scale* or increasing returns to scale, IRTS

Rising *AC*: *diseconomies of scale* or decreasing returns to scale, DRTS

Falling *AFC* but often rising *AVC* → U-shaped *AC* curve.
Output at lowest AC: *minimum efficient scale MES*



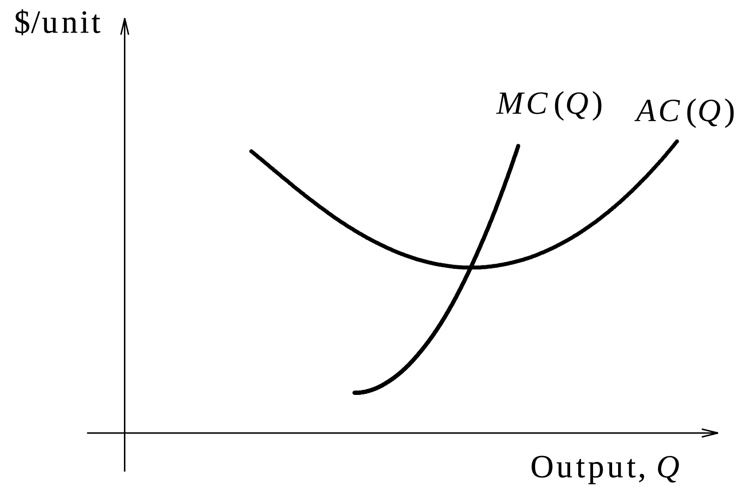
AC very important for size and scope of firm
AC very important for structure of industry

Marginal Costs MC: the incremental cost of producing exactly one more unit of output.

MC can vary with output level — overtime payments? older, less reliable machinery? training temps?

Average Cost ≠ Marginal Cost:
except when Total Costs vary in direct proportion to output,
then $AC(Q) = MC(Q)$ = a constant, for all Q

More generally,
- when $MC < AC$, AC falls with output Q
- when $MC = AC$, AC invariant with Q
- when $MC > AC$, AC rises with Q
- (Think: average speed versus speedo reading.)



1.1.2 Economic versus Accounting Costs

Accountants use historical costs, objective and verifiable to outsiders.

Business decisions require economic costs, based on *opportunity costs*:

> the cost (or sacrifice) of using a resource is the value of the best forgone alternative use of that resource.

e.g. shareholders' funds:
could liquidate the firm for \$100 million,
so forgo say 5% of \$100m per year
plus 1% w&t and obsolescence per year
6% $\rightarrow$ \$6 million per year
an economic cost
if firm's return on capital < \$6 million a year,
then making a negative economic profit

Total costs include economic costs.

Example 1: EVA analysis:
Economic Value Added = operating profit – cost of capital $\times$ capital

Example 2: Bill asserts that he could not even "give away" (for literally zero dollars) a building that he owns and uses in his business. In economic jargon, the building has a zero opportunity cost.
Is this true?

1.1.3 Time Horizon & Costs

Short run: period in which the firm cannot adjust the size of its production facilities

For each plant size, is associated SAC curve (*Short-run Average Cost*)

SAC: annual costs of all relevant variable inputs VC (labour, materials, energy) plus annualised FC of the plant itself

$$SAC(Q) = AV(Q) + AFC(Q)$$

Larger plant's MES will be higher than a smaller plant's.

AC of a smaller plant at some Q may be lower than the $AC(Q)$ of a larger plant.

Firm: choose the scale of plant to minimise SAC associated with planned output Q.

If planned Q smallish, reduce costs via lower FC and lower VC.

LAC (*Long-run Average Cost*): minimum cost at any *Q*, given the possibility of choosing the best plant for that level *Q*.

LAC is the *AC* curve the firm faces before commitment.

LAC can exhibit economies of scale.
but to realise these economies,
not only large plant,
but also sufficient output

Possible: large plant with small output, and high *AC*,
but wrong to conclude: no economies of scale.

1.1.4 Sunk Costs

Sunk Costs: costs already incurred *and* which cannot be recovered.

Avoidable Costs: the opposite, could be avoided.

Decision makers should ignore sunk costs (but often don't) and consider only avoidable costs.

Example 3:

You see an advertisement for shirts on special twenty kilometres away, at prices substantially less than at your local shirt shop.

Since you "need" new shirts, and the prices advertised are substantially lower, you drive over.

But when you get there, you find that none of the shirts on special are in your size. The shop stocks your sized shirts, but at prices only slightly less than your local shop.

What should you do?

a. Should you refuse to buy any shirts because they are not cheap enough to justify the expense of the twenty-km drive?

b. Should you buy some shirts anyway?

c. Should you buy large numbers of shirts so that the total savings offset the cost of driving over?

d. What if your sized shirts are more expensive than your local shop's? Should you buy them anyway, since you might as well get something for your trip?

Answer:

a. No. Ignores sunk costs already incurred and unrecoverable.

b. Yes. You should buy some shirts anyway— you've already incurred the cost of driving over (and back): it's sunk.

c. Depends if you like them and if you think they won't go out of style or size.

d. No. Throwing good money after bad.

Irrelevance of Sunk Costs: bygones are bygones.

- Sunk costs ≠ fixed costs
  Fixed costs: the minimum necessary for producing any output at all.
  If some fixed costs are recoverable (say, by reselling equipment at purchase price, or because equipment was leased), then these costs are recoverable, and hence not sunk.

- Sunk costs important for analysing:
  — rivalry among firms,
  — firms' entry and exit decisions from markets, and
  — firms' decisions to adopt new technology.

Example 4:

For the established steel firm, the cost of its old technology is sunk. Would only switch to new technology with higher *FC* and lower *VC* if the savings in *VC* exceed the new *FC*.

For the new, greenfields firm, the *FC* of the old technology is avoidable: will adopt new technology if the savings in operating costs exceeds the difference between the *FC*s of the old and new technologies, a lower threshold.

1.2 Demand & Revenues

How does a firm's Total sales Revenue TR depend on its pricing decision?

Now, TR equals the product of price P and quantity Q ($TR = P \times Q$), so we must examine the relationship between the changes in the price P and the quantity Q sold.

Consider: the demand function and the price elasticity of demand.

Topics:

1. Demand function
   — The law of demand
2. The price elasticity of demand
   — Determinants of sensitivity to price,
   — Brand-level v. industry-level elasticities.
3. Total TR and Marginal Revenue MR.
   — Revenue and price elasticity,
   — The mark-up formula.
4. Consumer surplus and producer surplus.

1.2.1 Demand Function

There is *maximum amount* Q per period that the firm is able to sell at a particular price P, *or*

a *maximum* uniform price P that the firm can charge to sell a particular quantity Q per period

The *demand function* shows all pairs of such prices and quantities.

We hold all else unchanging (i.e. *ceteris paribus*):

— the prices of related products,

— the incomes and tastes of consumers,

— the quality of the products,

— advertising,

— and the many other marketing variables of the firm and its rivals

The Law of Demand: in response to an increase in the price asked, the quantity demanded will never increase, *cet. par*.

Possible violations?

— Prices and prestige.

— Prices as proxies for unobserved quality.

Graphically, the demand curve never slopes up: note that economists plot demand with price P on the vertical axis and quantity Q on the horizontal axis.

1.2.2 The Price Elasticity of Demand

If a firm increases its price P, the quantity Q of goods or services it sells will fall, from the Law of Demand.

What of its Total sales Revenue TR?

Depends how sensitive its customers are to price changes:

— very sensitive, and the fall in quantity will out weigh the rise in price so that Total Revenue will fall:

elastic demand

— very insensitive, and TR will rise:

inelastic demand

— between, and the rise in price will be exactly offset by a fall in demand, and TR is unchanged.

The measure of the *price elasticity of demand* summarises this sensitivity:

> the percentage change in quantity when there is a 1 percent change in price:
>
> $$\eta = -\frac{\Delta Q / Q_1}{\Delta P / P_1}$$
>
> where ΔQ is the change in quantity, $Q_2 - Q_1$, and ΔP is the change in quantity, $P_2 - P_1$.

When η is less than 1, demand is *inelastic*.
When η is greater than 1, demand is *elastic*.

Factors that tend to make demand more elasticity:

- few unique features, and buyers aware of rivals' products
- buyers spending a large fraction of their total expenditures on the products
- the product is used to produce a final product whose final demand is itself price elastic.

Factors that tend to make demand less elastic:

- comparisons among substitute products are difficult
- buyers pay only a fraction of the full price
- significant switching costs
- product used as a complement with another product that buyers have committed themselves to.

1.2.2.1 Brand-Level versus Industry-Level Elasticities

Brand-level elasticities higher than industry-level elasticities because consumers of brands have greater substitution possibilities.

Which to use? Depends on rivals' responses.

- If other brands ignore one brand's price change, then use the brand-level elasticity.
- If other brands will respond, then use the industry-level elasticity.

1.2.3 Total Revenue and Marginal Revenue

Total Revenue TR = Price $P(Q) \times$ Quantity Q

How will a change in output affect revenues?

The Marginal Revenue MR is the change in Total Revenue from the sale of an additional unit of output.

With a downwards-sloping demand curve (The Law of Demand), the price must fall to induce the sale of more units of output.

While earning more revenue on the next unit sold, the firm loses revenue on all the units it would have sold at the higher price.

MR may be positive at high prices, but falls as price falls, to become negative at low prices.

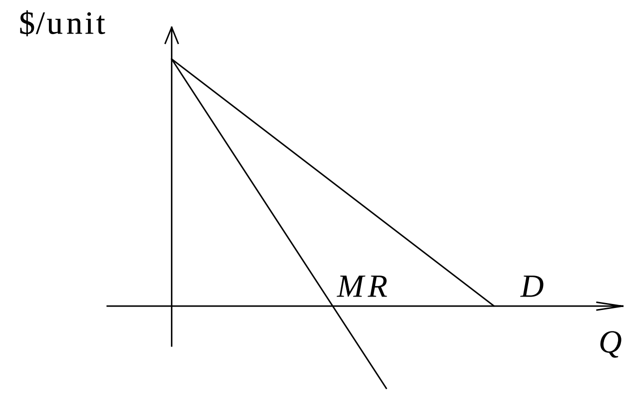
1.2.3.1 The Mark-Up

Whether MR is positive or negative depends on the price elasticity of demand η:

$$MR = P\left(1 - \frac{1}{\eta}\right)$$

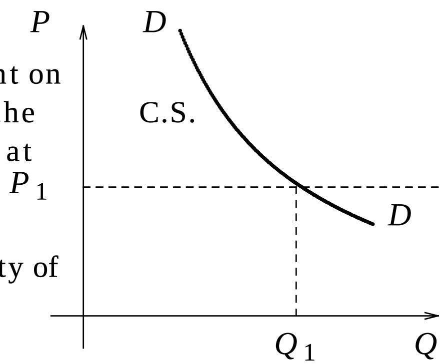
The mark-up equation shows that $P > MR$, as expected.

With elastic demand ($\eta > 1$), MR is positive.
With inelastic demand ($\eta < 1$), MR is negative.



1.2.4 Consumer Surplus and Producer Surplus

Consumers’ Surplus:



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

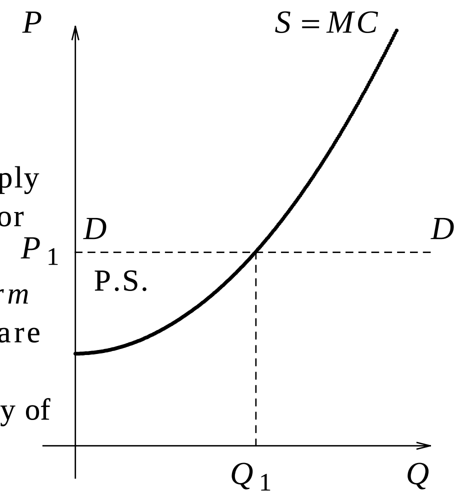
At price P_1 there exist some consumers (represented by the demand curve to the left) whose *net willingness to pay* is still positive.

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 *producers’ surplus* at the expense of consumers’ surplus.

Producers’ Surplus and Economic Rent

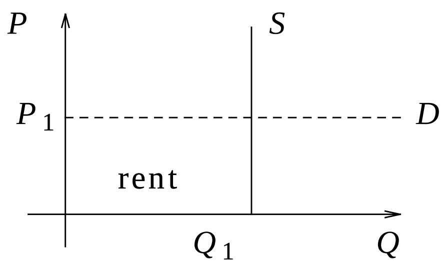


Each point on the supply curve (the *MC* curve for price-taking firms) gives the *lowest uniform price* which suppliers are willing to sell the corresponding quantity of output.

The firm’s view: P.S. = $TR - VC$
$\therefore \pi$ = P.S. – FC

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

At 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 price and above the supply curve.



1.3 Theory of the Firm: Pricing & Output Decisions

Theory of the firm: firm maximises its profit:

Profit = Total Revenue – Total Cost

If $MR > MC$, firm's profit will rise by selling more output, by lowering its price.

If $MR < MC$, firm's profit will rise by selling less output, by raising its price.

When $MR = MC$, the firm cannot increase its profits by altering its output: output Q and price P are at their optimal levels.

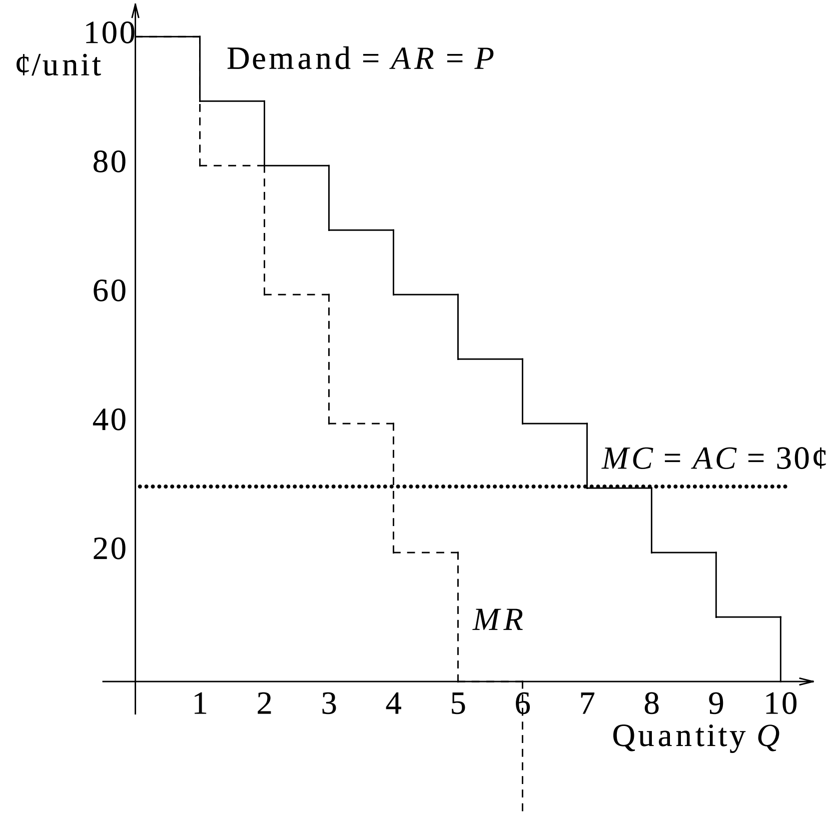
The mark-up formula shows that $P > MC$, since

$$MC = MR = P\left(1 - \frac{1}{\eta}\right),$$

and the firm will always sell where the demand is elastic.

(1) Price	(2) Quantity Demanded	(3) Total Revenue	(4) Marginal Revenue	(5) Profit with $AC = MC = 30¢$ $\pi = TR - TC$
		(1) × (2)	Δ (3)	(3)–[(2)×0.30]
$1.00	1	$1.00		$0.70
0.90	2	1.80	0.80	1.20
0.80	3	2.40	0.60	1.50
0.70	4	2.80	0.40	1.60
0.60	5	3.00	0.20	1.50
0.50	6	3.00	0.00	1.20
0.40	7	2.80	–0.20	0.70
0.30	8	2.40	–0.40	0.00
0.20	9	1.80	–0.60	–0.90
0.10	10	1.00	–0.80	–2.00

$$MC = AC \Rightarrow \text{constant cost firm}$$



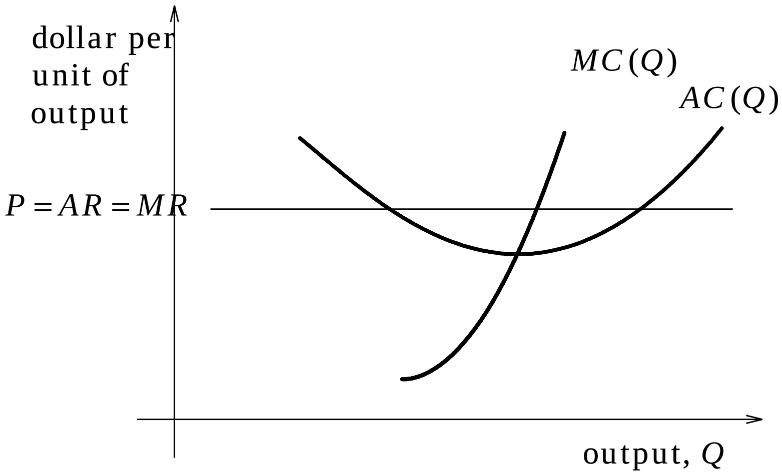
$$TR = P \times Q, \qquad P = P(Q)$$

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

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

1.4 Perfect Competition

An industry with many sellers and many buyers and identical products, with no barriers to entry or exit:
firms are *price takers*: instead of sloping downwards, the firm's demand curve is horizontal:



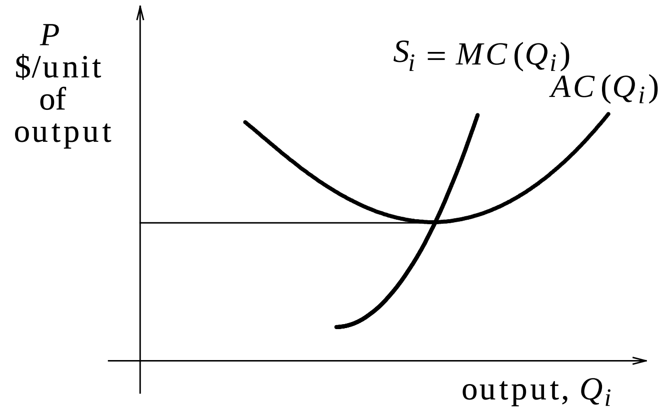
The decision: how much to produce?

For the price-taking competitive firm, $MR = P$,

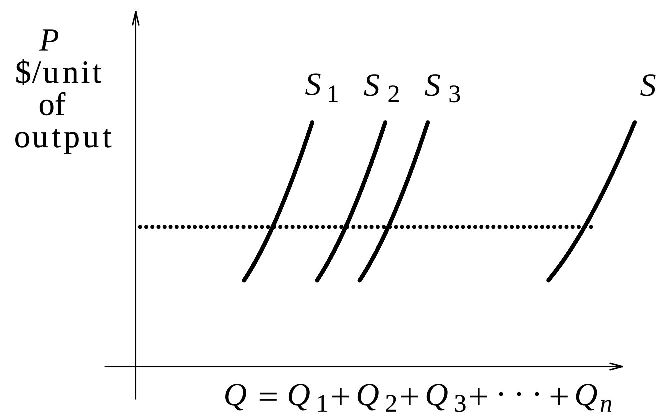
so Q: $P = MC(Q)$.

1.4.1 Firm and Industry Supply Curves

The firm's *supply curve*: the firm's profit-maximising output as a function of the price P it faces, identical to its MC function.



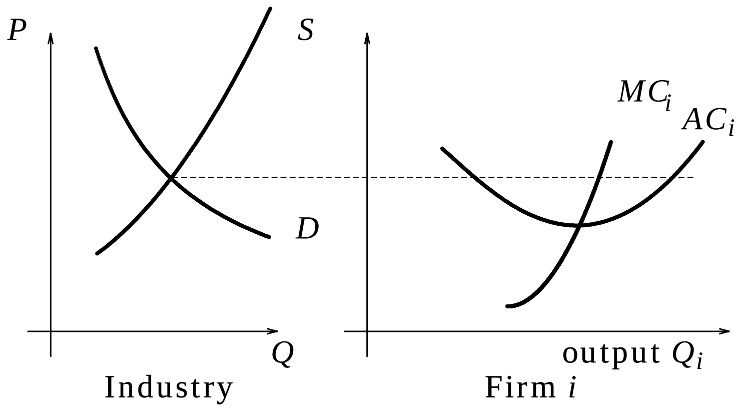
The industry supply curve S is the horizontal sum of the supply curves $S_1, S_2, S_3, \cdots S_n$ of the n individual price-taking firms:



1.4.2 Equilibrium

The firm is a price-taker, facing a horizontal demand curve, but the industry demand curve is still downwards sloping:

In the short run …



In the short run:

$P > SRAC \therefore$ profit is positive

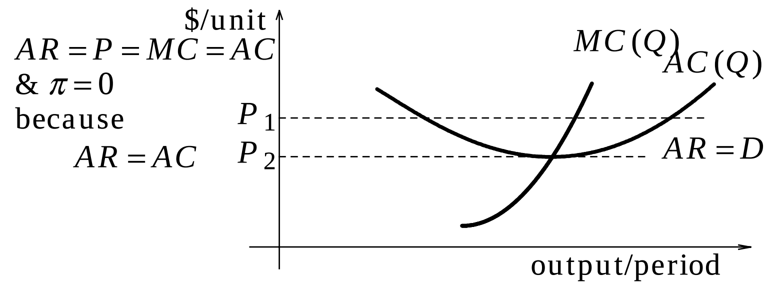
Since Price is greater than Average Cost, the firm makes a positive economic profit.

But with no barriers to entry, this is unsustainable.

In the long run · · ·

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

A 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.

1.4.3 Efficiency and Perfect Competition

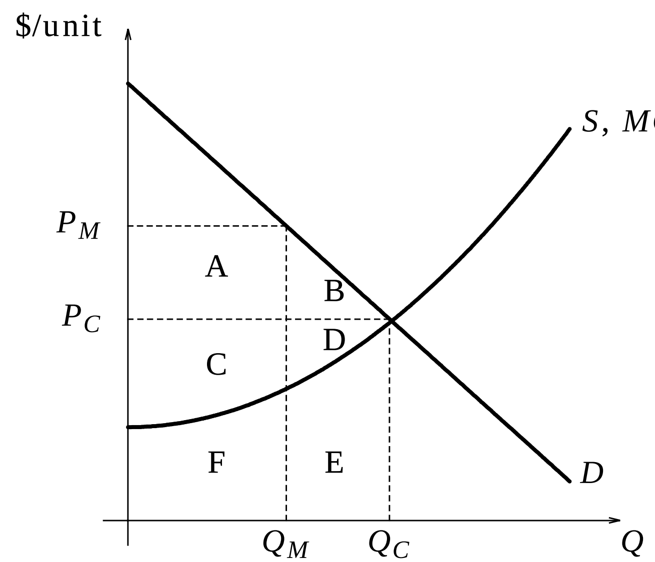
An *efficient allocation*: one in which we cannot move to another to make one or more people better off without making at least one worse off: no waste.

Under certain conditions allocations from perfect competition are efficient:

- non-satiation in consumption
- no external benefits
- no external costs
- increasing AC, or decreasing returns to scale
- all buyers and sellers are price takers
- full information of all offers to buy and sell
- free entry and exit.

We can show that moving from the allocation chosen by a profit-maximising firm exercising market power by squeezing output to Q_M and pushing up price to P_M to a competitive allocation, where demand = supply and price $P_C = MC(Q_C)$, makes consumers better off in aggregate through a lower price and higher quantity than it makes the firm worse off through a lower price and so a lower profit.

Consider the graph:



Areas on this graph correspond to dollar amounts: costs, revenues, profits, losses, and surpluses (net willingnesses to pay or to supply).

Consider a shift from monopoly (Q_M, P_M) to competitive (Q_C, P_C):

The Consumer Surplus rises by area $A + B$

Sales Revenue:

old	=	$A + C + F$	=	$P_M \times Q_M$
new	=	$C + D + E + F$	=	$P_C \times Q_C$
∴ rises	by	$D + E - A$		

but Total Costs rise by area E.

Now, the change in profits $\Delta\pi = \Delta TR - \Delta TC$.

$\therefore$ Profits fall by $E - (D + E - A) = A - D$

& the gain in C.S. + gain in P.S. = area $B + D$.

$\therefore$ Gain in Consumers Surplus – Loss of Profit
$= \text{area } B + D$

That is, moving from monopolistic (Q_M, P_M) to competitive $(Q_C, P_C = MC(Q_C))$ leads to a *gain in efficiency*, since at monopolistic output the *Dead-Weight Loss* $= B + D$.

So: the loser (the monopoly) *could* be compensated by the winners (the consumers) the amount $(A - D)$ and then

no-one (the monopoly) would be worse off and someone (the consumers) would be better off.

In principle, the winners (buyers) could completely compensate the loser (the firm), and still be better off than previously: an improvement in efficiency which is possible because exercise of market power had imposed an inefficiency on the market, as measured by the Dead-Weight Loss of area $B + D$.

1.5 Game Theory

Small numbers of firms may result in strategic interaction, in which what Firm 1 does in choosing price or quantity affects Firm 2's profits, and vice versa.

How to incorporate the reactions of your rivals into your profit-maximising?

Look forwards and reason backwards.

Put yourself in their shoes, as they try to anticipate your actions.

Use *game theory*: assuming rationality.

Example:

Piemax Inc. bakes and sells sweet (dessert) pies.

Its decision:

— price *high* or *low* for today's pies?

Considerations?

— prices of rivals' pies?

— prices of non-pie substitutes?

One possibility:

simply optimise its pricing policy for some given (exogenous) beliefs about rivals' prices;

this may take the form of estimates of the probabilities of its rivals' possible actions.

Or:

try to predict those prices,
using Piemax' knowledge of the industry,

in particular: Piemax' knowledge that its rivals choose their prices on the basis of their own predictions of the market environment, including Piemax' own prices.

Game Theory →

Piemax should build a *model* of the behaviour of each individual competitor,

Seek behaviour → *an equilibrium* of the model.

What is an equilibrium?

Ought Piemax to believe that the market outcome → equilibrium?

What kind of model?

Simplest:

— all bakers operate *for one day only* (a so-called one-shot model)

— all firms know the production technology of the others

— study with the tools of:

- *strategic-form* (or matrix-form) games and
- *Nash equilibrium*

If *more than one day* (a repeated game or interaction):

— then Piemax's objectives?
(more than maximising today's profits)

e.g. low price today may

→ customers switch from a rival brand

→ may increase Piemax' market share in the future

e.g. baking a large batch of pies may

→ allow learning by doing by the staff

→ lower production costs in the future

But beware:

rivals influenced by Piemax's price today

→ low Piemax price may

→ *a price war*.

dynamic games and extensive-form models

→ solution concept of *subgame perfection*

Uncertainty?

What if Piemax is *uncertain* of the cost functions or the long-term objectives of its rivals?

— Has Cupcake Pty Ltd just made a breakthrough in large-batch production?

— Does Sweetstuff plc care more about market share than about current profits?

— And how much do these rivals know about Piemax?

Incomplete information games.

Learning:

- if the industry continues for several periods, then Piemax ought to *learn* about Cupcake's and Sweetstuff's private information *from their current pricing behaviour*
  and use this information to improve its future strategy.
- In anticipation, Cupcake and Sweetstuff may be loath to let their prices reveal information that enhances Piemax's competitive position:
- they may attempt to *manipulate Piemax's information*.

1.5.1 Payoff Matrices and Nash Equilibrium

Two firms each produce identical products and each must decide whether to Expand its capacity in the next year or not (DNE).

A larger capacity will increase its share of the market, but at a lower price.

The simultaneous capacity game between Alpha and Beta can be written as a payoff matrix.

The Capacity Game

		Beta DNE	*Beta* Expand
Alpha	DNE	\$18, \$18	\$15, \$20
Alpha	Expand	\$20, \$15	**\$16, \$16**

The payoff matrix (Alpha, Beta)

A non-cooperative, positive-sum game, with a dominant strategy.

Efficient or Pareto Optimal at _____

Nash Equilibrium at _____

At a *Nash equilibrium*, each player is doing the best it can, given the strategies of the other players.

We can use arrows in the payoff matrix to see what each player should do, given the other player's action.

The Nash equilibrium is a self-reinforcing focal point, and expectations of the other's behaviour are fulfilled.

The Nash equilibrium is not necessarily efficient (maximise the aggregate profit of the players).

The game above is an example of the Prisoner's Dilemma: in its one-shot version there is a conflict between collective interest and self-interest.

Example

Given the social costs associated with litigation, why is it increasing?

David Ogilvy has said, "Half the money spent on advertising is wasted; the problem is identifying which half."

Is the explanation for the amount of advertising similar?

Other simple simultaneous games:

Chicken!

		Bomber	
		Veer	Straight
Alien	Veer	Blah, Blah	Chicken!, Winner
	Straight	Winner, Chicken!	Death? Death?

The Gift of the Magi

		Jim	
		Sell watch	Keep watch
Della	Keep hair	1, 2	0, 0
	Sell hair	–2, –2	2, 1

1.5.2 Game Trees and Subgame Perfection

How to solve sequential games? Use a game tree, in which the players, their actions, their information sets, and the timing of their actions and when they learn about the other's actions are explicit.

Allow three choices for each of the two players, Alpha and Beta: Do Not Expand (DNE), Small, and Large expansions.

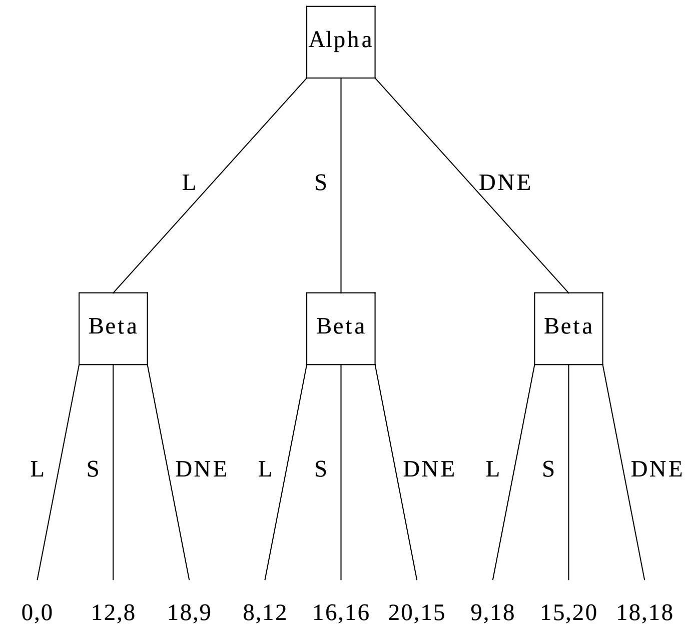
The payoff matrix for simultaneous moves is:

The Capacity Game

		Beta DNE	Small	Large
Alpha	DNE	\$18, \$18	\$15, \$20	\$9, \$18
	Small	\$20, \$15	\$16, \$16	\$8, \$12
	Large	\$18, \$9	\$12, \$8	\$0, \$0

The payoff matrix (Alpha, Beta)

If Alpha preempts Beta, by making its capacity decision before Beta does, then use the *game tree*:



Payoffs: Alpha's, Beta's

Use *subgame perfect Nash equilibrium*, in which each player chooses the best action for itself at each node it might reach, and assumes similar behaviour on the part of the other.

With complete information (all know what each has done), we can solve this by *backwards induction*:

1. From the end (final payoffs), go up the tree to the first parent decision nodes.
2. Identify the best (i.e. the highest payoff) decision for the deciding player at each node. The choice at each node is part of the player's optimal strategy.
3. "Prune" all branches from the decision node in 2. Put payoffs at new end = best decision's payoffs
4. Do higher decision nodes remain? If "no", then finish.
5. If "yes", then go to step 1.
6. For each player, the collection of best decisions at each decision node of that player $\rightarrow$ best strategies of that player.

The outcome differs from the simultaneous game: in the sequential game, Alpha's capacity choice has *commitment value*: it gives Alpha (in this case) *first-mover advantage*.

CONTENTS