# COSTS AND SUPPLY

## GENERAL PICTURE OF ONE FIRM'S COST CURVES

Reminder of notation:

FC = fixed cost (does not vary as output Q varies but stays > 0)
FSC = fixed and sunk cost (unavoidable even if Q = 0)
FAC = fixed but avoidable (not sunk) cost (can be avoided if Q = 0)
So FC = FSC + FAC

TVC = total variable cost, avoidable by definition
TAC = total avoidable (also "economic") cost = FAC + TVC

TC = FC + TVC (Total splits into fixed and variable)

$$= \overbrace{FSC + FAC}^{FC} + TVC$$

$$= FSC + \underbrace{FAC + TVC}_{TAC}$$

= FSC + TAC

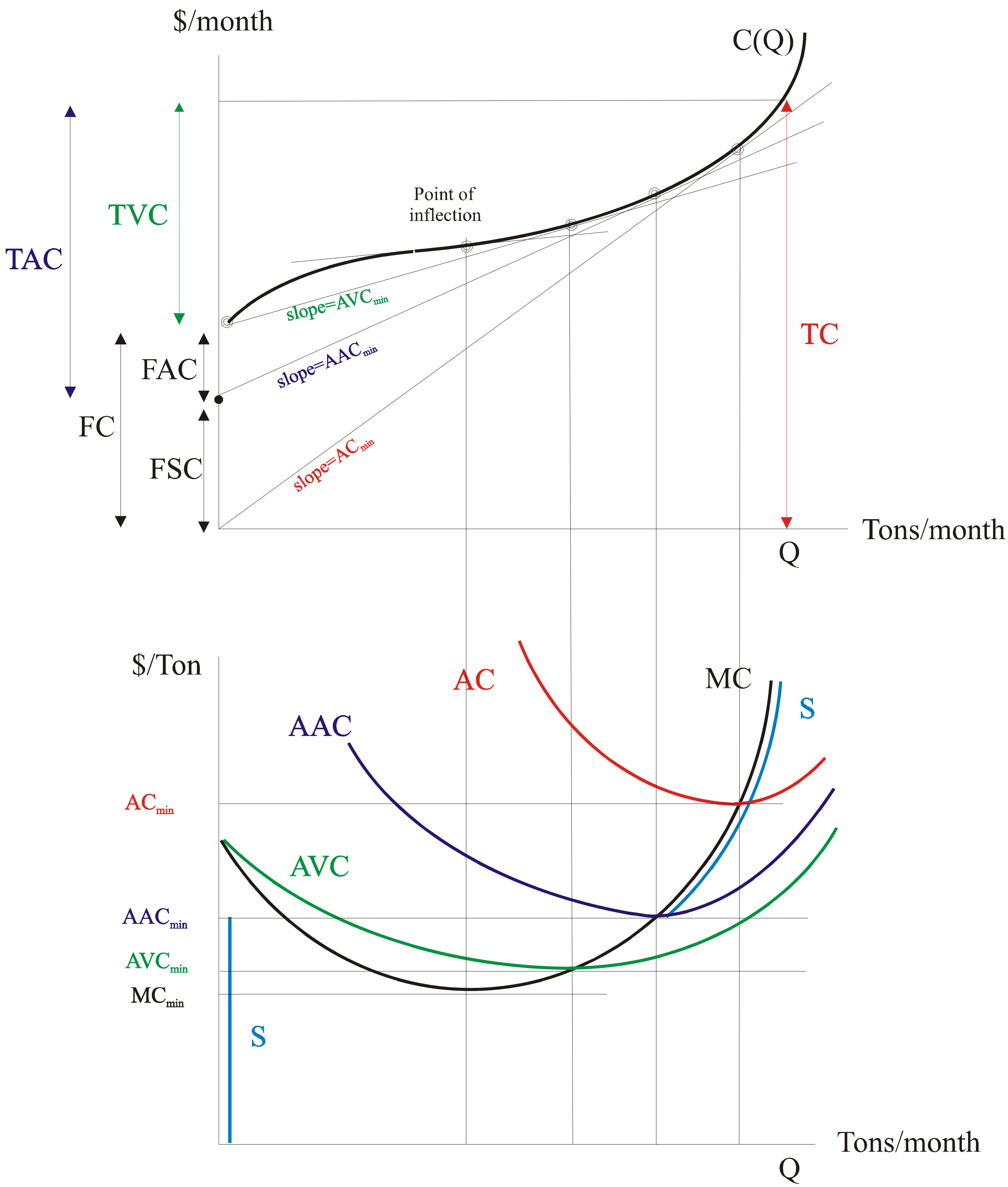
AC = TC / Q = average cost
AVC = TVC / Q = average variable cost
AAC = TAC / Q = average avoidable cost
(AAC is P-R's "average economic cost" on p. 270)

AC = AVC + FC / Q
AC = AAC + FSC / Q
AAC = (TVC + FAC) / Q = AVC + FAC / Q

Marginal cost

$$MC = d(TC)/dQ$$
$$= d(FC+TVC)/dQ = 0 + d(TVC)/dQ = d(TVC)/dQ$$
$$= d(FSC+TAC)/dQ = 0 + d(TAC)/dQ = d(TAC)/dQ$$

MC curve passes through the min of all of AC, AAC, AVC


$/month
C(Q)
TVC
TAC
Point of
inflection
slope=AVCmin
slope=AACmin
slope=ACmin
FAC
FC
FSC
TC
Tons/month
Q
$/Ton
AC
MC
S
AAC
ACmin
AVC
AACmin
AVCmin
MCmin
S
Tons/month
Q

SHORT-RUN SUPPLY CURVE OF A PRICE-TAKING FIRM
P-R pp. 268-70

Q chosen to maximize profit $\pi(Q) = P\,Q - TC(Q)$
First-order condition: $d\pi/dQ = P - dTC/dQ = 0$, or $P = MC$
Second-order condition: $d^2\pi/dQ^2 = - d^2TC/dQ^2 = - dMC/dQ < 0$
so MC must be increasing at this point
Total condition : $\pi(Q) > \pi(0) = - FSC$, so
$PQ > TC - FSC = TAC$, or $P > AAC$

See how these apply in the figure:

1. If $P < MC_{min}$ , cannot find Q satisfying first-order cond. P = MC
P < MC everywhere, so optimum Q = 0 (corner solution)

2. If $MC_{min} < P < AAC_{min}$ , can find Q such that P = MC,
but avoidable costs not covered, so total condition fails.
P = MC gives only local optimum; True global optimum is Q = 0

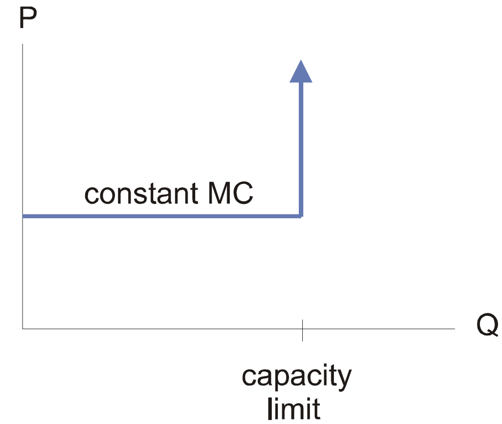
3. If $AAC_{min} < P < AC_{min}$ , can find Q such that P = MC,
firm is making an accounting loss,
but avoidable (economic) costs are covered.
True optimum is where P = MC

4. If $AC_{min} < P$ , can find Q such that P = MC
firm covers accounting (and economic) costs
"Regular" optimum where P = MC

Summing up :

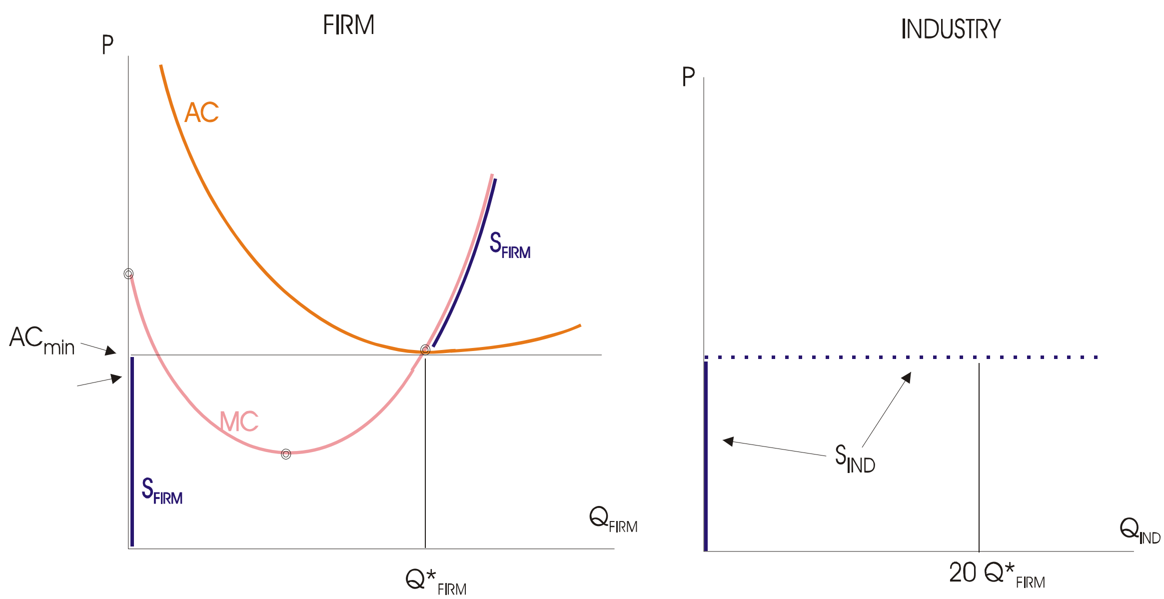
Supply curve S coincides with MC when $P > AAC_{min}$
coincides with vertical axis when $P < AAC_{min}$

SOME SPECIAL CASES OF INTEREST: (P-R pp. 275-9)




1. Each firm has constant MC
   up to a “capacity limit”;
   producing more is not possible
   (Is infinitely costly) for it
   Suppose all fixed costs are sunk
   Then the firm’s supply curve
   has the form shown here –
   If the industry has many such
   firms with different MC’s,
   Then industry supply will consist of steps
   This happens e.g. in mining, electricity production, ...
   where different MC’s correspond to different deposits
   or different technologies of production (see P-R pp. 271, 275)
   Then even in the long run, lower-cost firms have positive profits
   these are “economic rents” to their special scarce factors

2. Free entry and exit (relevant for long run, with no sunk costs)
   If all firms have identical U-shaped AC curves
   then industry supply is horizontal line at P = $AC_{min}$
   This is a constant-cost industry (P-R pp. 288-9)
   (Actually succession of discrete multiples of each firm’s
   AC-minimizing quantity, but in practice a continuous line)



3. Cost-spillovers across firms in one industry (P-R 289-90)

Negative – greater industry output raises each firm's cost curves

e.g. because price of scarce input used by all rises

Result can be an increasing-cost industry

Positive – greater industry output lowers each firm's cost curves

e.g. because of increasing returns in upstream supplier, or learning effects spread across firms

Result can be a decreasing-cost industry

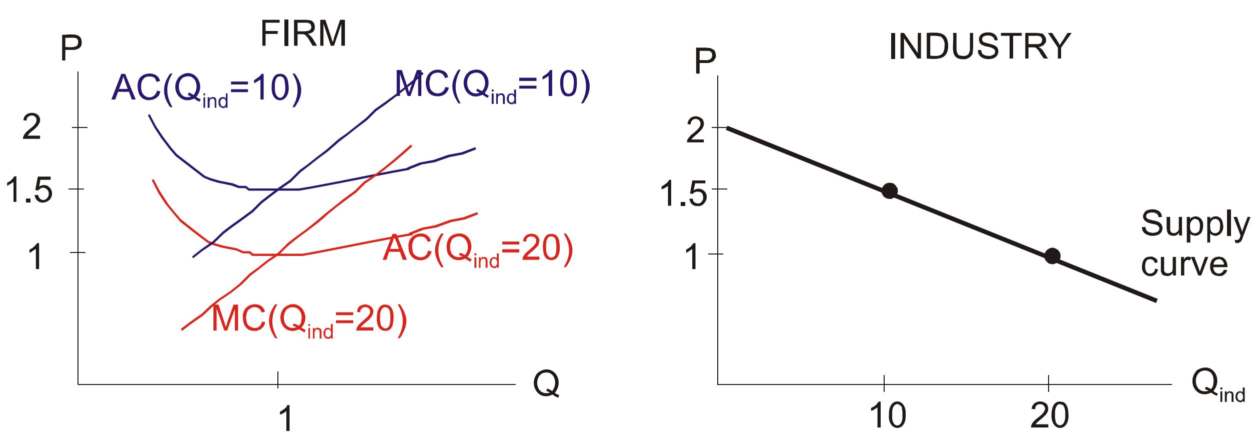
Example – Firm's output Q, industry output $Q_{ind}$

$TC = 1 + k\, Q_{ind}\, Q + Q^2$ , $AC = Q^{-1} + k\, Q_{ind} + Q$ , $MC = k\, Q_{ind} + 2\, Q$

Given industry output $Q_{ind}$ , each (small) firm's Q minimizes its AC when $d(AC)/dQ = -Q^{-2} + 1 = 0$, or $Q = 1$,and $AC_{min} = 2 + k\, Q_{ind}$ or equivalently, when AC = MC,

$$Q^{-1} + k\, Q_{ind} + Q = k\, Q_{ind} + 2\, Q, \quad Q^{-1} = Q, \text{ or } Q = 1$$

Figure shows case of decreasing cost, $k = -0.05$ and two points on the industry supply curve, with $Q_{ind}$ = 10 and 20



DISCUSSION OF ASSUMPTIONS UNDERLYING THIS THEORY

1. Firms maximize profits (P-R p. 264)

Agency problems between shareholders and managers:
Managers want large empires etc. and sacrifice some profit
Can be overcome in part by design of managerial incentives
Will study some of this in second half
Governments may force firms to take into account
interests of other "stakeholders" in society –
maintain employment, train workers, support local causes, ...
This can be seen as constraints on profit-maximization
or modification of objective function itself

2. Each firm is a price-taker (P-R pp. 262-4)

Requires each firm to be small in relation to market
Market is defined to contain closely homogeneous product,
with large cross-elasticities of demand across firms
But this may also depend on consumers finding out
the best prices quickly at negligible search cost
Each firm's AC-minimizing quantity should be small
relative to the size of the whole market
This condition will not be met if production has
significant economies of scale in each firm
(External economies of scale across firms in the industry OK)
Industries with substantial economies of scale in each firm
usually become monopolies or oligopolies (1 or few large firms)
But few firms do not automatically form a cartel to raise prices –
they may instead compete fiercely
Conversely, in mature industries with little entry or exit,
even though several firms coexist,
they may form implicit collusive arrangements
Will look at many issues of imperfect competition in second half