MANAGERIAL ECONOMICS CHAPTER 8

Cost Analysis

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Cost Analysis
Chapter 8

- The meaning and measurement of cost
- Short-run Cost Functions
- Long-run Cost Functions
- Scale Economies and Cost
- **Appendix 8A**: Cobb-Douglas & Long Run Cost

The Object of Cost Analysis

- Managers seek to produce the highest quality products at the lowest possible cost.
- Firms that are satisfied with the *status quo* find that competitors arise that can produce at lower costs.
- The advantages once assigned to being large firms (economies of scale and scope) have not provided the advantages of flexibility and agility found in some smaller companies.
- Cost analysis is helpful in the task of finding lower cost methods to produce goods and services.

Managerial Challenge: US Airways

- US Airways created in **mergers** with Allegheny, Mohawk, Lake Central, Pacific Southwest and Piedmont Airways.
- Mostly in the East, with high cost but high yields (most seats were filled).
- But, this situation invites entry by competitors by Continental or others.
- The key to US Airways' survival lays in managing its high cost.

MEANING OF COST

There an Many Economic Cost Concepts

- **Opportunity Cost** -- value of next best alternative use.
- **Explicit *vs.* Implicit Cost --** actual prices paid *vs.* opportunity cost of owner supplied resources.

Examples of Relevant Cost Concepts

- **Depreciation Cost Measurement.** Accounting depreciation (*e.g.*, straight-line depreciation) tends to have little relationship to the actual loss of value
  - To an economist, the actual loss of value is the true cost of using machinery.
- **Inventory Valuation.** Accounting valuation depends on its acquisition cost
  - Economists view the cost of inventory as the cost of replacement.

- **Unutilized Facilities.** Empty space may appear to have "no cost"
  - Economists view its alternative use (*e.g.*, rental value) as its opportunity cost.
- **Measures of Profitability.** Accountants and economists view *profit* differently.
  - Accounting profit, at its simplest, is revenues minus explicit costs.
  - Economists include other implicit costs (such as a normal profit on invested capital).

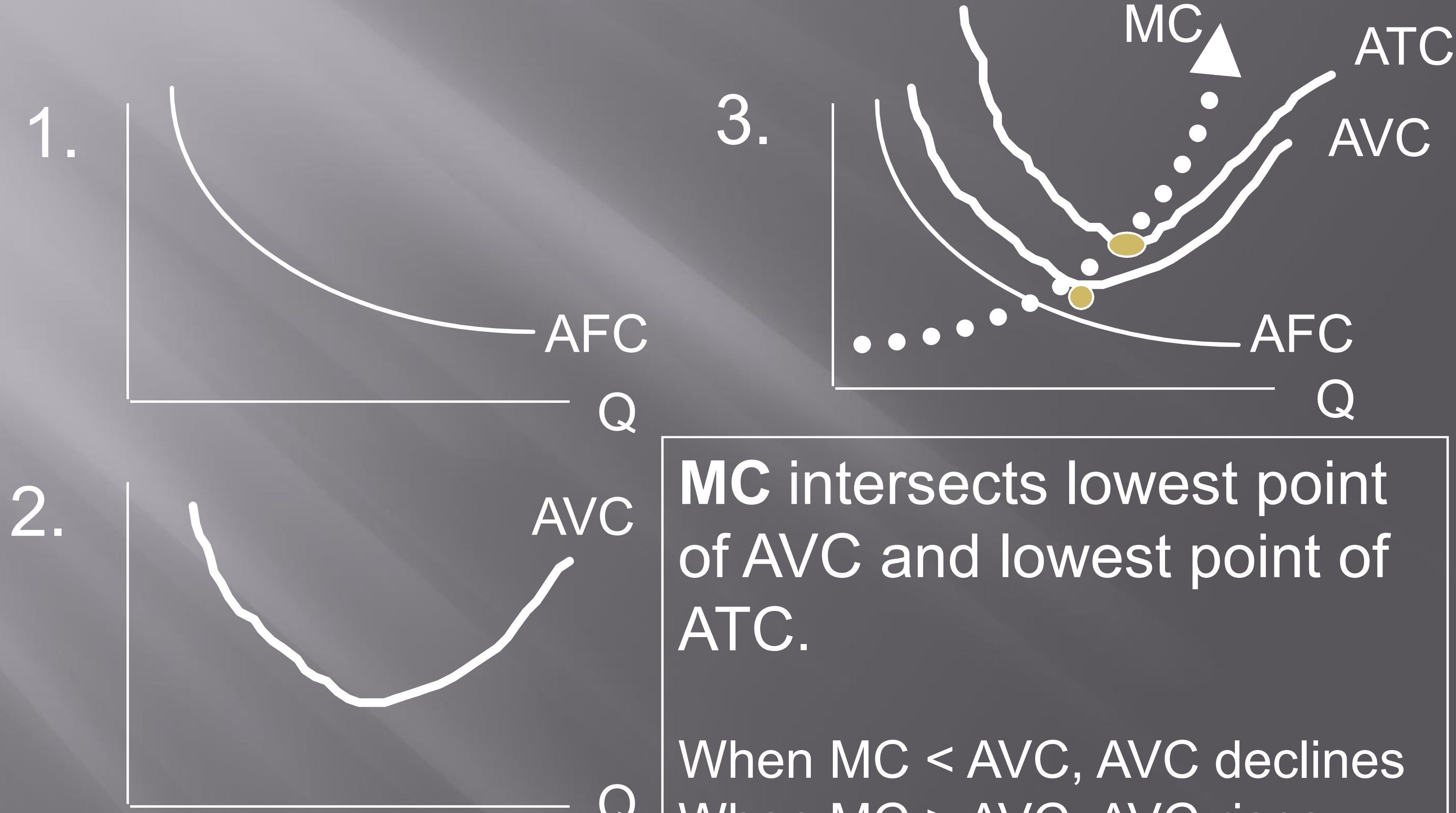
Economic Profit = Total Revenues - Explicit Costs - Implicit Costs

- **Sunk Costs --** already paid for, or there is already a contractual obligation to pay
- **Incremental Cost** - - extra cost of implementing a decision = Δ TC of a decision
- **Marginal Cost** -- cost of last unit produced = $\partial TC / \partial Q$

SHORT RUN COST FUNCTIONS

1. TC = FC + VC fixed & variable costs
2. ATC = AFC + AVC = FC/Q + VC/Q

Short Run Cost Graphs

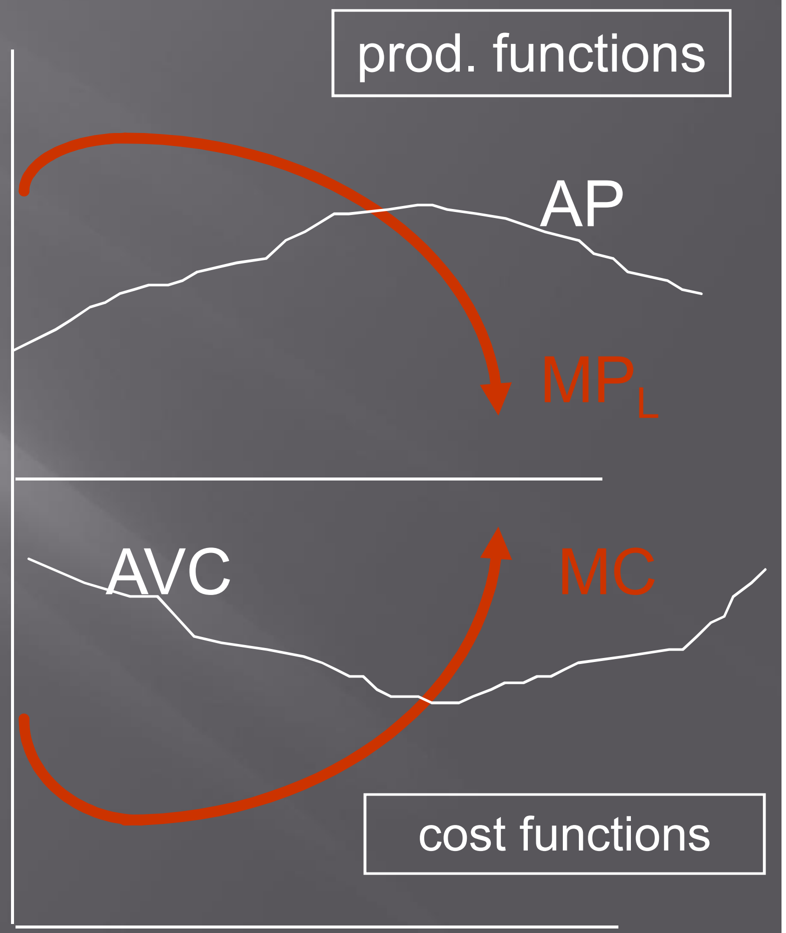


MC intersects lowest point of AVC and lowest point of ATC.

When MC < AVC, AVC declines
When MC > AVC, AVC rises

Relation of Cost & Production Functions in SR

- **AP & AVC are inversely related.** (ex: one input)
- $AVC = WL / Q = W/(Q/L) = W/ AP_L$
  - As AP_L rises, AVC falls
- **MP and MC are inversely related**
- $MC = dTC/dQ = W\ dL/dQ = W / (dQ/dL) = W / MP_L$
  - As MP_L declines, MC rises



Problem

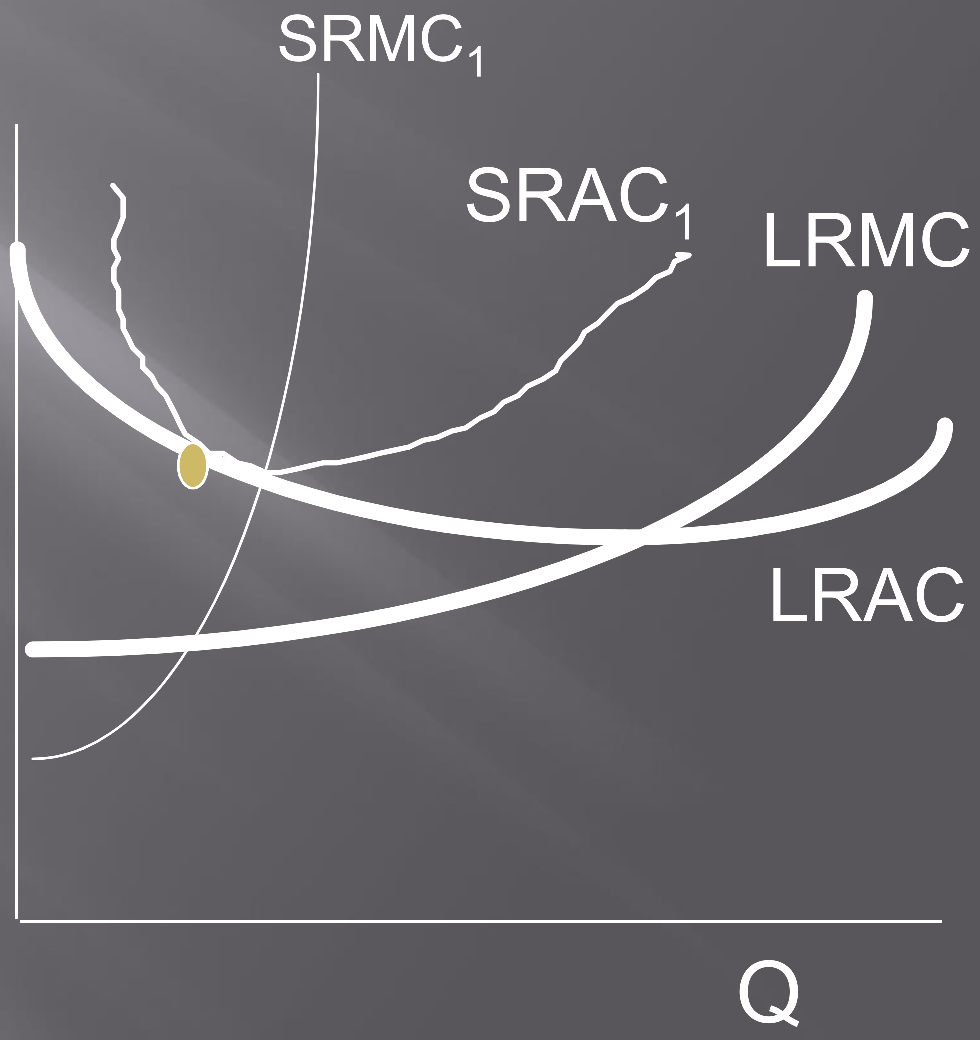
- **Let there be a cubic VC function:**

$$VC = .5\,Q^3 - 10\,Q^2 + 150\,Q$$

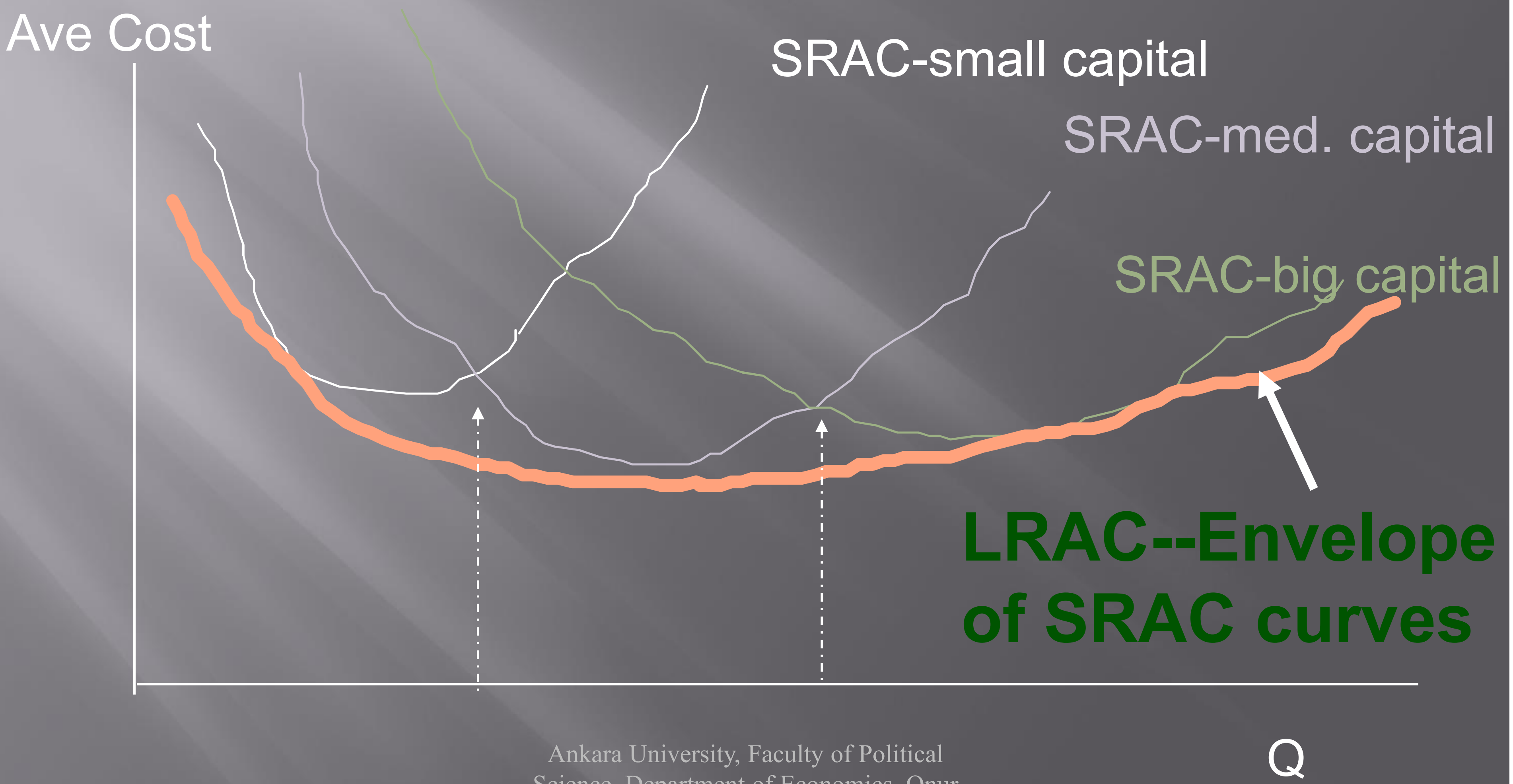
  - find AVC from VC function
  - **find minimum variable cost** output
  - and find MC from VC function
- Minimum AVC, where **dAVC/dQ = 0**
  - $AVC = .5\,Q^2 - 10\,Q + 150$
  - $dAVC / dQ = Q - 10 = 0$
  - **Q = 10**, so AVC = 100 @ Q = 10
- $MC = dVC/dQ = 1.5\,Q^2 - 20\,Q + 150$

Long Run Costs

- In Long Run, ALL inputs are variable
- LRAC
  - long run average cost
  - ENVELOPE of SRAC curves
- LRMC is FLATTER than SRMC curves



Long Run Cost Functions: Envelope of SRAC curves



Economists think that the LRAC is U-shaped

- Downward section due to:
  - **Product-specific economies** which include specialization and learning curve effects.
  - **Plant-specific economies**, such as economies in overhead, required reserves, investment, or interactions among products (*economies of scope*).
  - **Firm-specific economies** which are economies in distribution and transportation of a geographically dispersed firm, or economies in marketing, sales promotion, or R&D of multi-product firms.

- Flat section
  - Constant returns to scale
- Upward rising section of LRAC is due to:
  - ***diseconomies of scale***. These include transportation costs, imperfections in the labor market, and problems of coordination and control by management.
  - The **minimum efficient scale** (MES) is the smallest scale at which minimum per unit costs are attained.
  - Modern business management offers techniques to avoid diseconomies of scale through profit centers, transfer pricing, and tying incentives to performance.

Equi-marginal Principle in LR

- Since, LR costs are least cost, they must be efficient; that is, obey the equi-marginal principle:

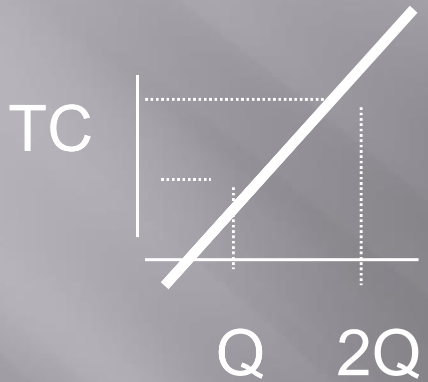
$$MP_X/C_X = MP_Y/C_Y.$$

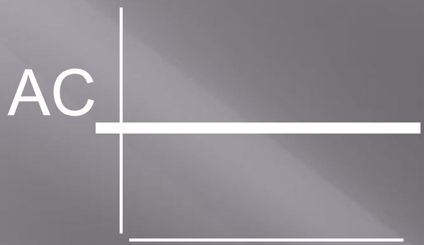
- That is, the marginal product per dollar in each use is equal.

Cost Functions and Production Functions:

LR Relationships and the Importance of Factor Costs

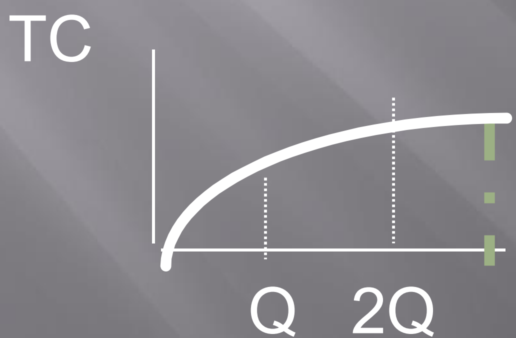
A. CRS & Constant Factor Prices:





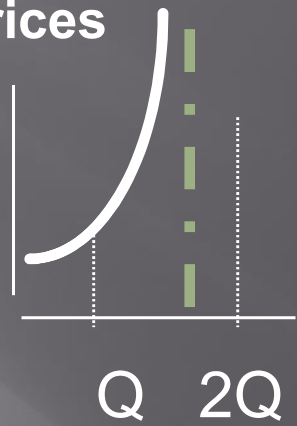
Constant cost

B. IRS & Constant Factor Prices:



More than doubles output

C. DRS & Constant Factor Prices



Doesn’t quite double output

D. CRS & Rising Factor Prices -- looks like “C”

Problem: Let TC & MC be:

- $TC = 200 + 5Q - .4Q^2 + .001Q^3$
- $MC = 5 - .8Q + .003\,Q^2$

a. FIND fixed cost

FIND AVC function

b. FIND minimum average variable cost point

c. If FC rises $500, what happens to minimum average variable cost?

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$$TC = 200 + 5Q - .4Q^2 + .001Q^3$$

$$MC = 5 - .8Q + .003 Q^2$$

a. FIND fixed cost

FIND AVC function

Answer: FC = 200 and **AVC = $5 - .4Q + .001Q^2$.**

b. FIND minimum average variable cost point

Answer: First find dAC/dQ = 0: From (a) that is:

$-.4 + .002Q = 0$, so Q = 2,000

c. If FC rises $500, what happens to minimum average variable cost?

Answer: No change, since AVC doesn't change.

Cobb-Douglas Production Function and the Long-Run Cost Function: *Appendix 8A*

- Long Run Costs & Production Functions: **1 Input**
  - In the long run, total cost is: TC = w·L, where w is the wage rate.
  - production function is Cobb-Douglas: $Q = L^{ß}$.
  - Solving for L in the Cobb-Douglas production function, we find: $L = Q^{1/ß}$.
  - Substituting this into the total cost function, we get:

One Input Case

- **$TC = w \cdot Q^{1/ß}$.**
- This also demonstrates that if the production function were constant returns to scale (ß=1), then TC rises linearly with output and average cost is constant.
- If the production function is increasing returns to scale (**ß >1**), then TC rises at a decreasing rate in output and **average cost is declining**.
- If the production function is decreasing returns to scale (ß<1), then TC rises at an increasing rate in output and average cost rises.

TWO Input Case

- With two inputs, long run cost is: $TC = w \cdot L + r \cdot K$,
  - where w is the wage rate and r is the cost of capital, K.
- Cobb-Douglas: $Q = K^{\alpha} \cdot L^{\beta}$.
- The manager attempts to minimize cost, subject to an output constraint. This is a **Lagrangian Multiplier problem**.
- Min $L = w \cdot L + r \cdot K + \lambda \cdot [K^{\alpha} \cdot L^{\beta} - Q]$
- Taking derivatives and solving yields a total cost:
- $TC = w \cdot L^{*} + r \cdot K^{*} =$
- $TC = w \cdot Q^{(1/(\alpha+\beta))} \cdot (\alpha \cdot w/\beta \cdot r)^{(\beta/(\alpha+\beta))} + r \cdot Q^{(1/(\alpha+\beta))} \cdot (\alpha \cdot w/\beta \cdot r)^{(\alpha/(\alpha+\beta))}$
- If ($\alpha+\beta>1$), then $1/(\alpha+\beta)$ less than 1, and total cost rises at a decreasing rate in output. That means that **average cost declines**.