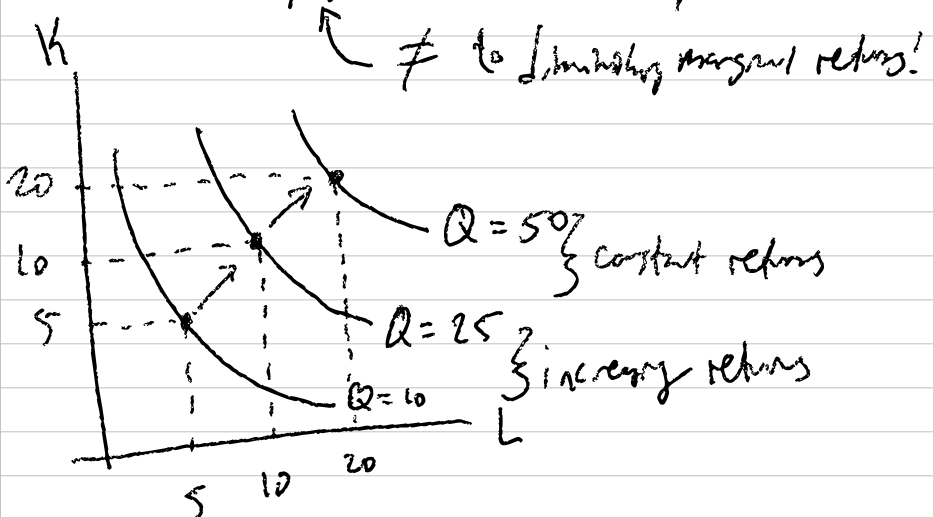


# Dylan Black

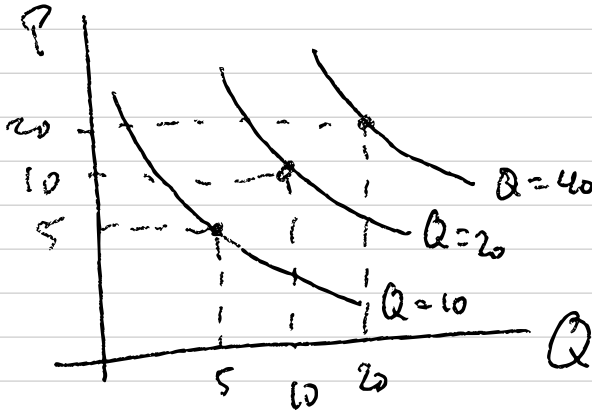
## Lecture 10 Production and its Costs

### Returns to Scale

- rate by which output  $\uparrow$  as all inputs increase proportionately
- Increasing returns to scale
  - double inputs, more than double output
- Constant returns
  - double inputs, double output
- Decreasing returns
  - double inputs, less than double output



Isocosts w/ constant returns



Cobb Douglas example

$$q(K, L) = K^\alpha L^\beta$$

$$\begin{aligned} q(2K, 2L) &= (2K)^\alpha (2L)^\beta \\ &= 2^\alpha K^\alpha \cdot 2^\beta L^\beta \\ &= 2^{\alpha+\beta} \underbrace{K^\alpha L^\beta}_{q(K, L)} \\ &= 2^{\alpha+\beta} q(K, L) \end{aligned}$$

if  $\alpha + \beta = 1$ , constant returns  
 $\alpha + \beta > 1$ , increasing returns  
 $\alpha + \beta < 1$ , decreasing returns

Accounting cost - actual \$ expenditures

Opp. Cost - next-best opp. foregone

$$\text{Econ. cost} = \text{Acc cost} + \text{Opp cost}$$

## Short Run Costs

Total Cost - econ cost

Fixed Cost - does not scale w/ output

Variable Cost - varies w/ output

$$\boxed{TC = FC + VC}$$

$$ATC = \frac{TC}{q}$$

$$\frac{TC}{q} = \frac{FC}{q} + \frac{VC}{q}$$

$$ATC = AFC + AVC$$

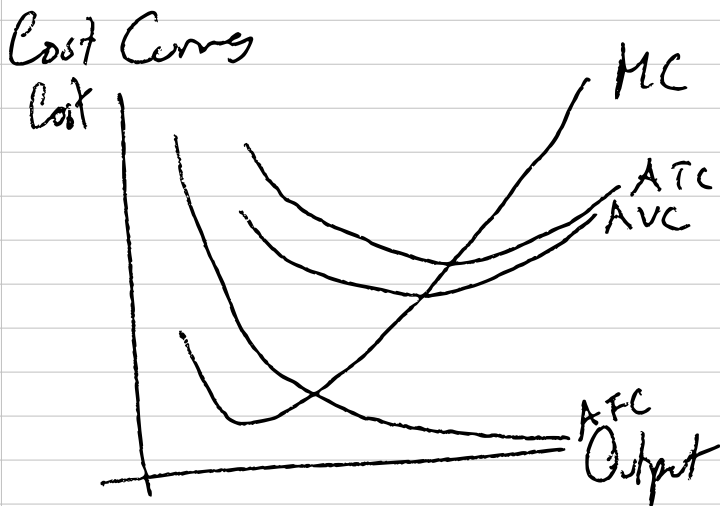
$$MC = \frac{\partial TC}{\partial q} \leftarrow \begin{array}{l} \text{Total cost is a function of} \\ \text{quantity (among other variables)} \end{array}$$

Assuming labor is our only variable cost

$$MC = \frac{\Delta C}{\Delta q} = \frac{\Delta FC + \Delta VC}{\Delta q} = \frac{\Delta VC}{\Delta q}$$

$$\Delta VC = w \Delta L \Rightarrow MC = \frac{w \Delta L}{\Delta q} = \frac{w}{MP_L}$$

$$\boxed{MC = \frac{w}{MP_L}}$$



## Shut Down Rule

- Firms shut down if it cannot recover its variable costs ( $P < AVC$ )
  - if  $TR > VC$ , firm continues to operate

## Long Run Costs

All costs are variable in the LR

- ↳  $P_{\text{Labor}} = w$
- ↳ User cost of capital ( $r$ )

$$r = \text{depreciation rate} + \text{interest rate}$$

In the LR,  $TC = VC$

Iso cost lines

$$\hookrightarrow TC = wL + rK \leftarrow \text{Budget line for producer}$$

$$K = TC / (r - (\frac{w}{r})L)$$

$$\text{Slope} = -\frac{w}{r} \left( \text{Price ratio } \frac{w}{r} \right)$$

