Managerial Economics in a Global Economy, 5th Edition
by
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Chapter 6

Production Theory and Estimation

The Organization of Production

- Inputs
  – Labor, Capital, Land
- Fixed Inputs
- Variable Inputs
- Short Run
  – At least one input is fixed
- Long Run
  – All inputs are variable

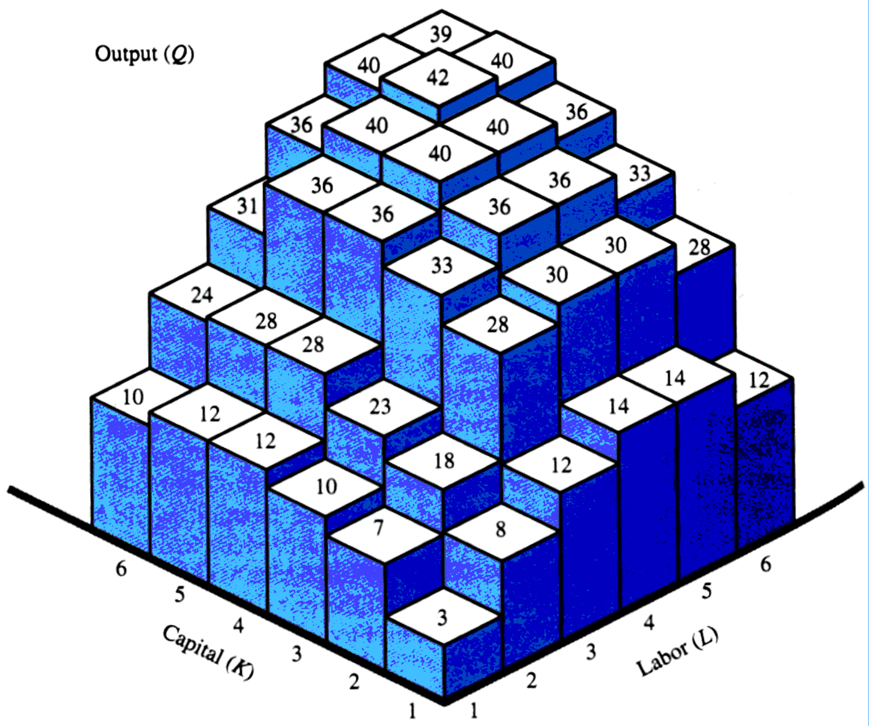
Production Function With Two Inputs

$$Q = f(L, K)$$

K							Q
6	10	24	31	36	40	39	
5	12	28	36	40	42	40	
4	12	28	36	40	40	36	
3	10	23	33	36	36	33	
2	7	18	28	30	30	28	
1	3	8	12	14	14	12	
	1	2	3	4	5	6	L

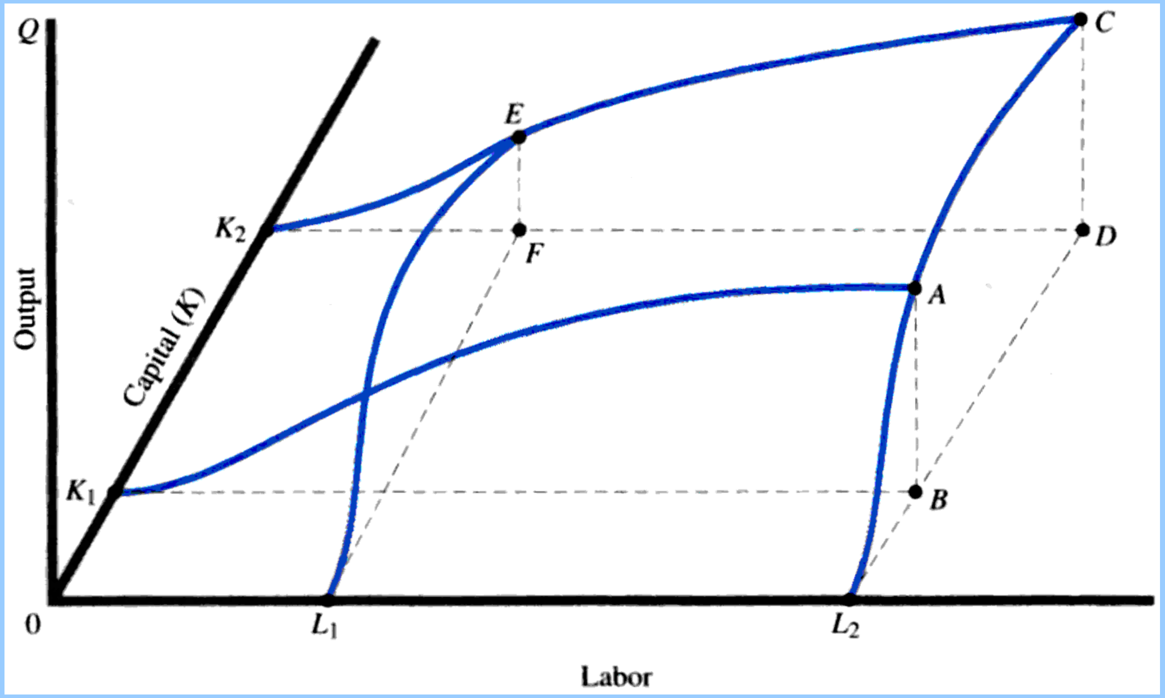
Production Function With Two Inputs

Discrete Production Surface



Production Function With Two Inputs

Continuous Production Surface



Production Function With One Variable Input

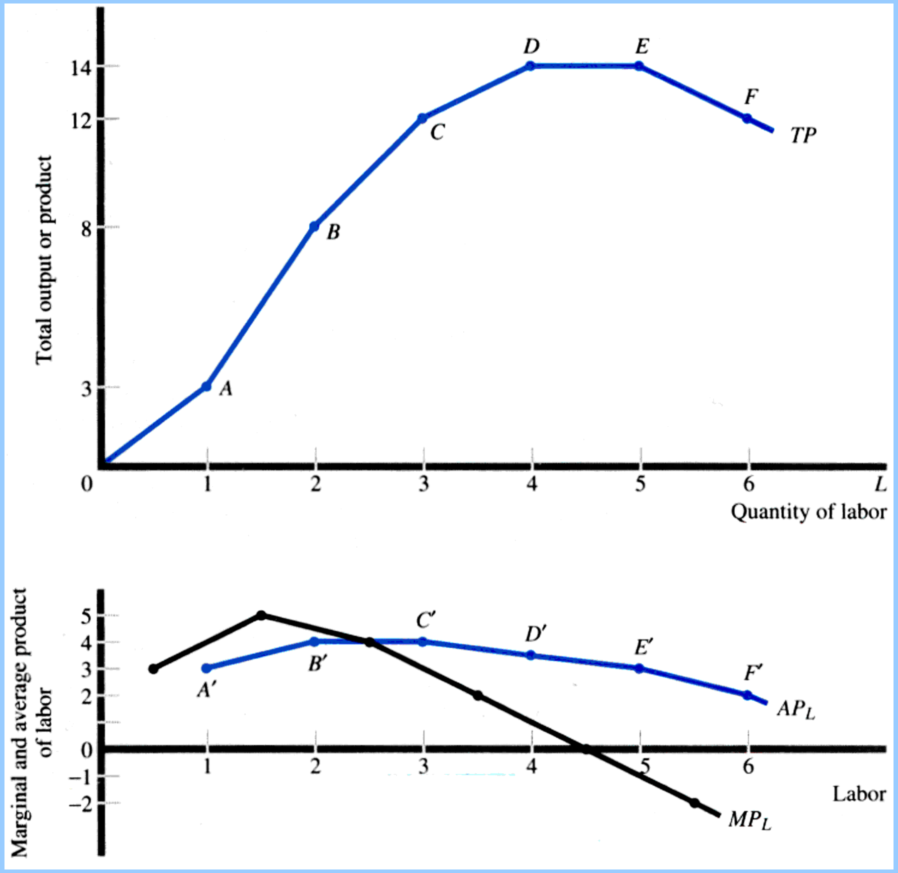
Total Product	$TP = Q = f(L)$
Marginal Product	$MP_L = \dfrac{\Delta TP}{\Delta L}$
Average Product	$AP_L = \dfrac{TP}{L}$
Production or Output Elasticity	$E_L = \dfrac{MP_L}{AP_L}$

Production Function With One Variable Input

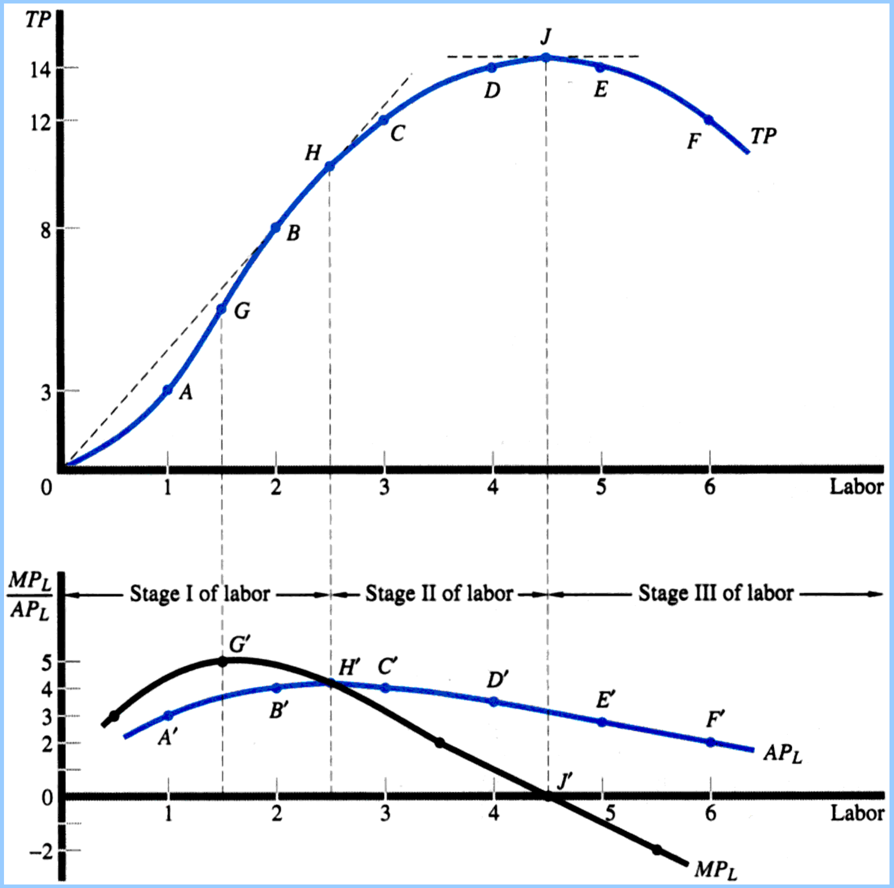
Total, Marginal, and Average Product of Labor, and Output Elasticity

L	Q	MP_L	AP_L	E_L
0	0	-	-	-
1	3	3	3	1
2	8	5	4	1.25
3	12	4	4	1
4	14	2	3.5	0.57
5	14	0	2.8	0
6	12	-2	2	-1

Production Function With One Variable Input



Production Function With One Variable Input



Optimal Use of the Variable Input

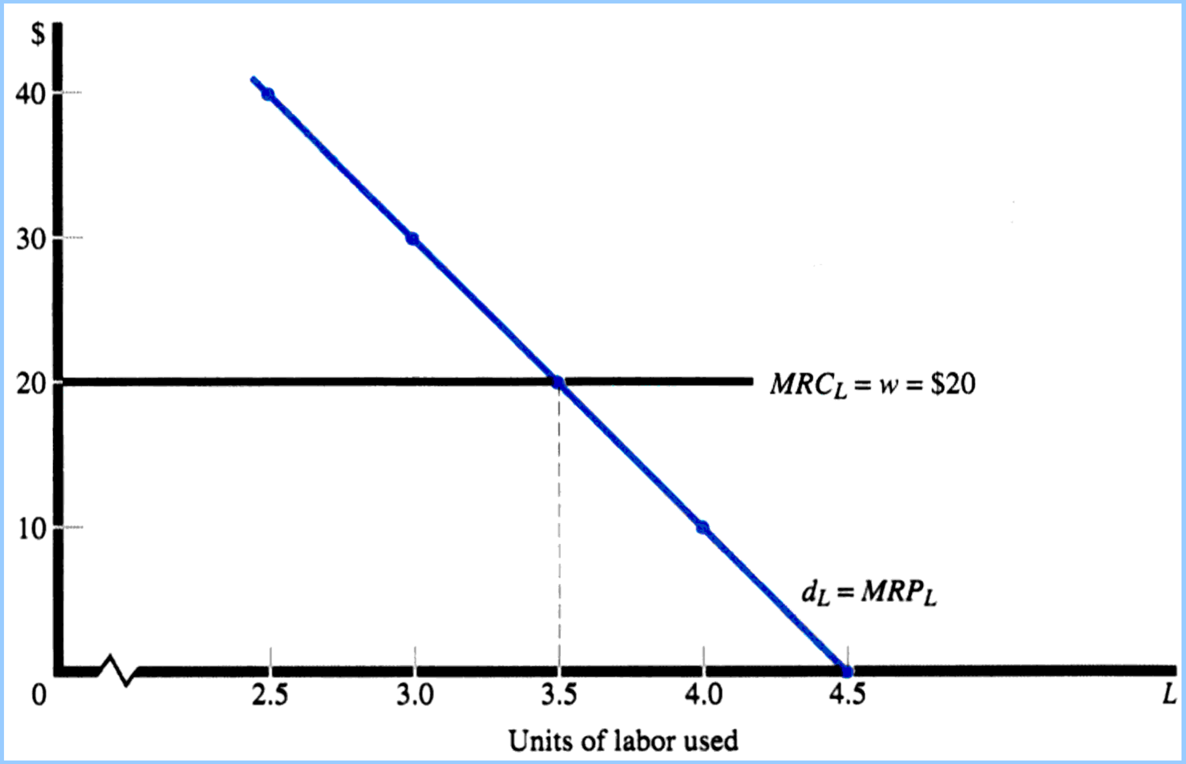
Marginal Revenue Product of Labor	$MRP_L = (MP_L)(MR)$
Marginal Resource Cost of Labor	$MRC_L = \dfrac{\Delta TC}{\Delta L}$
Optimal Use of Labor	$MRP_L = MRC_L$

Optimal Use of the Variable Input

Use of Labor is Optimal When L = 3.50

L	MP_L	MR = P	MRP_L	MRC_L
2.50	4	$10	$40	$20
3.00	3	10	30	20
3.50	2	10	20	20
4.00	1	10	10	20
4.50	0	10	0	20

Optimal Use of the Variable Input



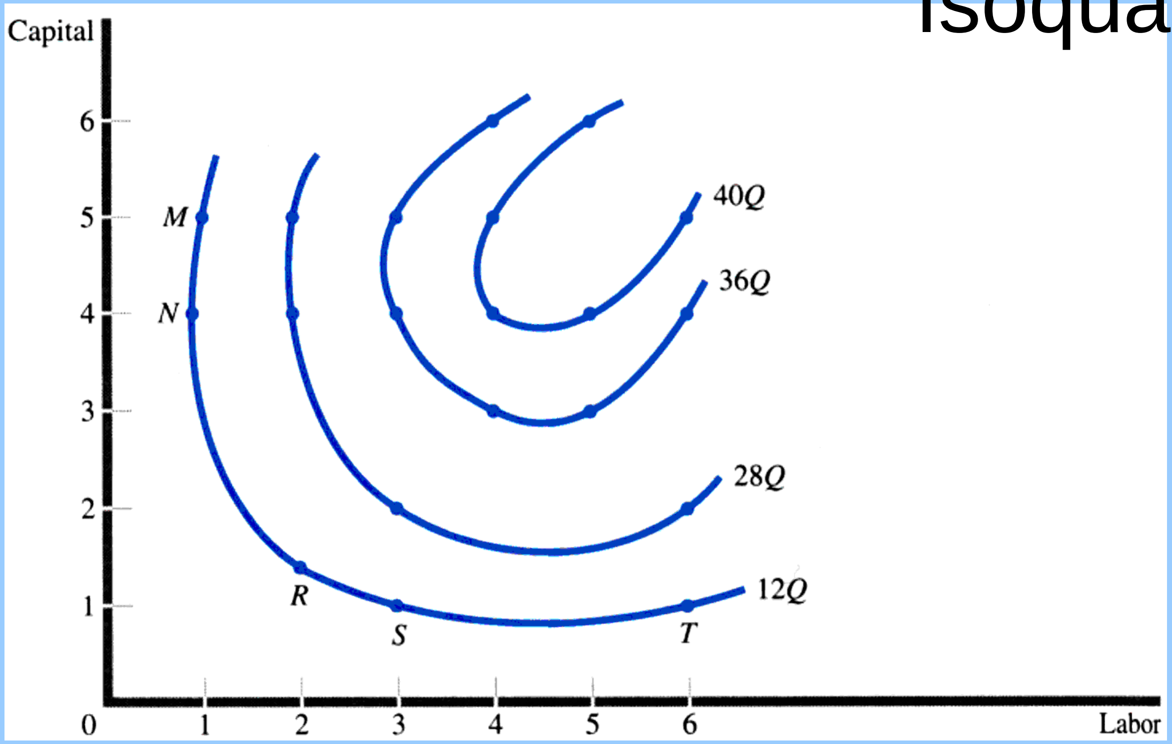
Production With Two Variable Inputs

Isoquants show combinations of two inputs that can produce the same level of output.

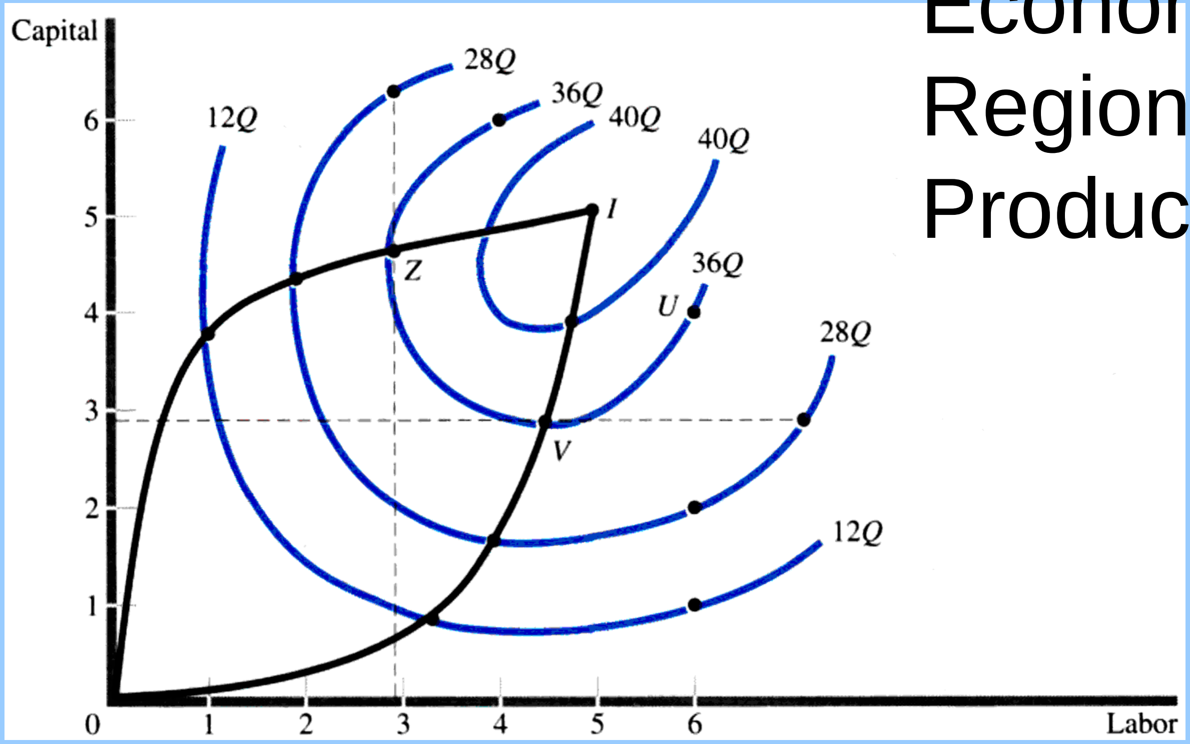
Firms will only use combinations of two inputs that are in the economic region of production, which is defined by the portion of each isoquant that is negatively sloped.

Production With Two Variable Inputs

Isoquants



Production With Two Variable Inputs



Economic Region of Production

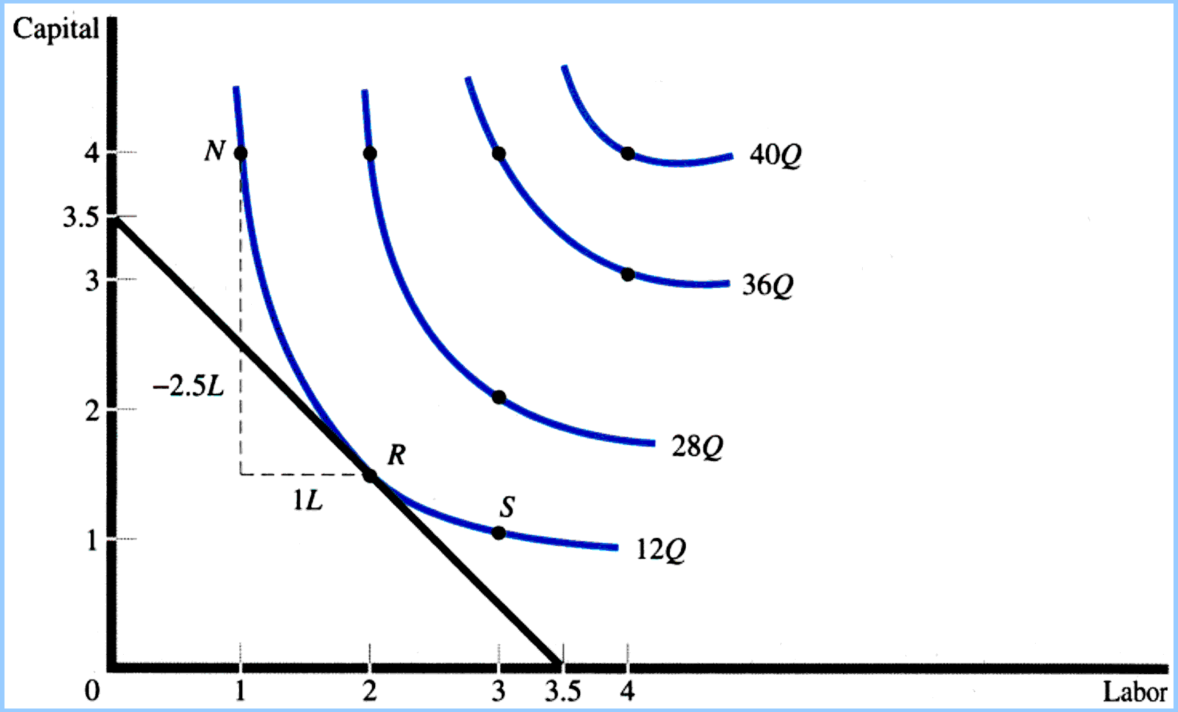
Production With Two Variable Inputs

Marginal Rate of Technical Substitution

$$MRTS = -\Delta K/\Delta L = MP_L/MP_K$$

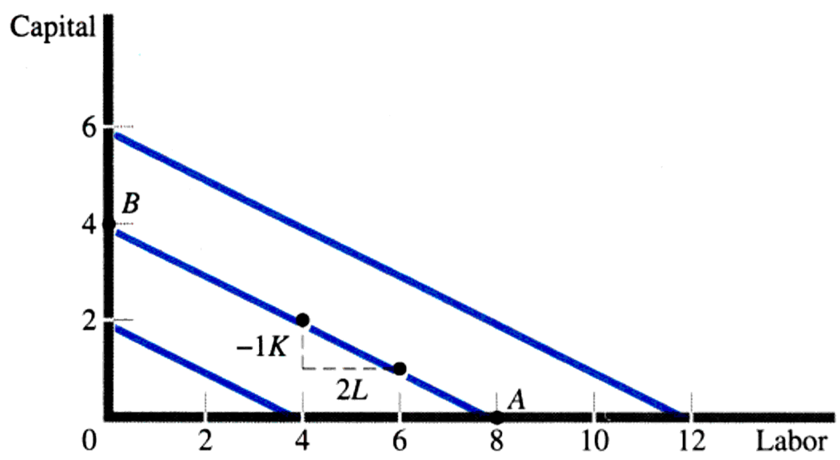
Production With Two Variable Inputs

MRTS = -(-2.5/1) = 2.5

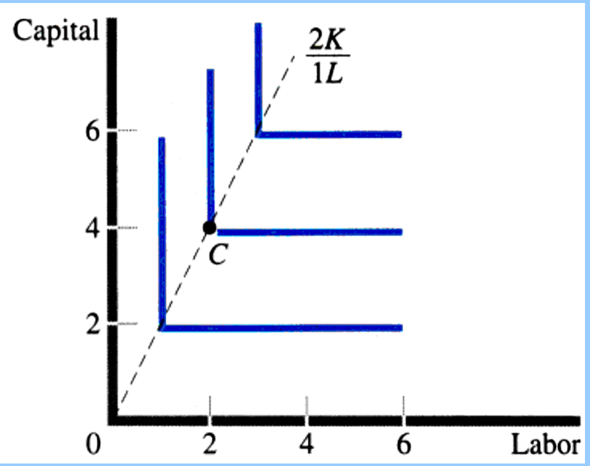


Production With Two Variable Inputs

Perfect Substitutes



Perfect Complements



Optimal Combination of Inputs

Isocost lines represent all combinations of two inputs that a firm can purchase with the same total cost.

$$C = wL + rK$$

$$C = Total\ Cost$$

$$w = Wage\ Rate\ of\ Labor\ (L)$$

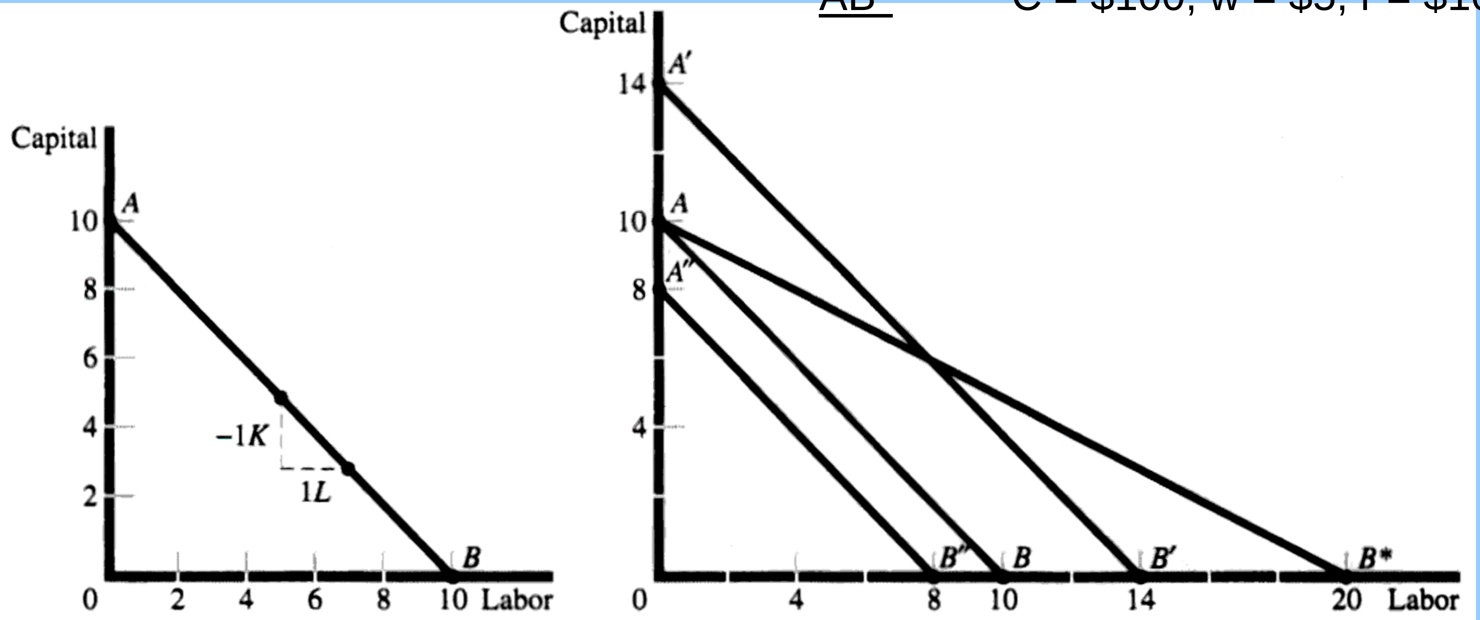
$$K = \frac{C}{r} - \frac{w}{r} L$$

$$r = Cost\ of\ Capital\ (K)$$

Optimal Combination of Inputs

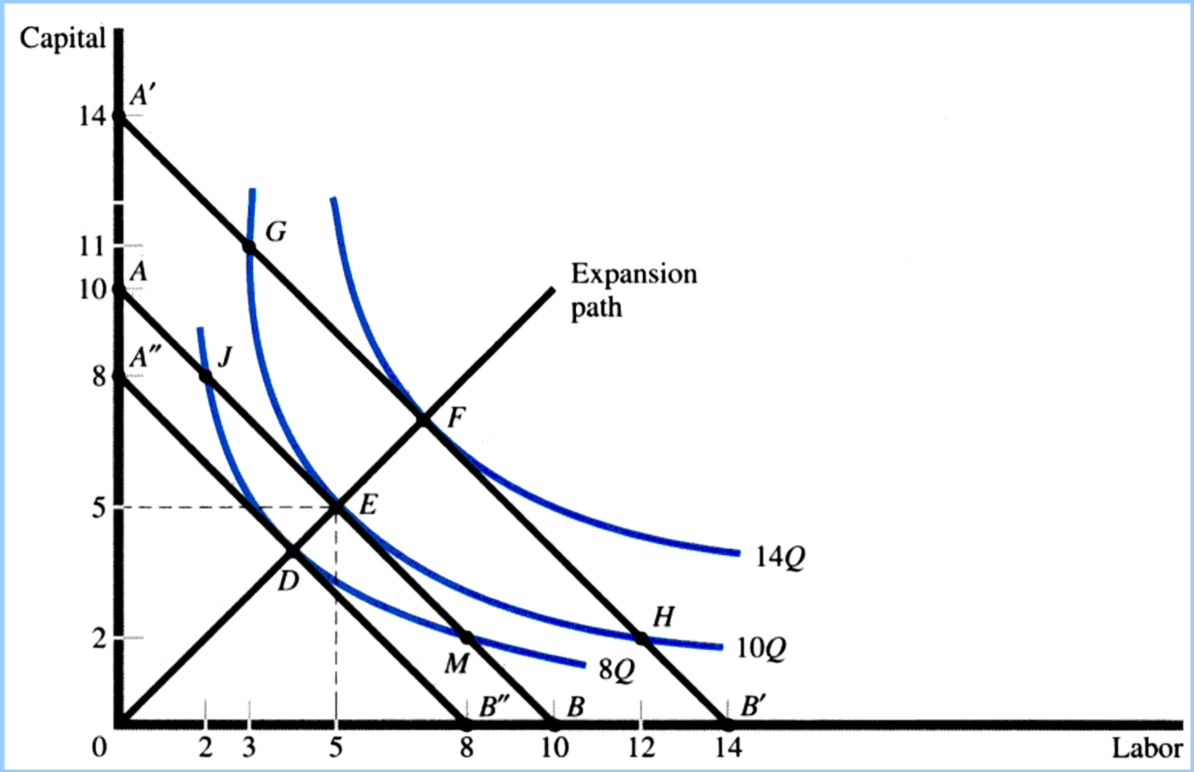
<u>Isocost Lines</u>

<u>AB</u>	C = \$100, w = r = \$10
<u>A'B'</u>	C = \$140, w = r = \$10
<u>A''B''</u>	C = \$80, w = r = \$10
<u>AB*</u>	C = \$100, w = \$5, r = \$10



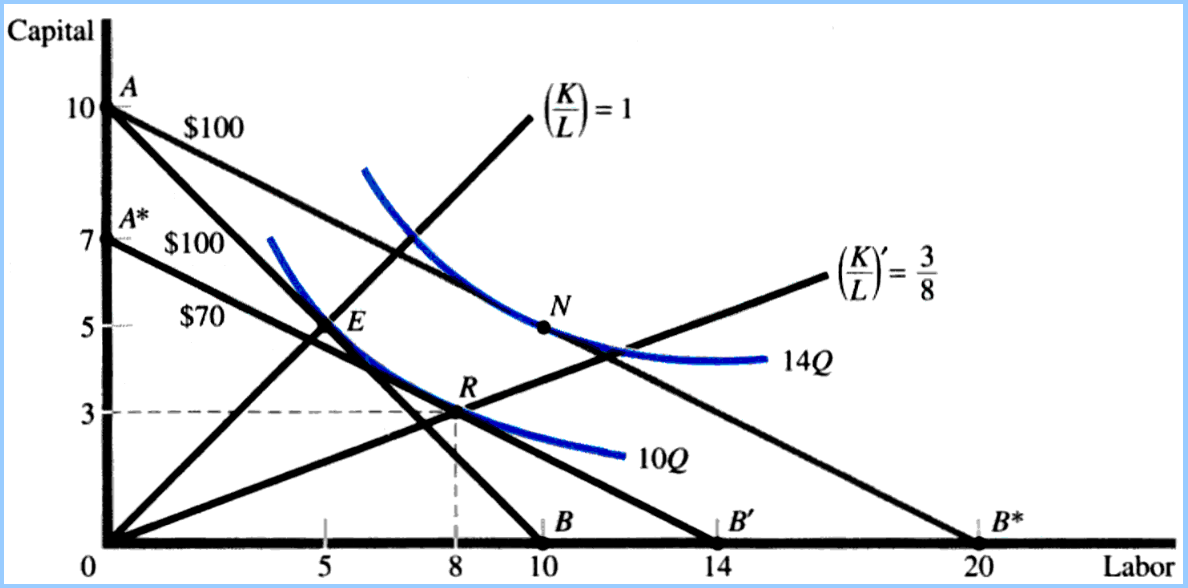
Optimal Combination of Inputs

MRTS = w/r



Optimal Combination of Inputs

Effect of a Change in Input Prices



Returns to Scale

Production Function $Q = f(L, K)$

$\lambda Q = f(hL, hK)$

If $\lambda = h$, then f has constant returns to scale.

If $\lambda > h$, then f has increasing returns to scale.

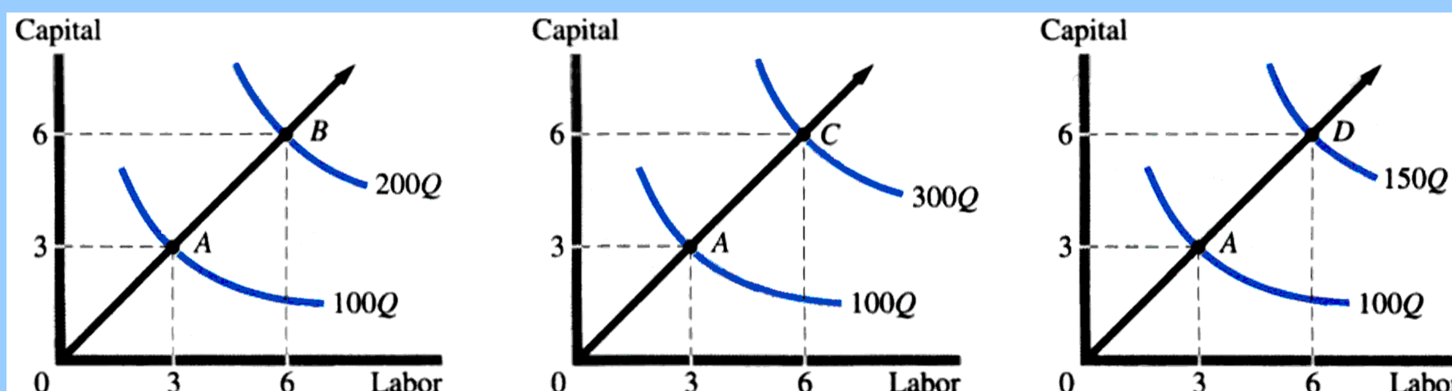
If $\lambda < h$, the f has decreasing returns to scale.

Returns to Scale

Constant Returns to Scale

Increasing Returns to Scale

Decreasing Returns to Scale



Empirical Production Functions

Cobb-Douglas Production Function

$$Q = AK^aL^b$$

Estimated using Natural Logarithms

$$\ln Q = \ln A + a \ln K + b \ln L$$

Innovations and Global Competitiveness

- Product Innovation
- Process Innovation
- Product Cycle Model
- Just-In-Time Production System
- Competitive Benchmarking
- Computer-Aided Design (CAD)
- Computer-Aided Manufacturing (CAM)