Economics for Managers
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Chapter 5:
Production and Cost Analysis in the Short Run

Defining the Production Function

The formula can be read as "quantity of output is a function of the inputs listed inside the parentheses"

$$Q = f\,(L, K, M\ldots)$$

where

Q = quantity of output

L = quantity of labor input

K = quantity of capital input

M = quantity of materials input

Fixed Inputs Versus Variable Inputs

- ***Fixed input***: quantity a manager cannot change during a given time
- ***Variable input***: quantity a manager can change during a given time
- Amount of output would vary as managers made decisions regarding amounts of input

Short-run Versus Long-run Production

- Not expressed in terms of calendar time, but in terms of fixed and variable inputs
- ***Short-run production function***: involves at least one fixed input
- ***Long-run production function***: production process in which all inputs are variable

Managerial Rule of Thumb: Short-run Production and Long-run Planning

- Managers operate in the short run, but must have long-run vision
- They need to be aware that the current amount of fixed inputs may not be appropriate as market conditions change
- Managers make more long run economic decisions

Model of the Short-run Production Function

Total product: total quantity of output produced with a given quantity of fixed and variable inputs

$$TP \text{ or } Q = f(L, \bar{K})$$

where

TP or Q = total product or quantity of output

L = quantity of labor input

$\bar{K}$ = quantity of capital input

Average Product

Average product: amount of output per unit of variable input

$$AP = TP / L \text{ or } Q / L$$

where

AP = The average product of labor

Marginal Product

Marginal product: **the additional output produced with an additional unit of variable input**

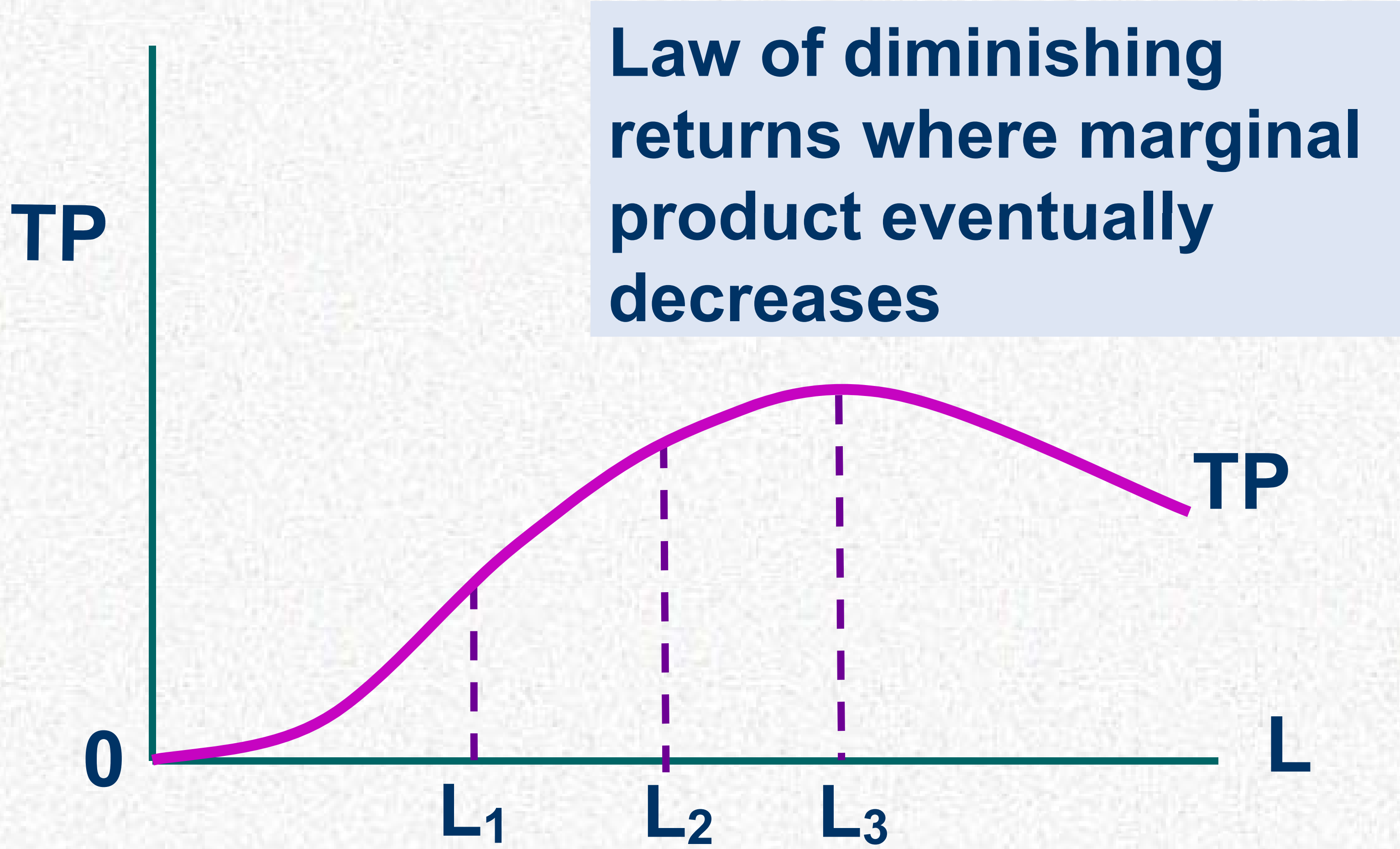
$$MP = \Delta TP / \Delta L = \Delta Q / \Delta L$$

where

MP = The marginal product of labor

Total Product: Short-run Production Function

Figure 5.1a

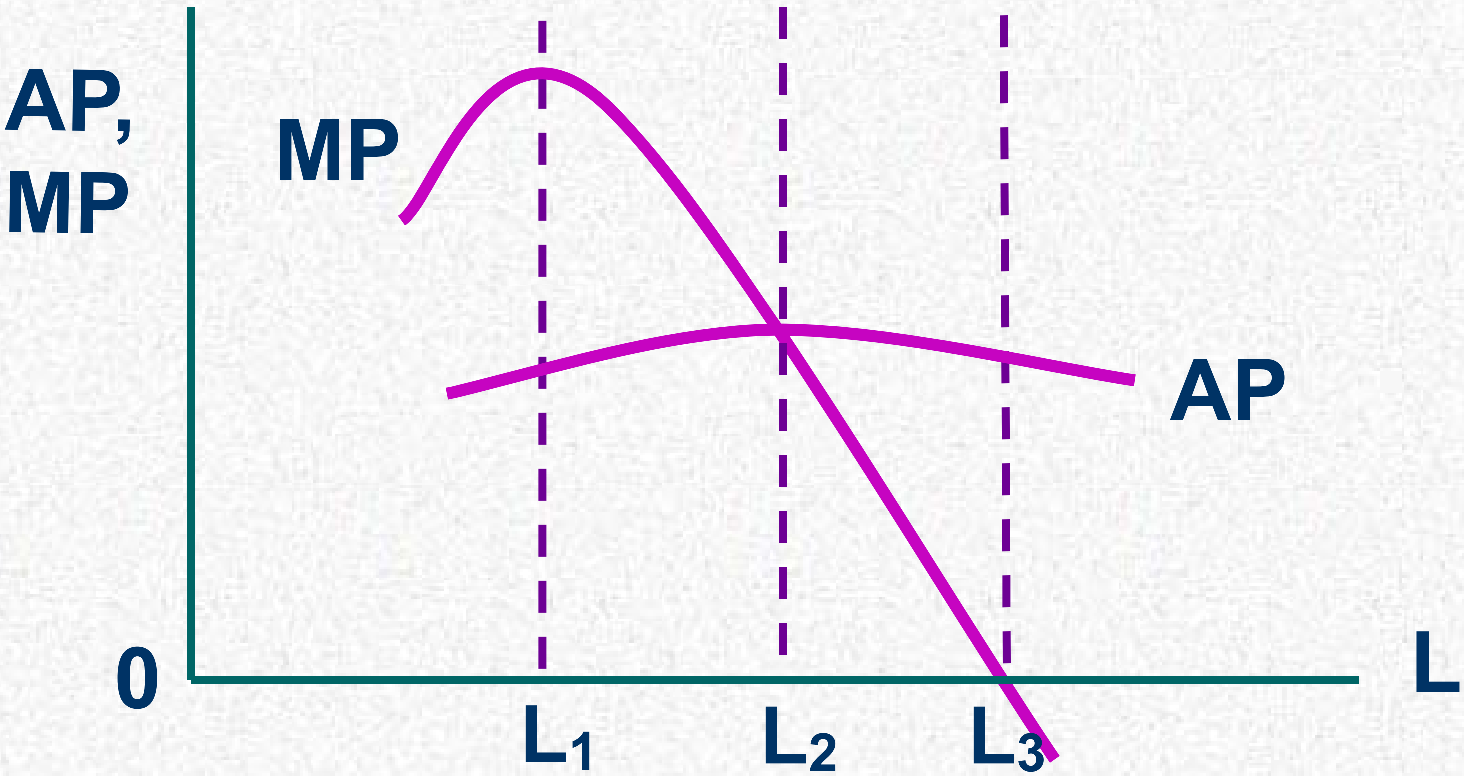


TP: Short-run Production Function

- TP increases rapidly up to level of labor input L_1 then increases at a slower rate as labor input increases
- TP curve becomes flatter and flatter until it reaches maximum output level at L_3
- Curve implies that marginal product of labor first increases rapidly then decreases, eventually becoming zero or less

AP and MP: Short-run Production Function

Figure 5.1b



AP and MP: Short-run Production Function

- Between zero and L_2, MP curve lies above AP curve, causing AP curve to increase
- Below L_2, MP curve is below AP curve, causing AP curve to decrease
- Therefore, MP curve must intersect AP curve at maximum point of AP curve

Economic Explanation

- ***Increasing marginal returns***: region where MP curve is positive and increasing
- ***Law of diminishing returns***: region where marginal product curve is positive but decreasing
- ***Negative marginal returns***: region where product curve is negative so that TP is decreasing

Law of Diminishing Returns

- Additional output generated by additional units of variable input (MP) is decreasing
- Occurs because capital input and technologies are held constant

Productivity Changes Across Industries

$$Q = f(K, L, E, M, t)$$

where

Q = industry output
K = capital services
L = labor services
E = energy use
M = materials use
t = level of technology

Model of Short-run Costs Functions

- ***Cost function***: shows relationship between cost of production and level of output
- ***Opportunity cost***: reflects use of resources in one activity while foregoing another

Model of Short-run Costs Functions

- *Explicit cost*: payment to an individual that is recorded in an accounting system
- *Implicit costs*: value of using a resource that is not explicitly paid out, is often difficult to measure, and not recorded in an accounting system

Measuring Opportunity Cost

- Prices that a firm pays for input reflects opportunity cost
- If managers do not recognize opportunity costs, they may have too much invested in buildings or other assets
- ***Historic cost***: amount of money a firm paid for an input when it was purchased

Accounting Profit and Economic Profit

- ***Profit***: difference between total revenue and total cost of production
- ***Accounting profit***: difference between total revenue and total explicit cost
- ***Economic profit***: difference between total revenue and total costs, both implicit and explicit

Managerial Rule of Thumb: Importance of Opportunity Costs

- Measuring opportunity costs can be difficult because accountants are trained to examine explicit costs
- Managers need to take into account both types of costs (explicit and opportunity costs)

Short-run Cost Functions

- *Short-run cost function*: shows relationship between output and costs based on underlying short-run production function
- It is a cost function for short-run production process in which there is at least one fixed unit of production

Costs

- ***Total fixed cost***: cost of using fixed input
- ***Total variable cost***: price per unit of labor times quantity of labor input
- ***Total cost***: sum of total fixed cost plus total variable costs

Costs

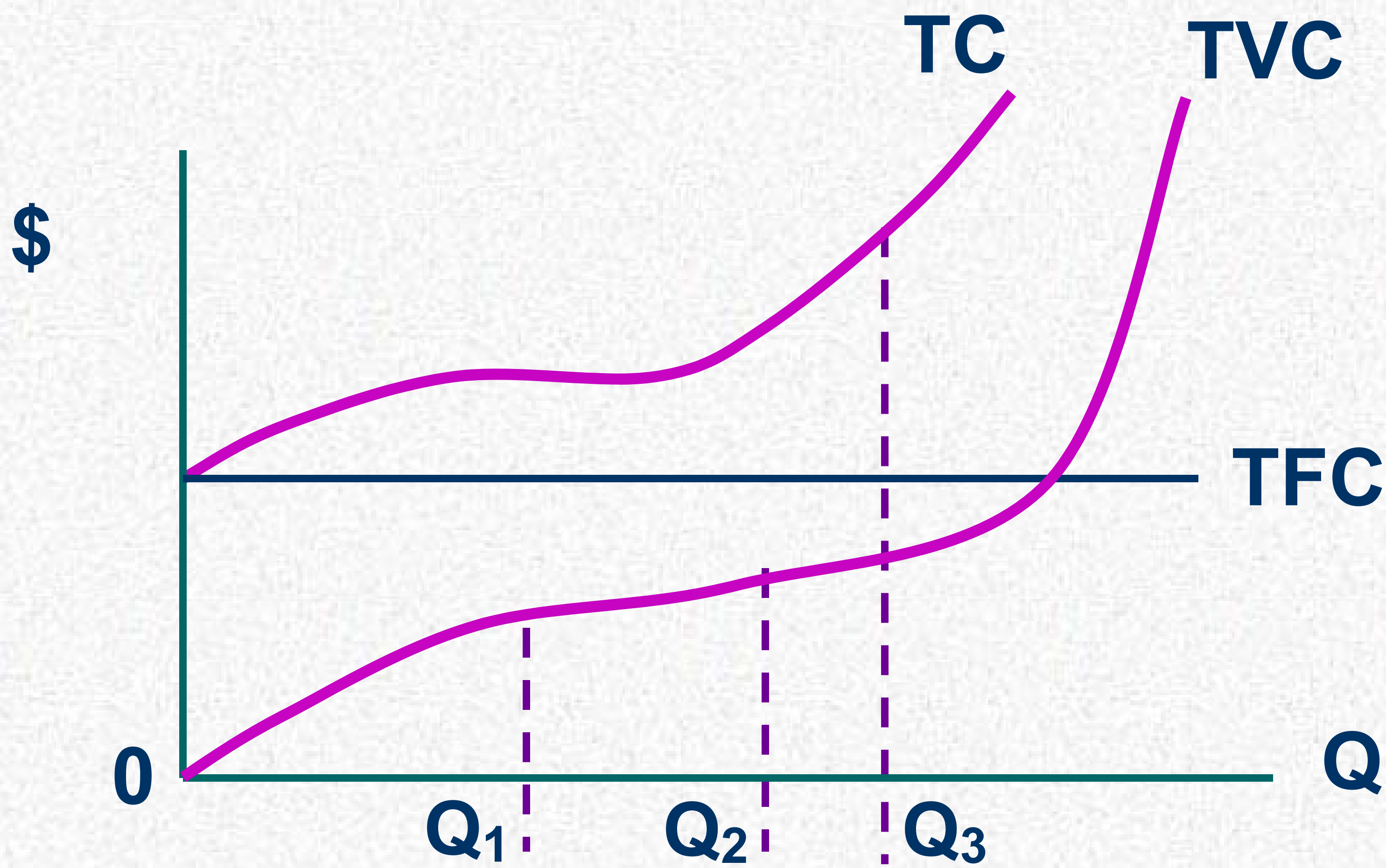
- ***Average fixed cost***: **total fixed cost per unit of output**
- ***Average variable cost***: **total variable cost per unit of output**
- ***Average total cost***: **total cost per unit of output plus average variable cost**
- ***Marginal cost***: **additional cost of producing additional units of output**

Total, Average, and Marginal Cost

- AFC decreases continuously as more output is produced
- Since TFC is constant, AFC must decline as output increases
- AVC and ATC first decrease then increase
- ATC always equals AFC plus AVC

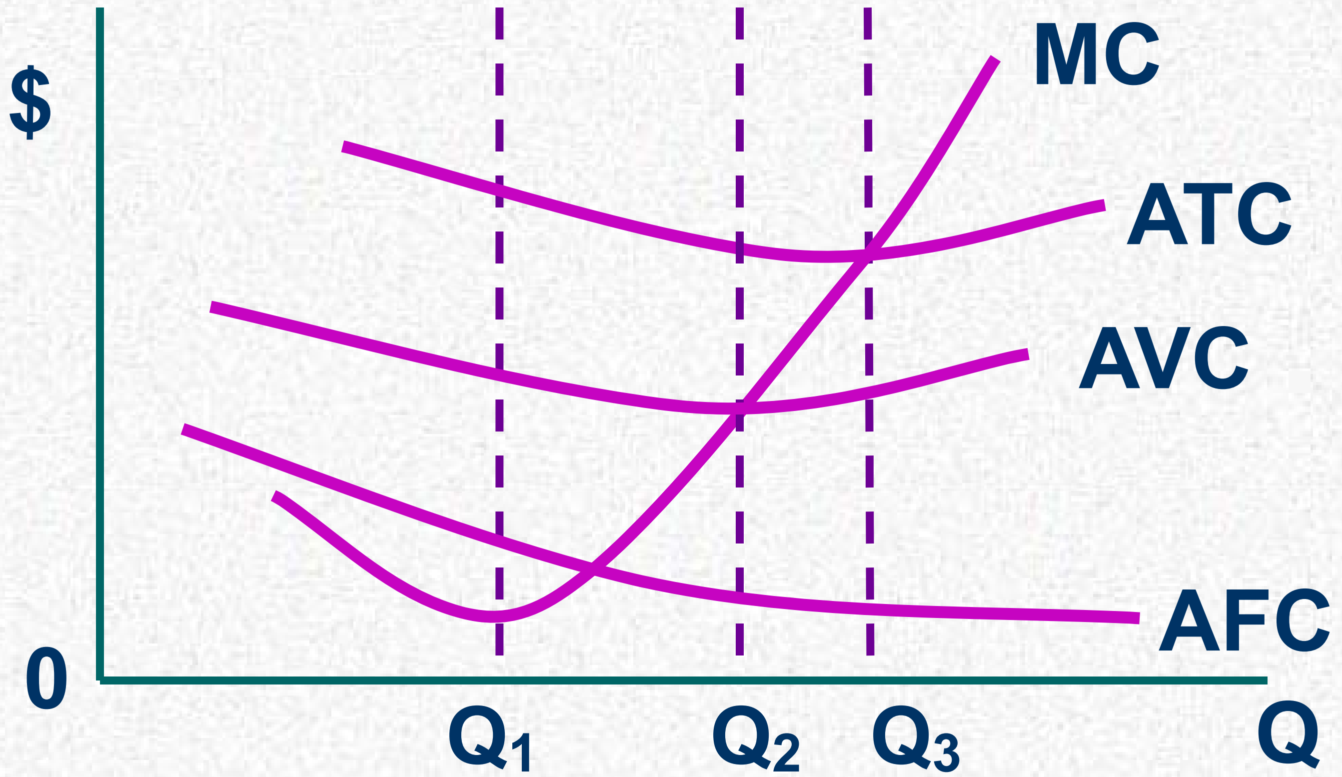
TC, TCV, TFC Functions

Figure 5.2a

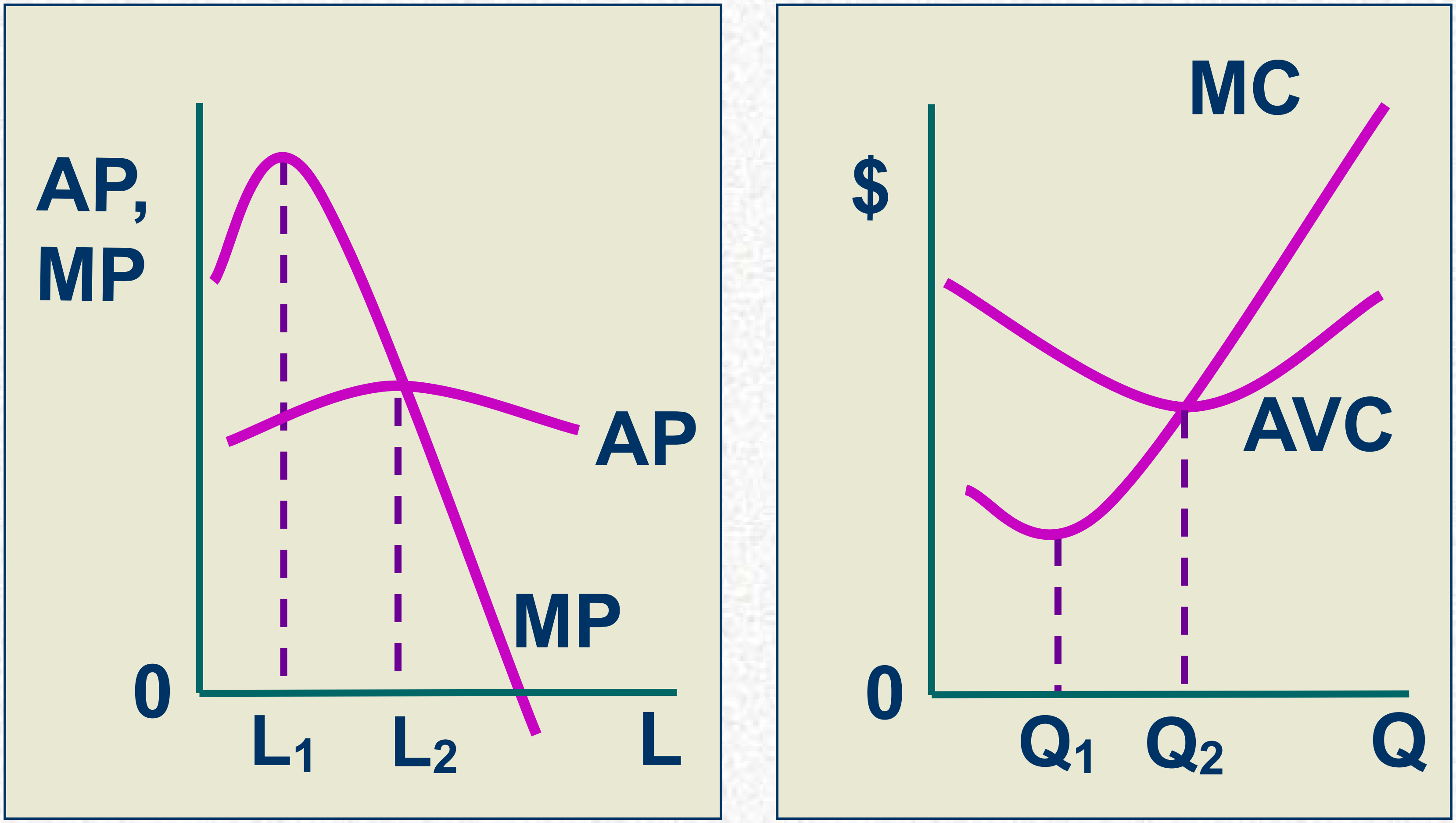


MC, ATC, AVC, and AFC Functions

Figure 5.2b



Short-run Production and Cost



Managerial Rule of Thumb: Understanding Your Costs

Managers need to understand

- Technology and prices paid for inputs of production
- Difference between variable and fixed costs
- Difference between average costs (costs per unit of output) and marginal costs (additional costs of producing additional units of output)

Econometric Estimation of Cost Functions

- Dean's studies of a furniture factory, a leather belt shop, 1976
- Johnston's study of British electric generating plants, road passenger transport, and food processing firm, 1960
- Hall, 1986
- Blinder, et al, 1990s

Summary of Key Terms

- Accounting profit
- Average fixed cost
- Average product
- Average total cost
- Average variable cost
- Cost function
- Economic profit
- Explicit cost
- Fixed input
- Historic cost
- Implicit cost
- Marginal returns
- Diminishing returns
- Long-run production functions

Summary of Key Terms

- Marginal cost
- Marginal product
- Negative marginal returns
- Production function
- Short-run production function
- Short-run cost function
- Total cost
- Total fixed cost
- Total product
- Opportunity cost
- Total variable cost
- Variable input