Econ 362. Macroeconomic Theory
Midterm Review

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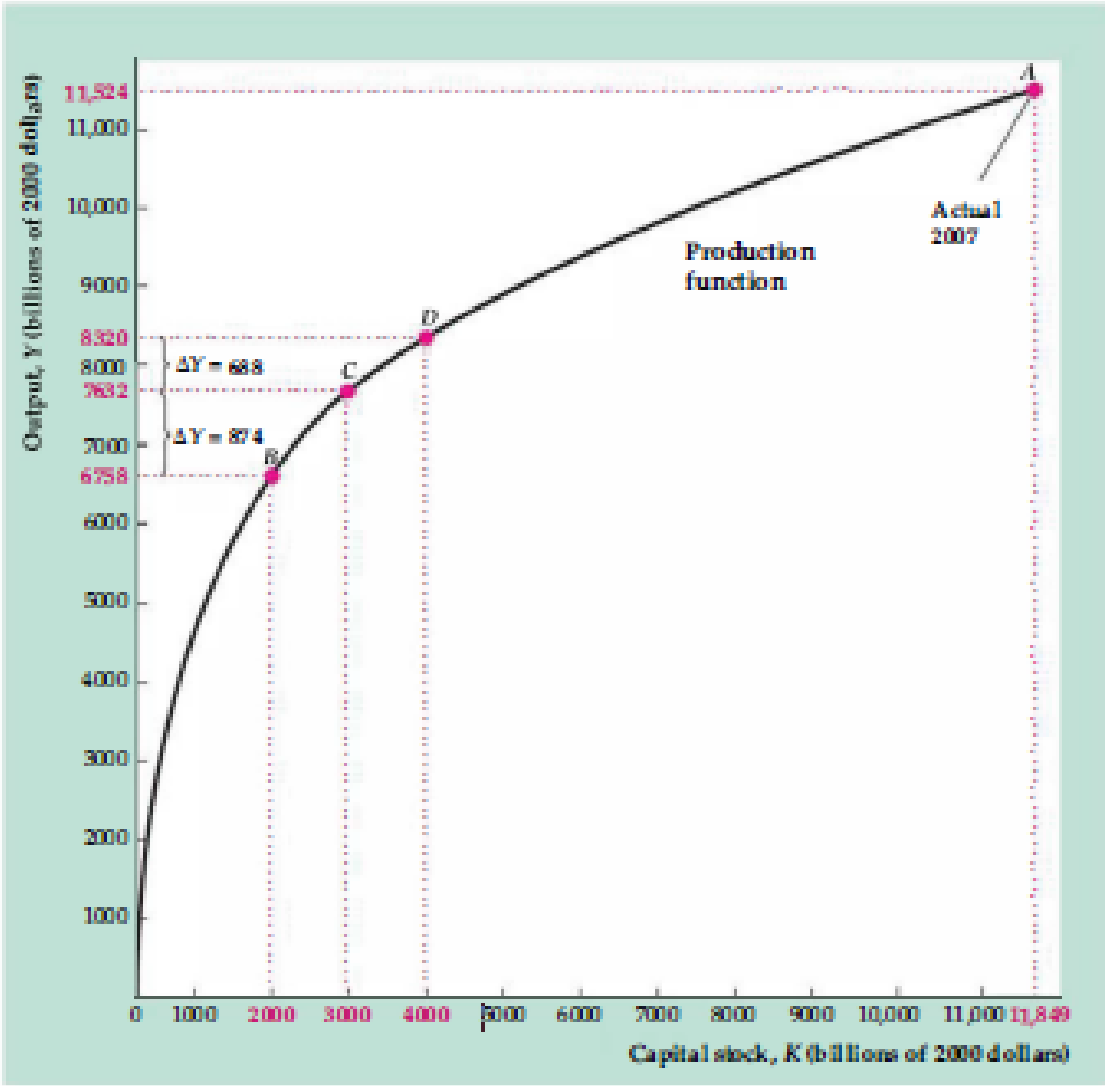
Chapter 3: Productivity, Output, and Employment

- **The production function**
- The economy's output depends on:
  - The quantity of inputs: labor (N), capital (K).
  - The productivity of these inputs (A).
- The production function:

$$Y = AF(K, N) \tag{1}$$

Graph: The Production Function

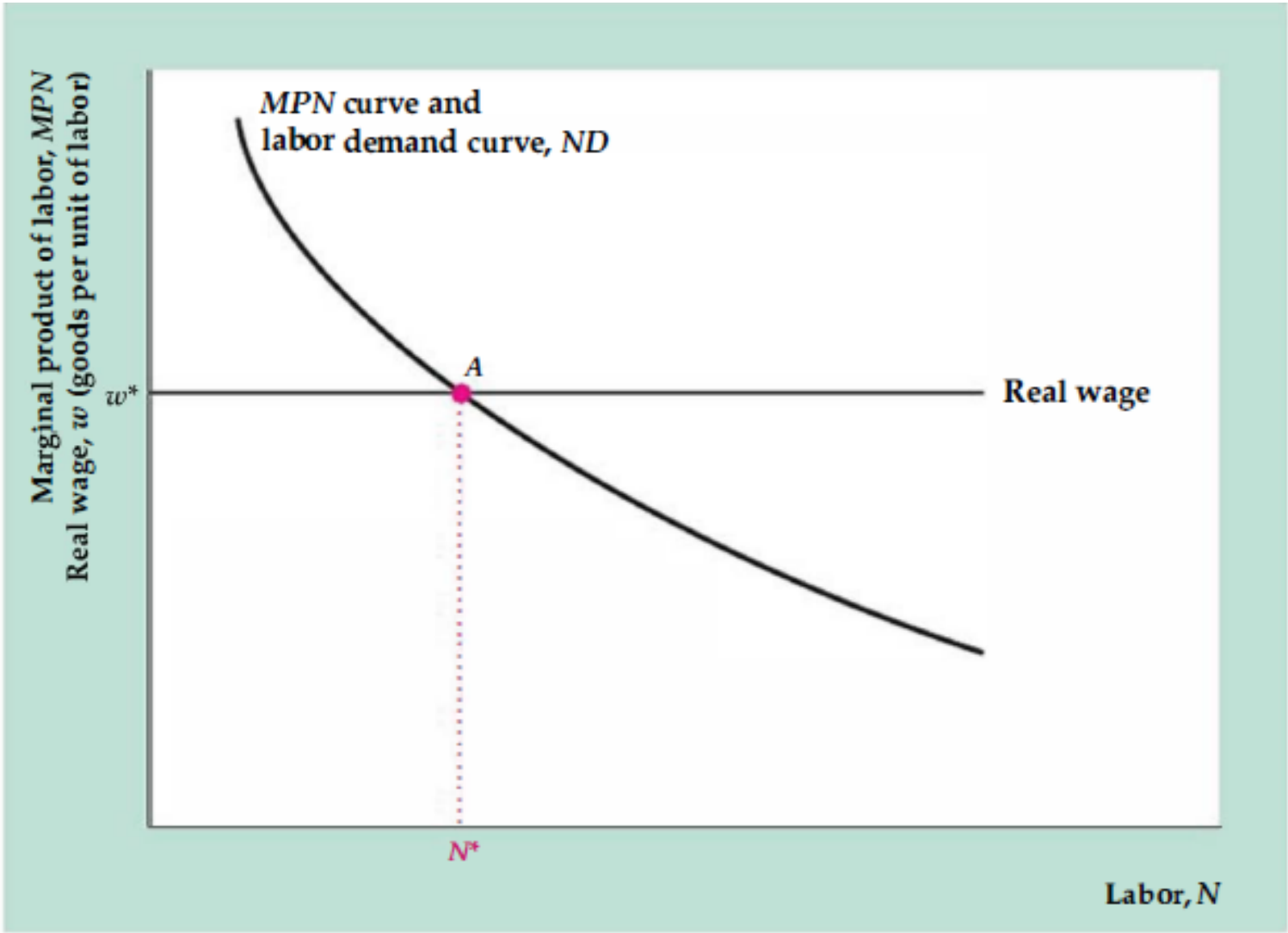


Labor Market Equilibrium

- Firms demand labor based on the marginal product of labor (MPN).
- Workers supply labor based on real wages.
- Equilibrium is where labor supply equals labor demand.

$$w^* = MPN(N^*) \tag{2}$$

Graph: Labor Market Equilibrium



Example: Labor Market Effects of an Adverse Supply Shock

- An adverse supply shock reduces the marginal product of labor (MPN).
- Labor demand shifts leftward: $N_D^1 \rightarrow N_D^2$.
- Equilibrium moves from A to B.
- The real wage decreases from w_1 to w_2.
- Full-employment level of labor falls from N_1 to N_2.

Full-Employment Output and Supply Shock

- Full-employment output is given by:

$$Y = AF(K, N) \tag{3}$$

- Supply shock reduces productivity (A) and employment (N), lowering Y.
- Direct effect: Lower A reduces output for given K and N.
- Indirect effect: Lower N further reduces output.

- Aggregate demand consists of:

$$Y = C + I + G + NX \tag{4}$$

- In a closed economy ($NX = 0$), we simplify to:

$$Y = C + I + G \tag{5}$$

- Government purchases (G) are exogenous.

Consumption and Saving

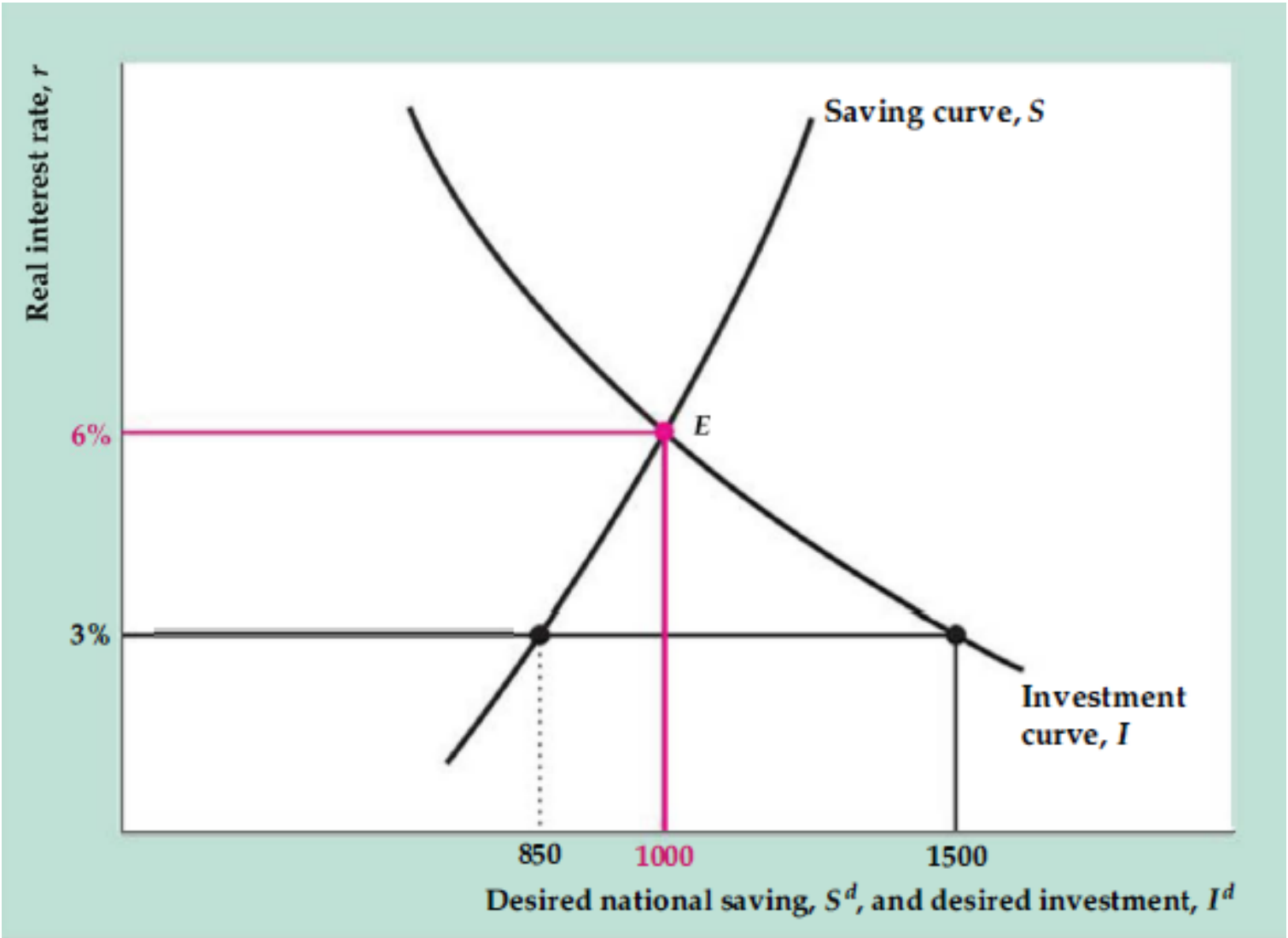
- Equivalently, in terms of saving and investment:

$$S^d = I^d \tag{6}$$

- Such that the desired national saving (S^d):

$$S^d = Y - C^d - G \tag{7}$$

Graph: Goods Market Equilibrium



Investment Decision

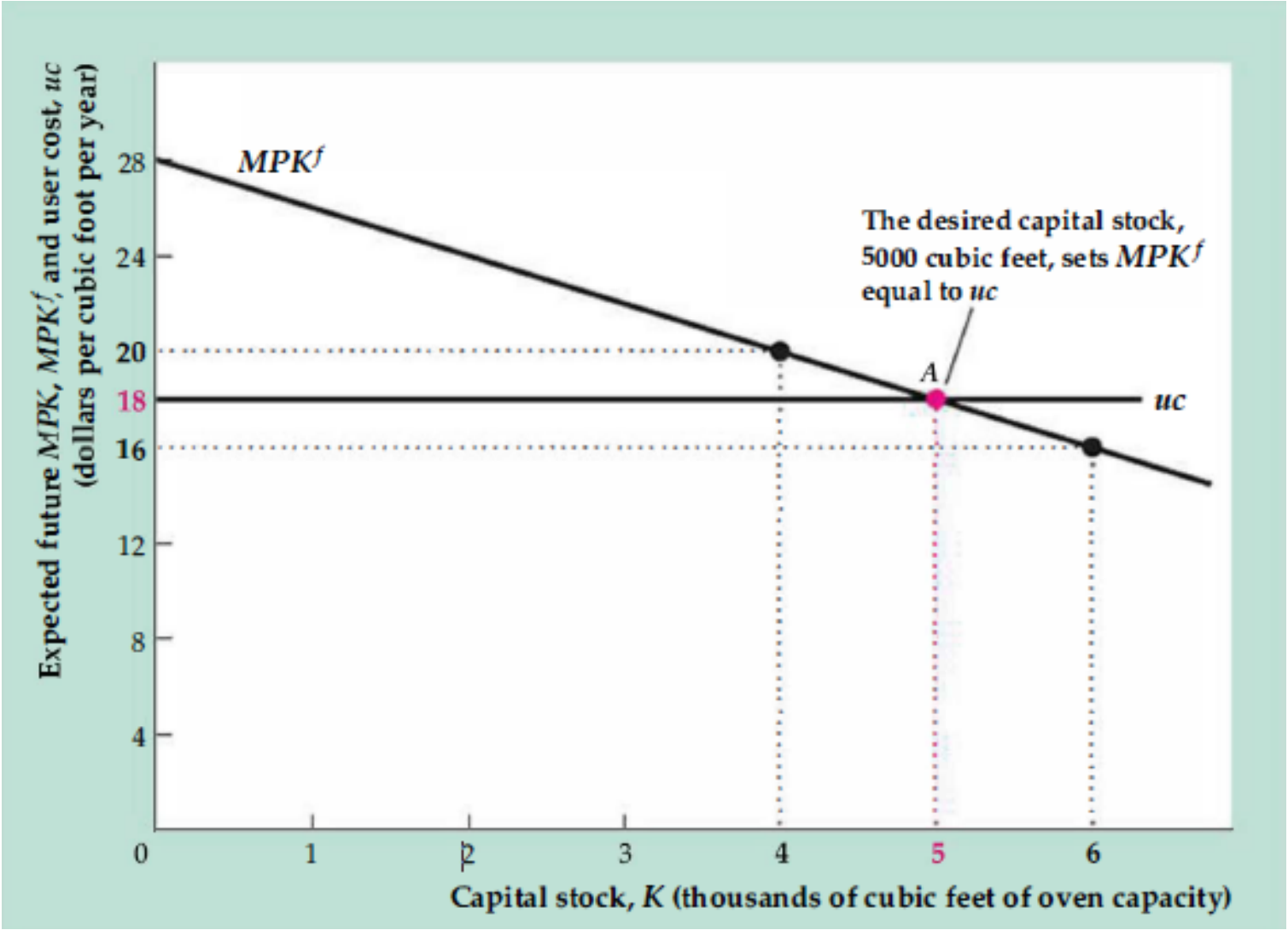
- Firms invest based on the user cost of capital (uc):

$$uc = (r + d)P_K \tag{8}$$

- Optimal capital stock is found where:

$$MPK_f = uc \tag{9}$$

Graph: Goods Market Equilibrium



Appendix: Intertemporal Choice Model

Assumptions:

- Two-period model: present and future.
- Fixed income, wealth, and real interest rate.

Budget Constraint:

$$c_f = (y + a - c)(1 + r) + y_f \tag{10}$$

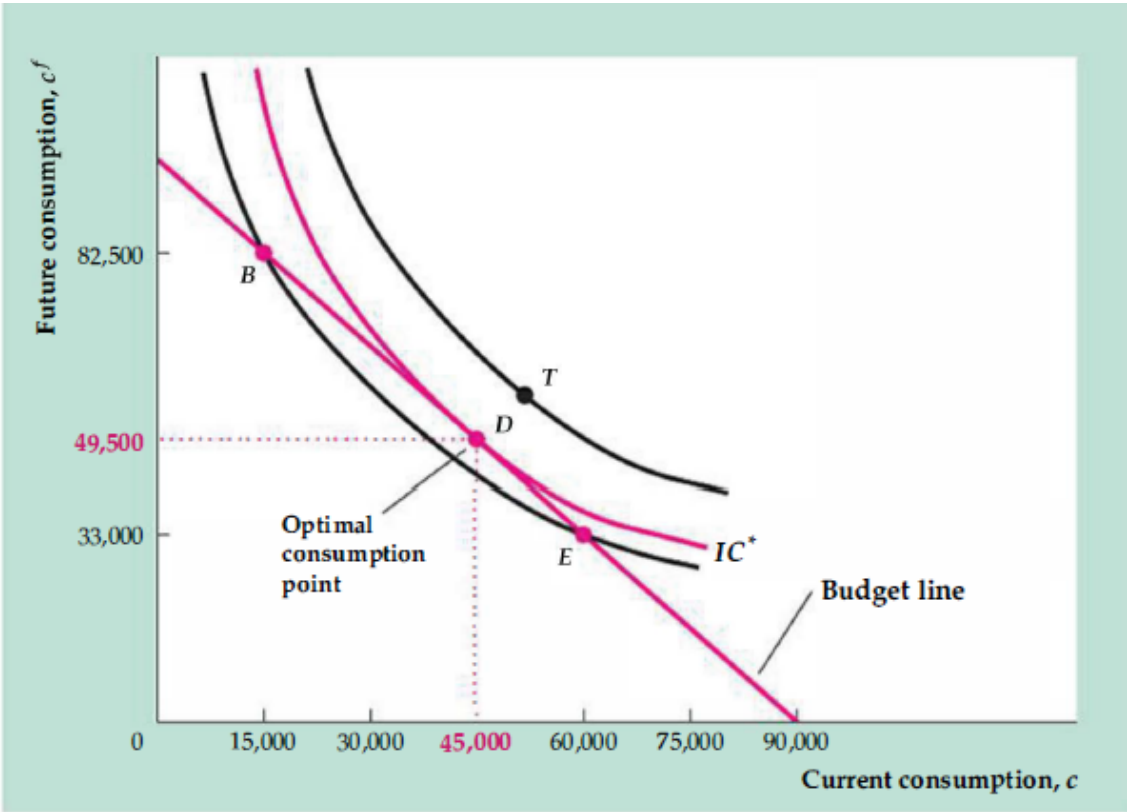
Present Value of Lifetime Resources (PVLR):

$$PVLR = a + y + \frac{y_f}{1 + r} \tag{11}$$

Consumer Preferences

Consumer Preferences:

- Consumers maximize lifetime utility.
- Indifference curves show combinations of c and c_f yielding the same utility.
- Optimal consumption choice where $MRS = 1 + r$.



- **Growth accounting:** From our production function:

$$Y = AF(K, N)$$

- We can write the following growth equation:

$$\frac{\Delta Y}{Y} = \frac{\Delta A}{A} + \alpha_K \frac{\Delta K}{K} + \alpha_N \frac{\Delta N}{N}$$

Solow Model Dynamics

- A model of capital accumulation and steady state.
- Graphical representation of output, saving, and depreciation.
- Effects of changes in saving rate and population growth.

Capital Accumulation in the Solow Model

- Defining output per worker: $y = Y/N$, capital per worker: $k = K/N$.
- We have the per-worker production function:

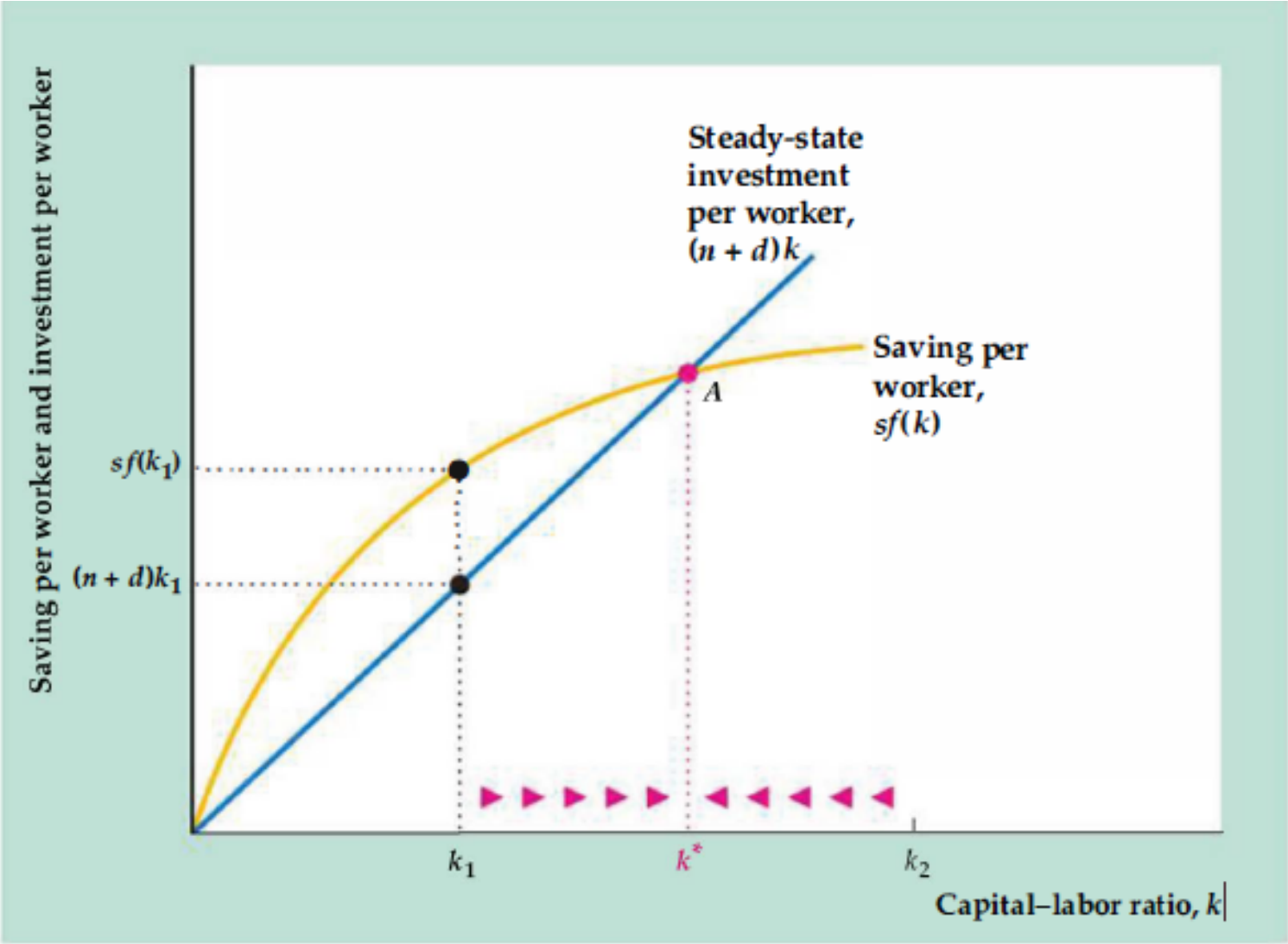
$$y = f(k) = Ak^{\alpha} \tag{12}$$

- Capital evolves, in per-worker terms:

$$\dot{k} = sf(k) - (n + d)k \tag{13}$$

where s is the savings rate, d is the depreciation rate, and n is the labor force growth rate.

Graph: Capital Accumulation in the Solow Model



Steady-State Capital and Consumption

- Consumption function in steady state:

$$c = f(k) - (n + d)k$$

- Equilibrium condition:

$$sf(k) = (n + d)k$$

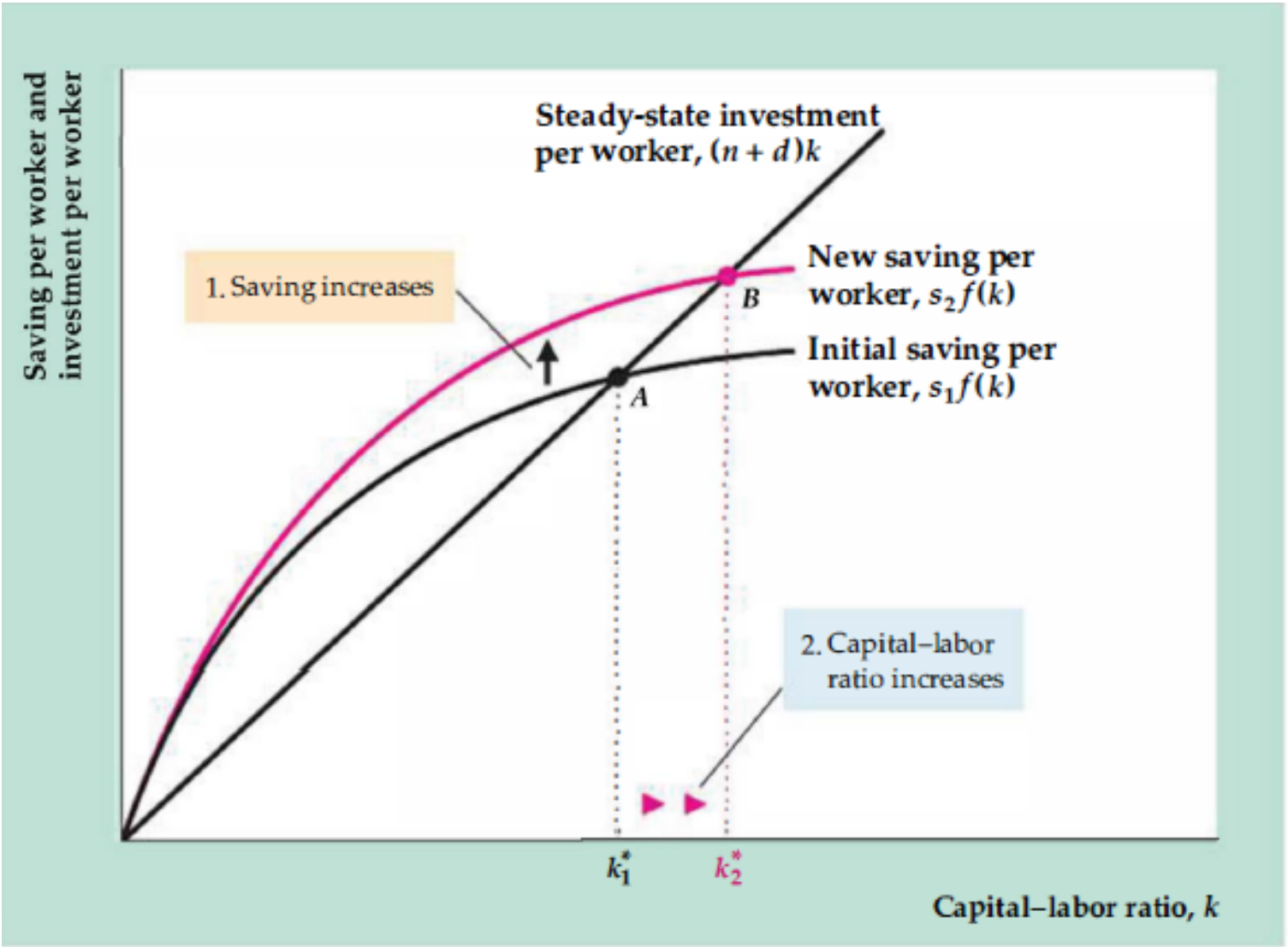
- The steady-state is where capital per worker remains constant ($\dot{k} = 0$):

$$sf(k^*) = (n + d)k^* \tag{14}$$

Effects of Parameter Changes

- Higher savings rate ($s \uparrow$) $\rightarrow$ *higher*k^*, y^*, c^*.
- Higher depreciation rate ($\delta \uparrow$) or population growth rate ($n \uparrow$) $\rightarrow$ *lower*k^*, y^*, c^*.
- Higher productivity ($A \uparrow$) $\rightarrow$ *higher*k^*, y^*, c^*.

Example 1: Higher Savings Rate



Example 2: Population Growth Increase