Long-Run Economic Growth

Economic Growth

A. It is the long-run upward trend in the economy. (i.e., growth in potential GDP)

B. Small differences in growth rates have large long-run effects.

1. Ex. Suppose that the current GDP per person (Y/AP) in both country A and country B is $100 per person in 2000. If country A is growing at 1% a year and country B is growing at 2%, then in 70 years Y/AP in country B ($400) will be twice as large as in country A ($200).

2. Growth accounting formula where Y/AP is the current GDP per person, $(Y/AP)_n$ is the GDP per person *n* years from now, and G is the annual growth rate (ex. G = 0.02).

$$(Y/AP)_n = (1 + G)^n \times (Y/AP). \tag{1}$$

3. Applying (1) to country A and country B:

a. Country A

$$(Y/AP)_{2070} = (1 + .01)^{70} \times (Y/AP)_{2000}.$$

$$(Y/AP)_{2070} = (1.01)^{70} \times 100.$$

$$(Y/AP)_{2070} = 2 \times 100.$$

$$(Y/AP)_{2070} = 200.$$

b. Country B

$$(Y/AP)_{2070} = (1 + .02)^{70} \times (Y/AP)_{2000}.$$

$$(Y/AP)_{2070} = (1.02)^{70} \times 100.$$

$$(Y/AP)_{2070} = 4 \times 100.$$

$$(Y/AP)_{2070} = 400.$$

The Determinants of Economic Growth

A. Labor (N)

1. <u>Labor input</u> is the total number of hours worked in the economy.

2. For the past forty-five years, the growth rate of labor has been strong due to the large number of baby boomers and women entering the labor force.

3. In the future, labor growth is expected to be weaker.

B. Capital (K)

1. This is the physical volume of plants, equipment, etc.

2. The amount of capital is the sum of all past investment less all depreciation.

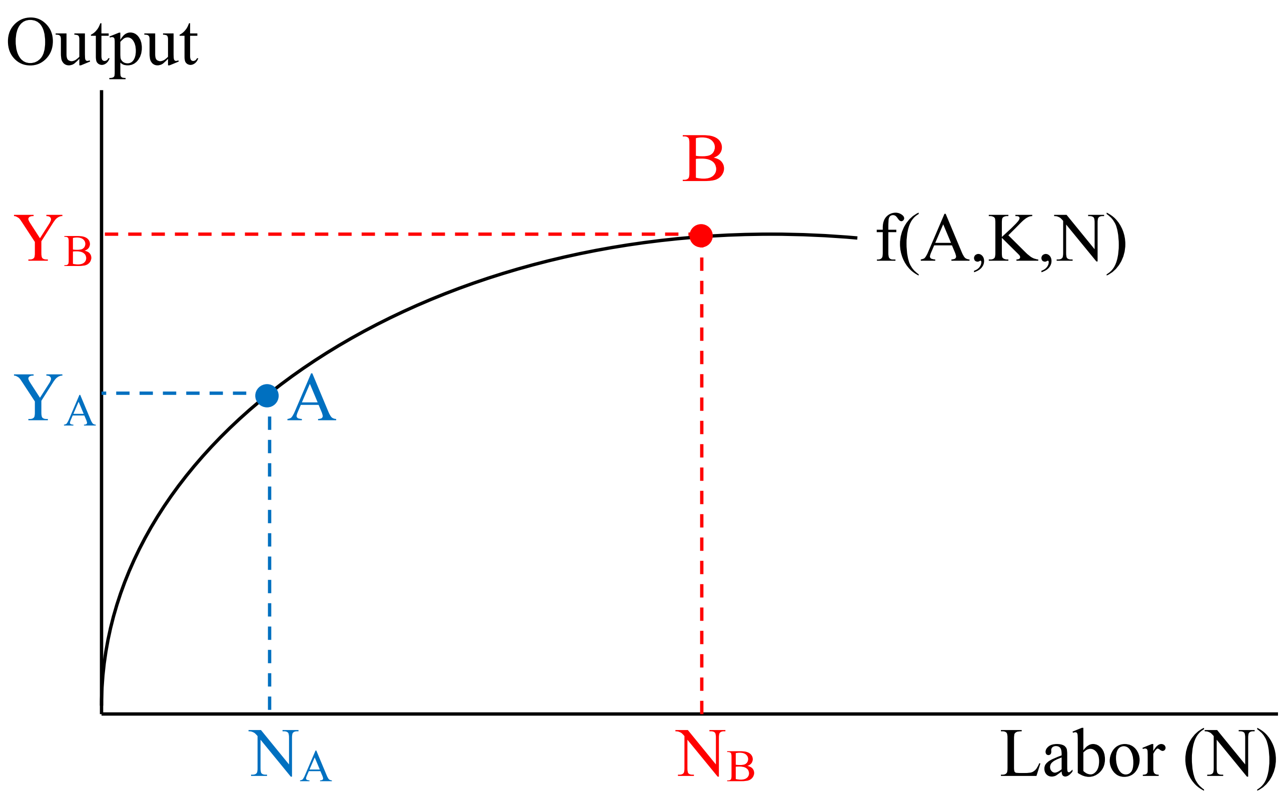
C. Technology (A) comprises anything that influences the productivity of labor and capital.

D. The production function (PF) represents how labor, capital, and technology combine to produce output.

1. Using symbols, the production function is stated as

$$Y = f(A,K,N).$$

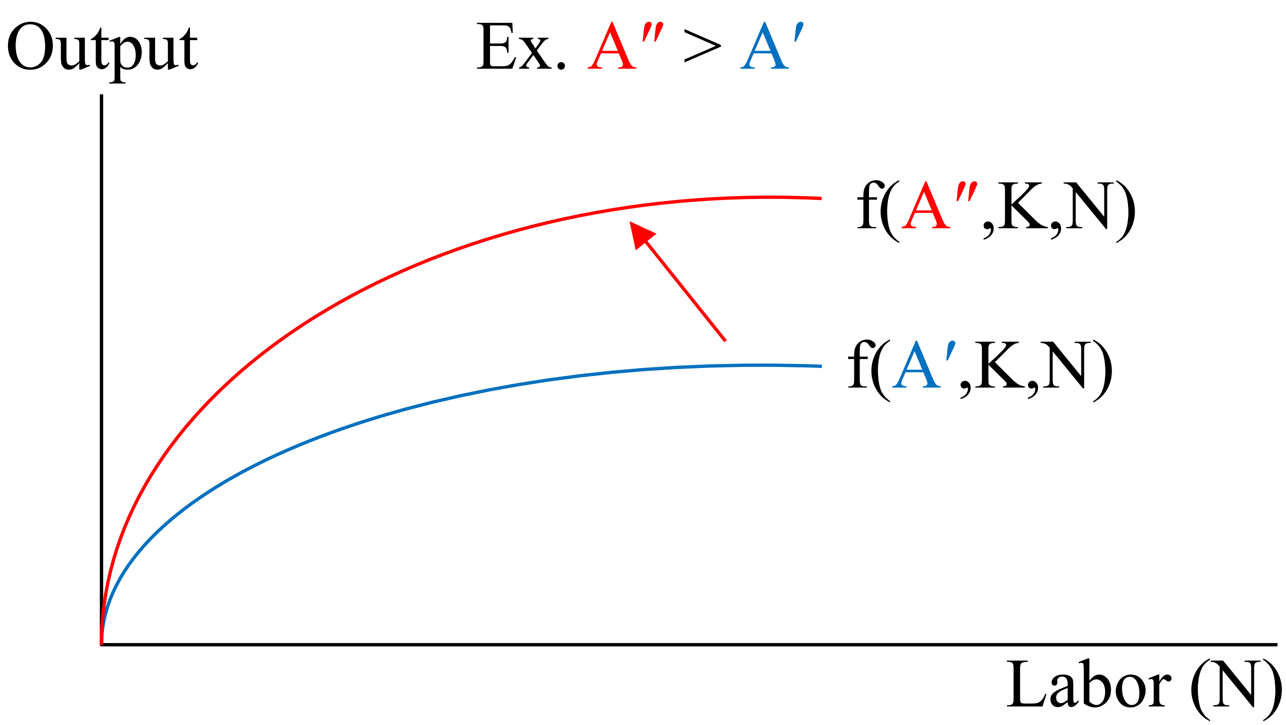
2. Graph of a production function



3. PF’s bowed shape is due to the law of diminishing returns.

4. Marginal product of labor (MP_L)
    a. It is the additional amount of output produced by working one additional hour.
    b. MP_L is the slope/derivative of the production function.
    c. When graphing the production function, Y = f(A,K,N), against N, we see that the $MP_L = (Y_B - Y_A)/(N_B - N_A)$
5. An increase in capital or technology rotates the PF upward.

Ex. $A'' > A'$



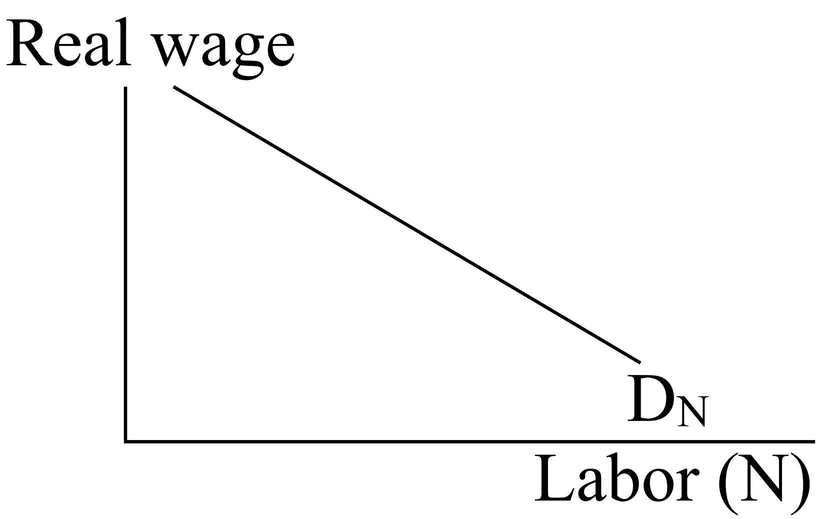
Full Employment and Potential Output

A. The Demand for Labor (D_N)

1. Firms choose a labor input (N_D) that maximizes their profit function, $P \times f(A,K,N_D) - W \times N_D$, where P is the price level and W is the real wage rate.

2. The optimal N_D is calculated by taking the derivative of the profit function with respect to N_D and setting it equal to zero, $P \times MP_L - W = 0$, which becomes $MP_L = W/P$. (see Figure 4.2)

3. The D_N curve is the MP_L for a range of values for N_D.



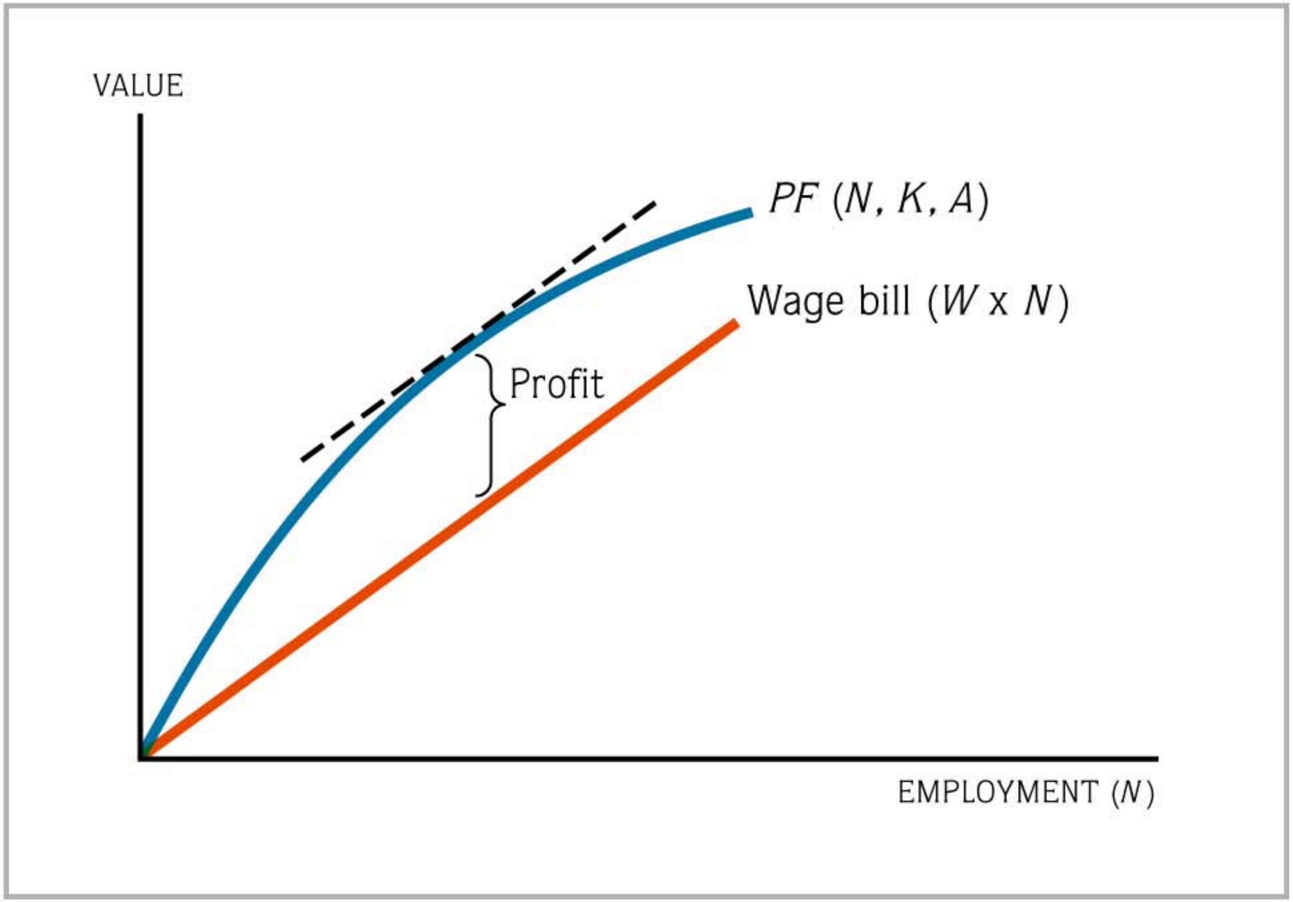


FIGURE 4.2 Profit Maximization

B. Supply of Labor (S_N)

1. Individuals determine how much they are willing to work (N_S) at the prevailing real wage (W/P).

2. A higher W/P has conflicting effects on N_S.

   a. The substitution effect says that an increase in W/P raises the opportunity cost of not working so N_S increases.

      <u>Substitution Effect</u>

      W/P↑→Opportunity cost of not working↑→N_S↑

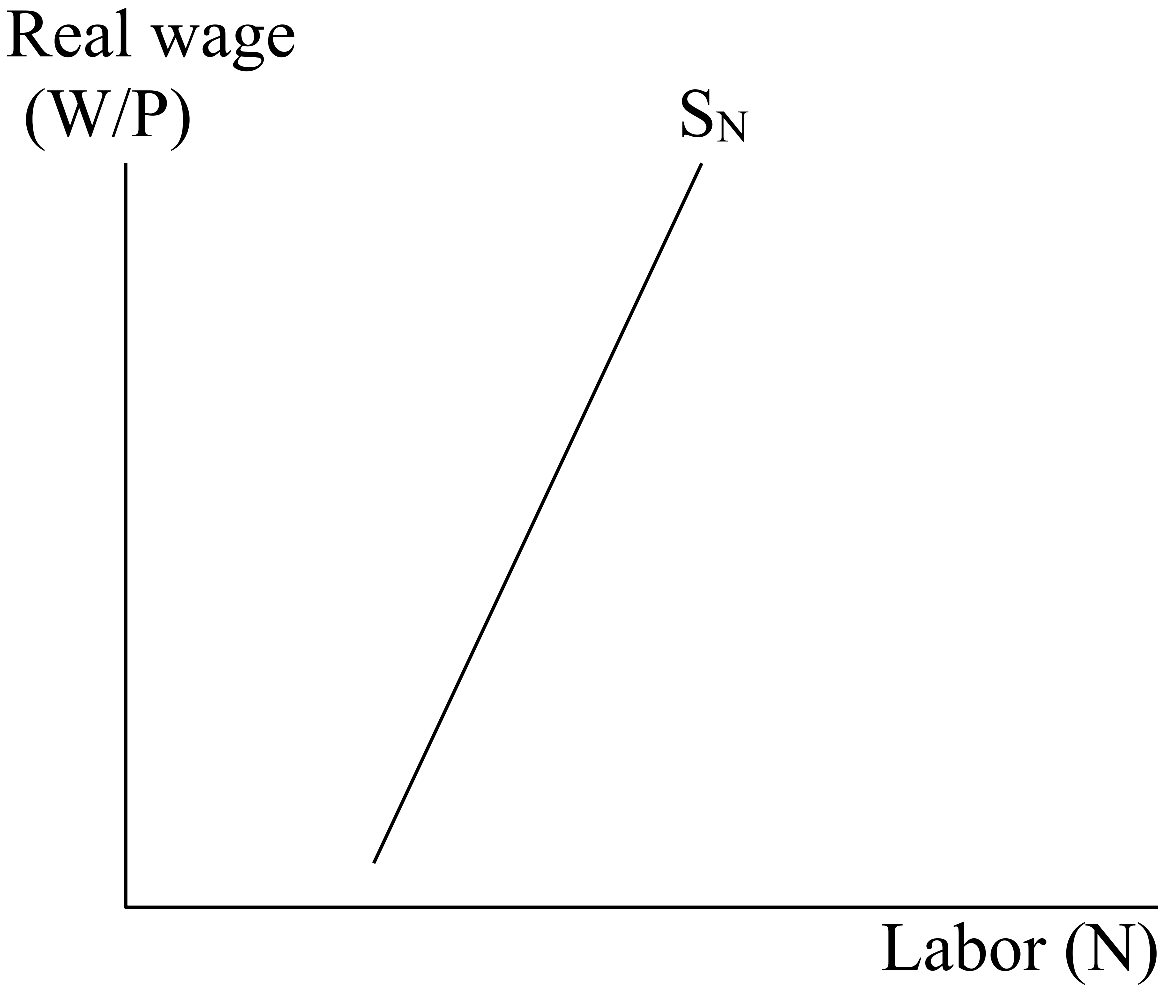
   b. The income effect says that an increase in W/P makes individuals richer (household income rises), so N_S falls.

      <u>Income Effect</u>

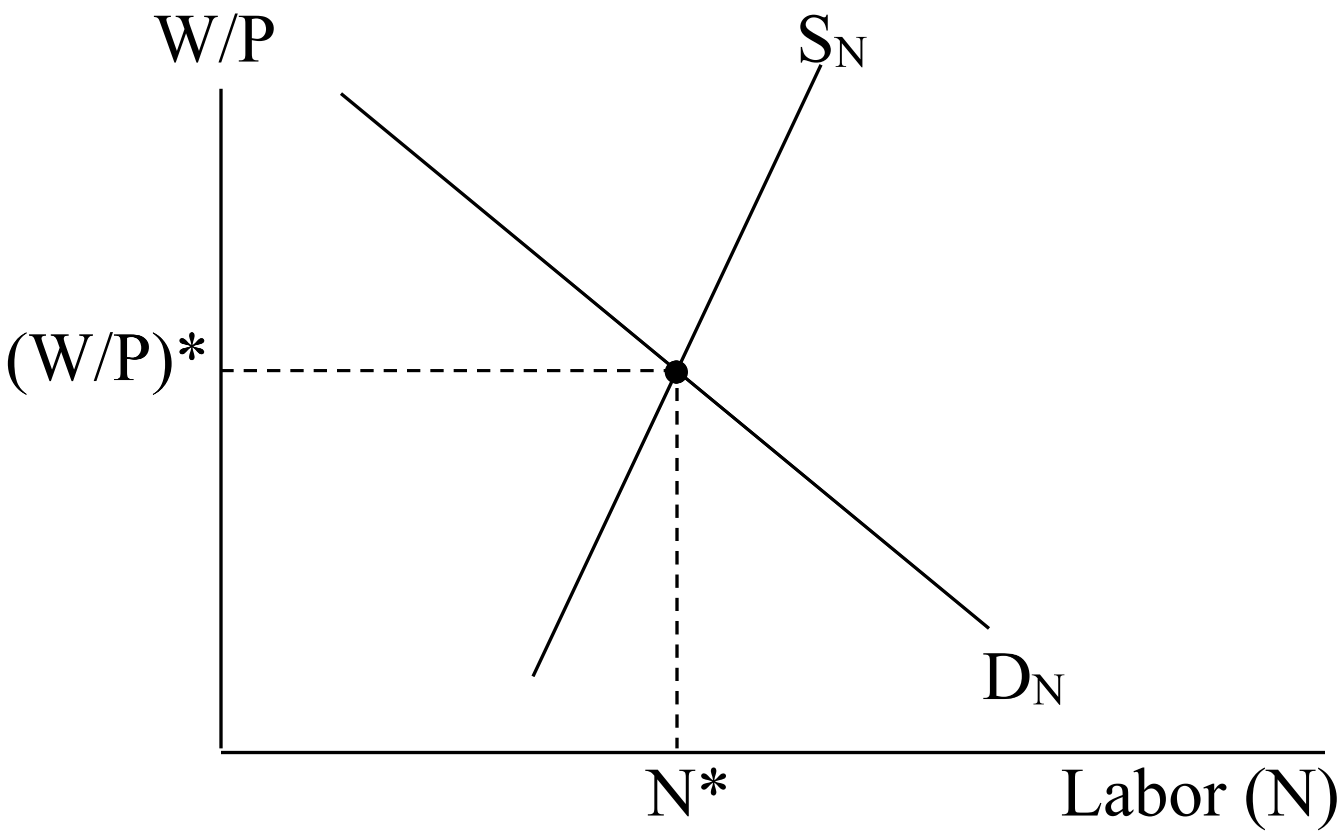
      W/P↑→Y↑→N_S↓

   c. The net effect is that the substitution effect slightly dominates the income effect so that a rise in W/P slightly increases N_S. [W/P↑→N_S↑]

3. Graph of the labor supply curve.



C. Labor market equilibrium occurs where $N_D = N_S$.



1. The level of employment where labor demand and labor supply intersect is called full employment (N*).

2. (W/P)* is the labor market clearing real wage rate.

D. Potential GDP (Y*)

1. Y* is the amount of output produced when the economy is at full employment:

$$Y^* = f(A,K,N^*).$$

2. Y* is also called the <u>full-employment level of output</u>.

E. The natural rate of unemployment (U*) is the unemployment rate at full employment.

F. Therefore, either

$$Y = Y^*,\ N = N^*,\ \text{and } U = U^*,\ \text{or}$$

$$Y \neq Y^*,\ N \neq N^*,\ \text{and } U \neq U^*.$$

The Solow Growth Model

A. Shows capital grows at the same rate as labor in the long run. (Balanced growth)

B. Assumptions

   1. Labor grows around n percent a year.
   2. Technology is constant.
   3. The economy is closed (i.e. no foreign sector).
   4. No depreciation.

C. Savings and balanced growth

1. Set the production function to be

$$Y = A \times K^{1/3} \times N^{2/3}.$$

2. Divide the production function by N to get output per worker (Y/N):

$$Y/N = A \times (K/N)^{1/3}.$$

3. Thus, Y/N depends on K/N since A is constant.

4. Balanced growth investment, $I = n \times K$.

5. Savings = $s \times Y$, where s is the savings rate.

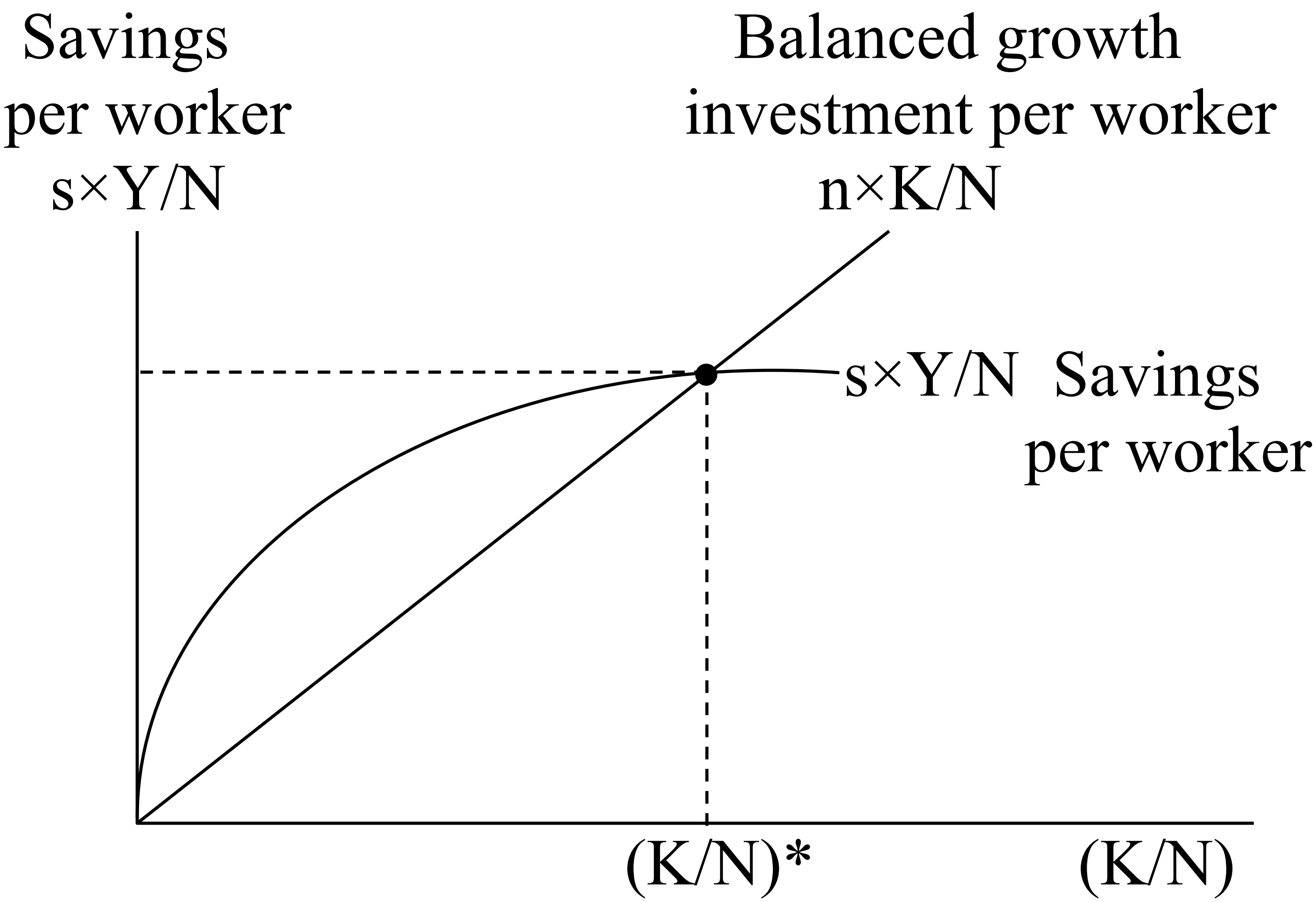
6. On the balanced growth path, savings (or actual investment) equals balanced growth investment

$$n \times K = s \times Y. \tag{2}$$

7. Divide (2) by N to get balanced growth investment per worker ($n \times K/N$) equal to savings per worker ($s \times Y/N$),

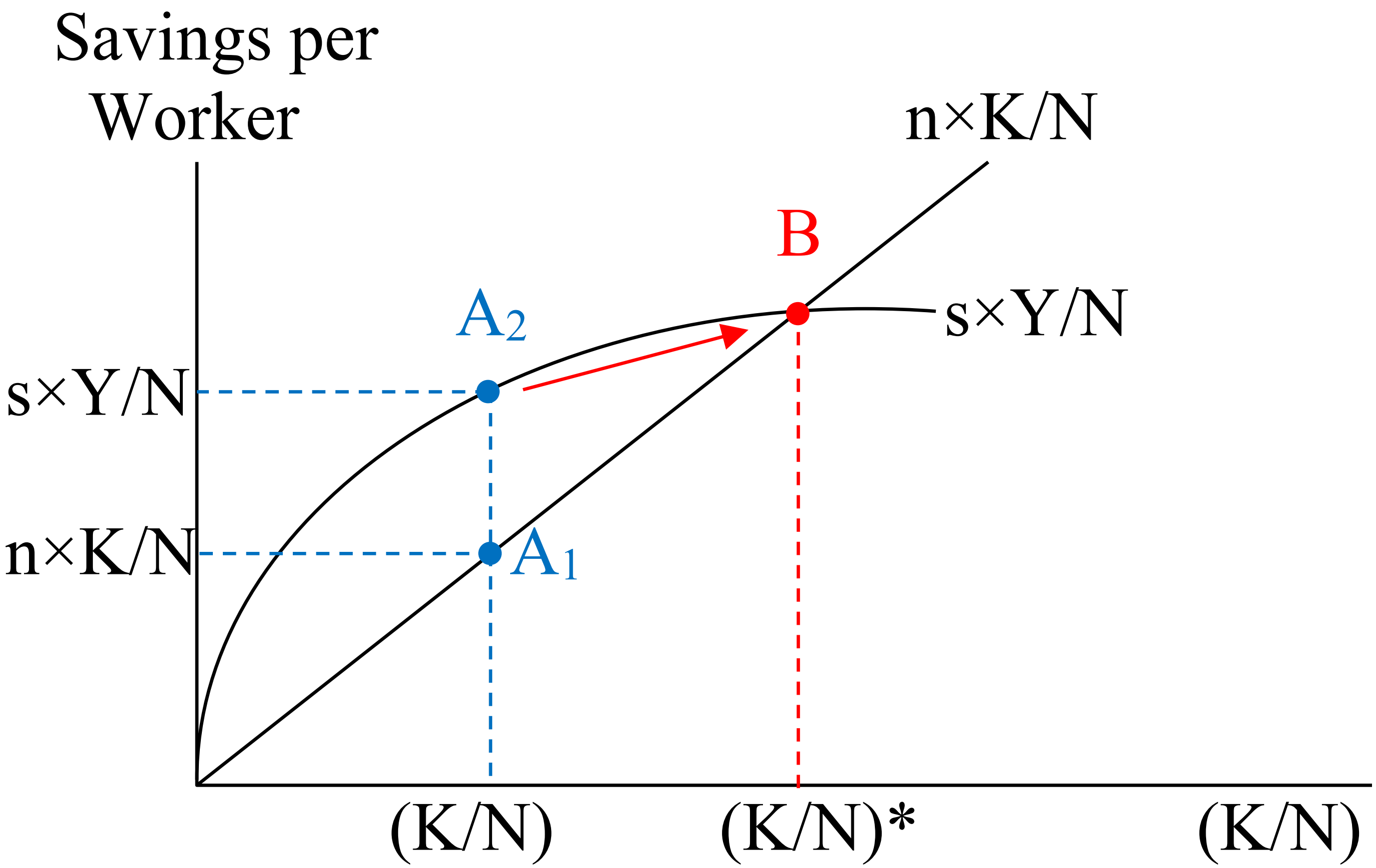
$$n \times K/N = s \times Y/N,$$

8. Graph of the steady state level of capital per worker $(K/N)^*$ given f(A,K,N) and s.

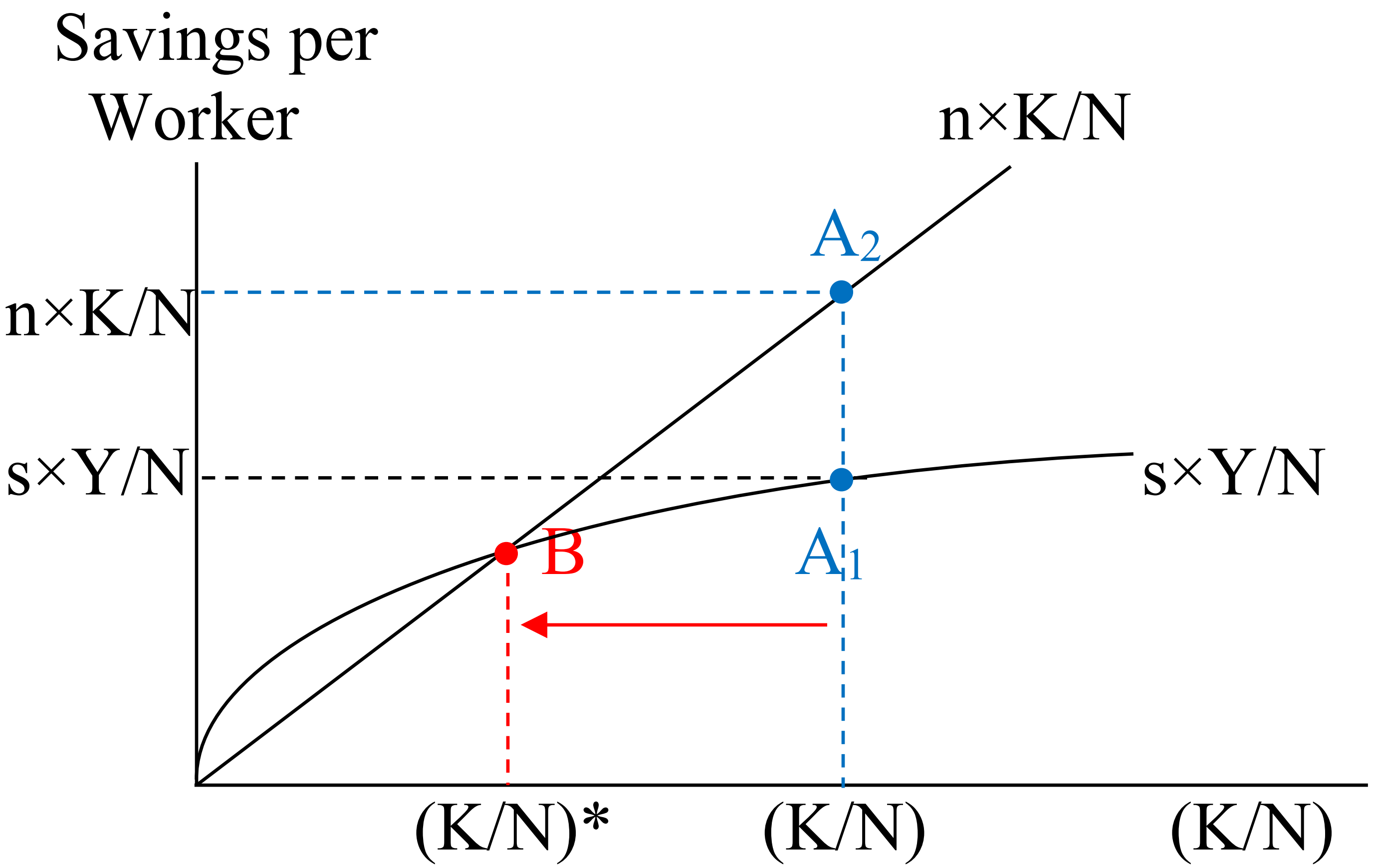


a. When $s \times Y/N = n \times K/N$, savings is just enough to keep K/N at $(K/N)^*$.

b. When $s \times Y/N > n \times K/N$ ($A_2 > A_1$), K/N increases each year until $s \times Y/N = n \times K/N$.



c. When $s \times Y/N < n \times K/N$ ($A_1 < A_2$), K/N decreases each year until $s \times Y/N = n \times K/N$.

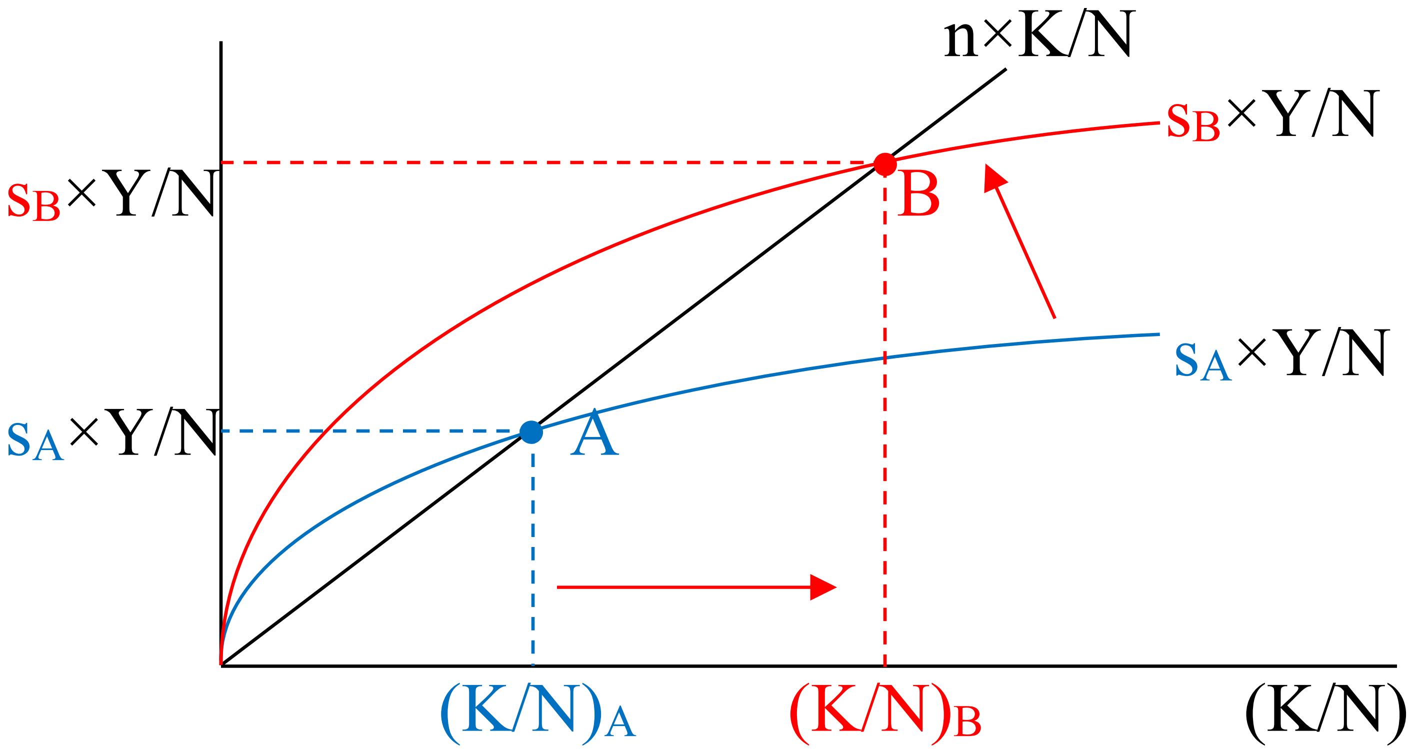


d. Thus, the growth rate of capital converges over time to the growth rate of labor (n).

D. The effect of savings on growth

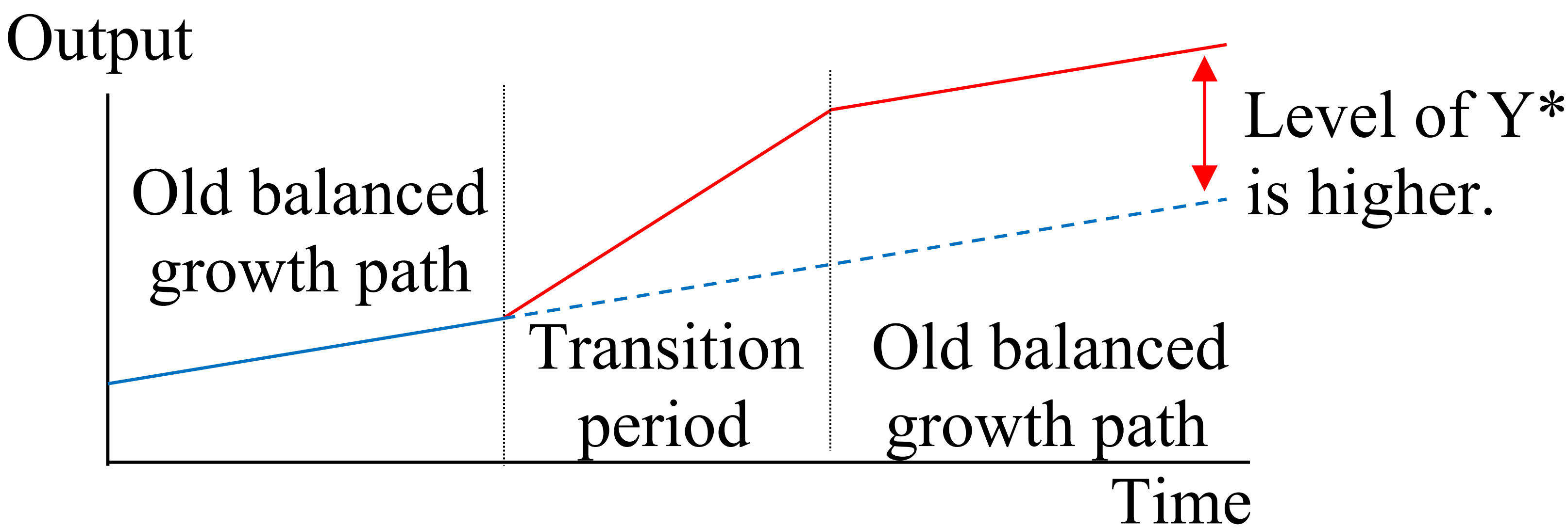
1. Suppose s rises permanently from s_A to s_B when capital is on its balanced growth path: $s_A \times Y/N = n \times (K/N)_A$.

2. This leads to $s_B \times Y/N > n \times (K/N)_A$, which causes the capital growth rate to rise temporarily until $s_B \times Y/N = n \times (K/N)_B$.



3. The temporary increase in capital growth leads to a temporary rise in output growth.

4. Once capital growth returns to the balanced growth path, the growth rate of potential output (slope of the line) returns to its old path, but the level of potential output is permanently higher.



5. The result is that an increase in the savings rate <u>temporarily</u> raises the output growth rate, but this increase in output growth is NOT permanent.