Technology and Economic Growth

Growth Accounting Formula

A. $\%\Delta Y = \%\Delta A + (2/3)\times\%\Delta N + (1/3)\times\%\Delta K$

B. Example: Suppose labor, capital, and technology each grow at 1% per year.

$$\%\Delta Y = 1 + (2/3)\times 1 + (1/3)\times 1$$

$$\%\Delta Y = 2$$

C. Growth accounting in the U.S. since the 1960s (see Figure 5.1)

1. The growth rate of output slowed from around 4% a year in the 1960s to about 3% a year in the 1970s.
2. The growth rate of output partially recovered to around 3.5% in the 1980s and 1990s.
3. The labor force growth rate has slowly declined.

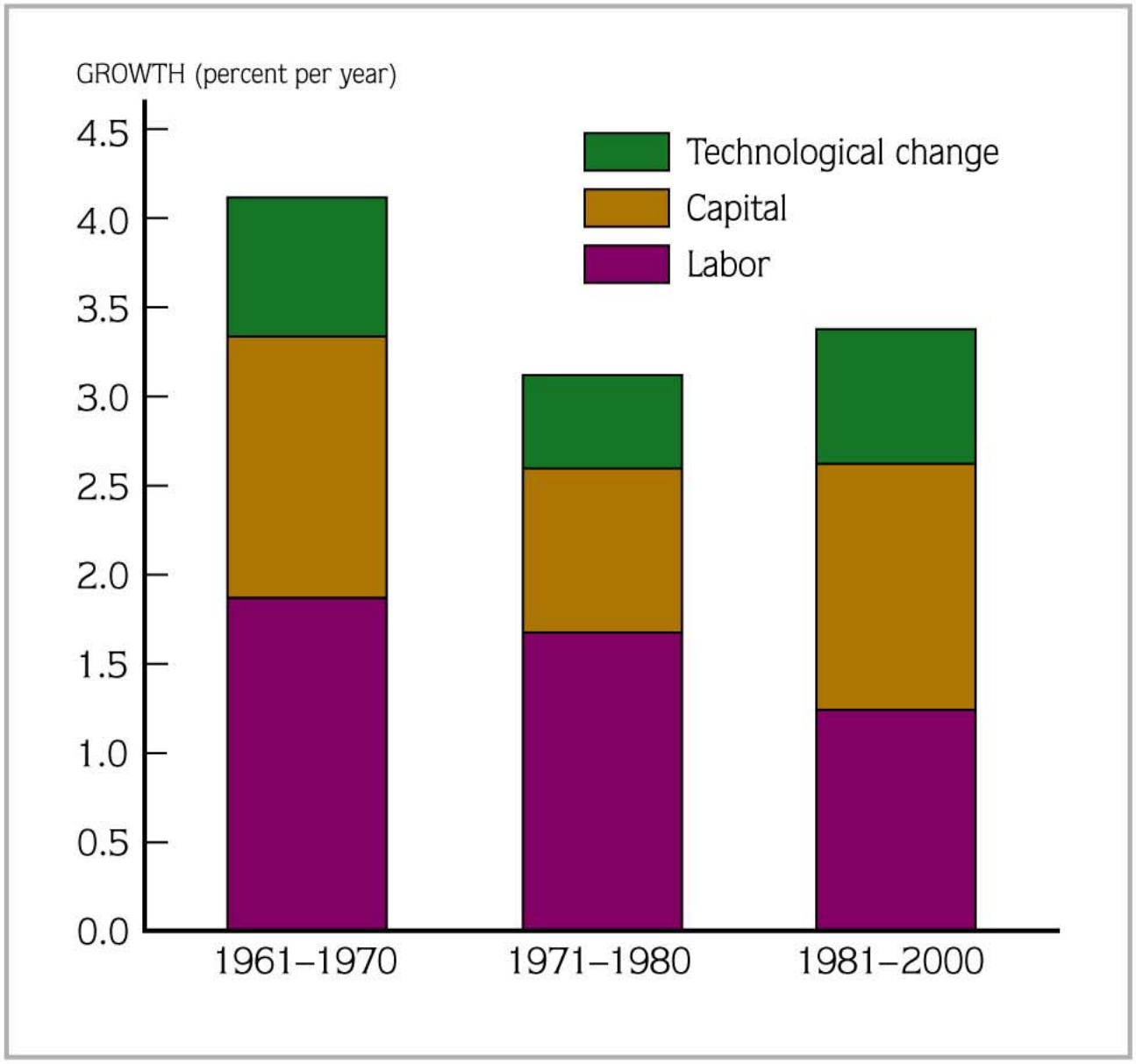


FIGURE 5.1 Sources of Growth

Macroeconomics, 6th Edition

4. Capital and technology growth fell in the 1970s but rose in the 1980s and 1990s.

Endogenous Growth Model

A. This model assumes that economies allocate their capital (K) and labor (N) between the production of goods and services and the production of technology.

   1. The more resources allocated toward the current production of goods and services, the more immediate utility people will receive.

   2. The more resources allocated toward current technology production, the more the economy will produce in the future.

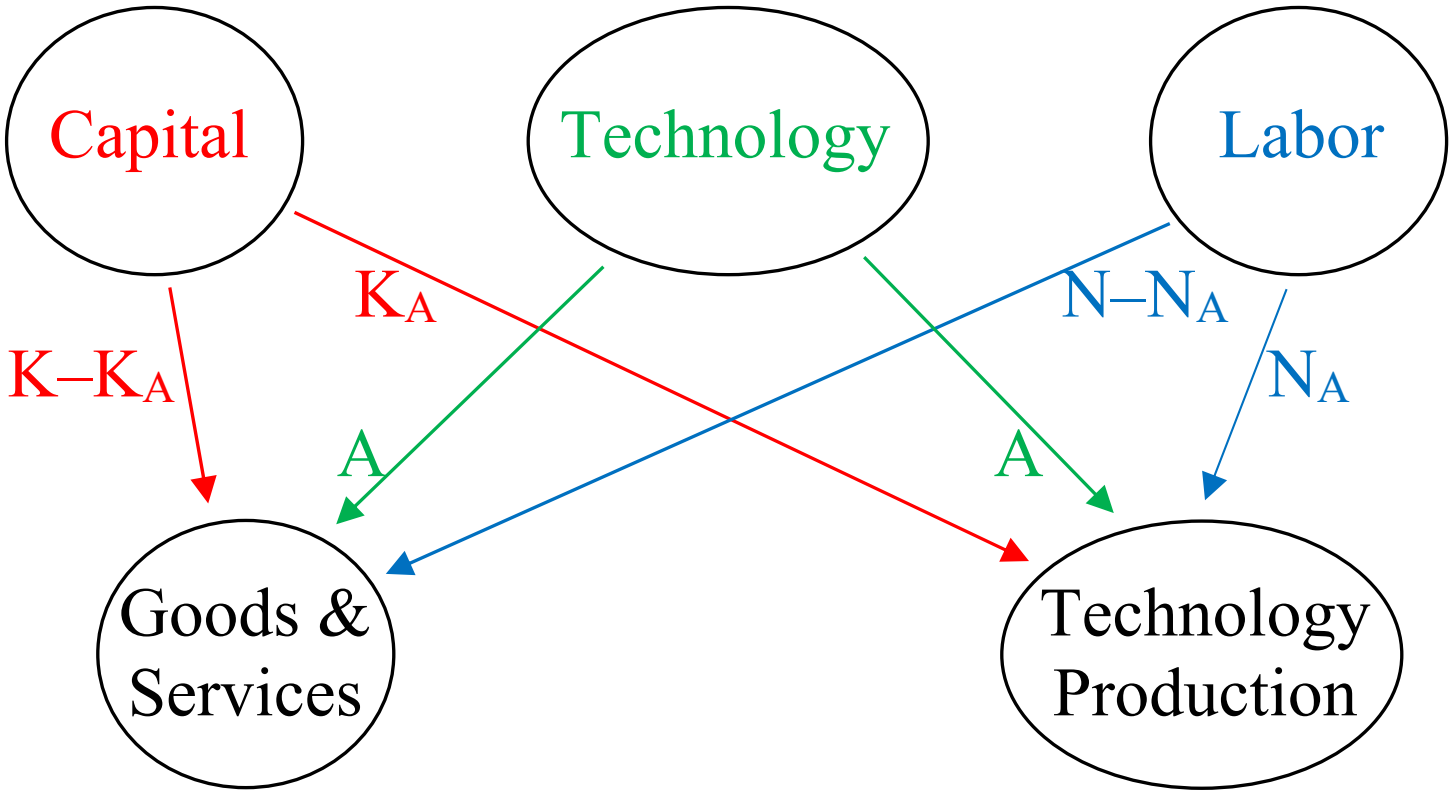
B. The amount of technology production (i.e., the level of technology growth) depends on the amount of capital (K_A) and labor (N_A) devoted to research and development (R&D), and the current state of technology (A).

C. The production function for technology is

$$\Delta A = T(A, K_A, N_A)$$

D. Note the production of technology (A) contributes to ΔA due to spillover effects.

E. Figure



E. Increasing the long-run growth rate of output

1. Suppose the technology production function is

$$\Delta A = c \times A \times K_A^{1/3} \times N_A^{1/2}$$

where c is a constant coefficient.

2. This implies that $\%\Delta A = c \times K_A^{1/3} \times N_A^{1/2}$,

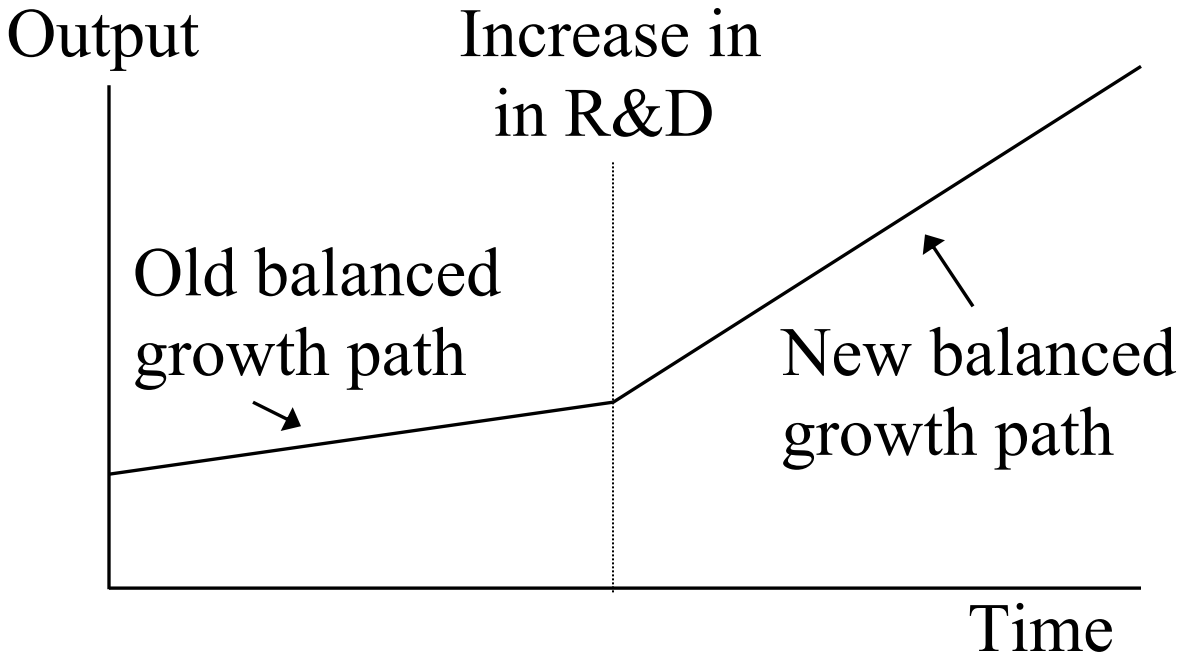
where $\%\Delta A = \Delta A / A$.

3. If K_A and/or N_A increase <u>permanently</u> (i.e. R&D spending rises), $\%\Delta A$ will rise <u>permanently</u>, which will lead to a higher <u>permanent</u> growth rate in output.
[$K_A\uparrow$ and/or $N_A\uparrow \rightarrow \%\Delta A\uparrow \rightarrow \%\Delta Y\uparrow$]

4. Recall, the technology production function and the growth accounting equation

$$\%\Delta A = c \times K_A^{1/3} \times N_A^{1/2}$$

$$\%\Delta Y = \%\Delta A + (2/3) \times \%\Delta N + (1/3) \times \%\Delta K$$



Policies to Raise the Growth Rate of Output

A. Policies to improve technology growth (i.e., raise productivity)
    1. Increase education funding.
    2. Increase public sector R&D spending (see Figure 5.4).
    3. Provide tax incentives for private sector R&D.
B. Policies to stimulate capital formulation
    1. Until recently, governmental policy focused on capital formation to promote economic growth.
    2. Ex. investment tax credits and accelerated depreciation.
    3. The problem with this approach is that large investment increases are needed to get modest output increases. (ex. a 34% increase in investment is needed to increase output 1%)
    4. Another problem is that large investment increases are unsustainable for the long term.

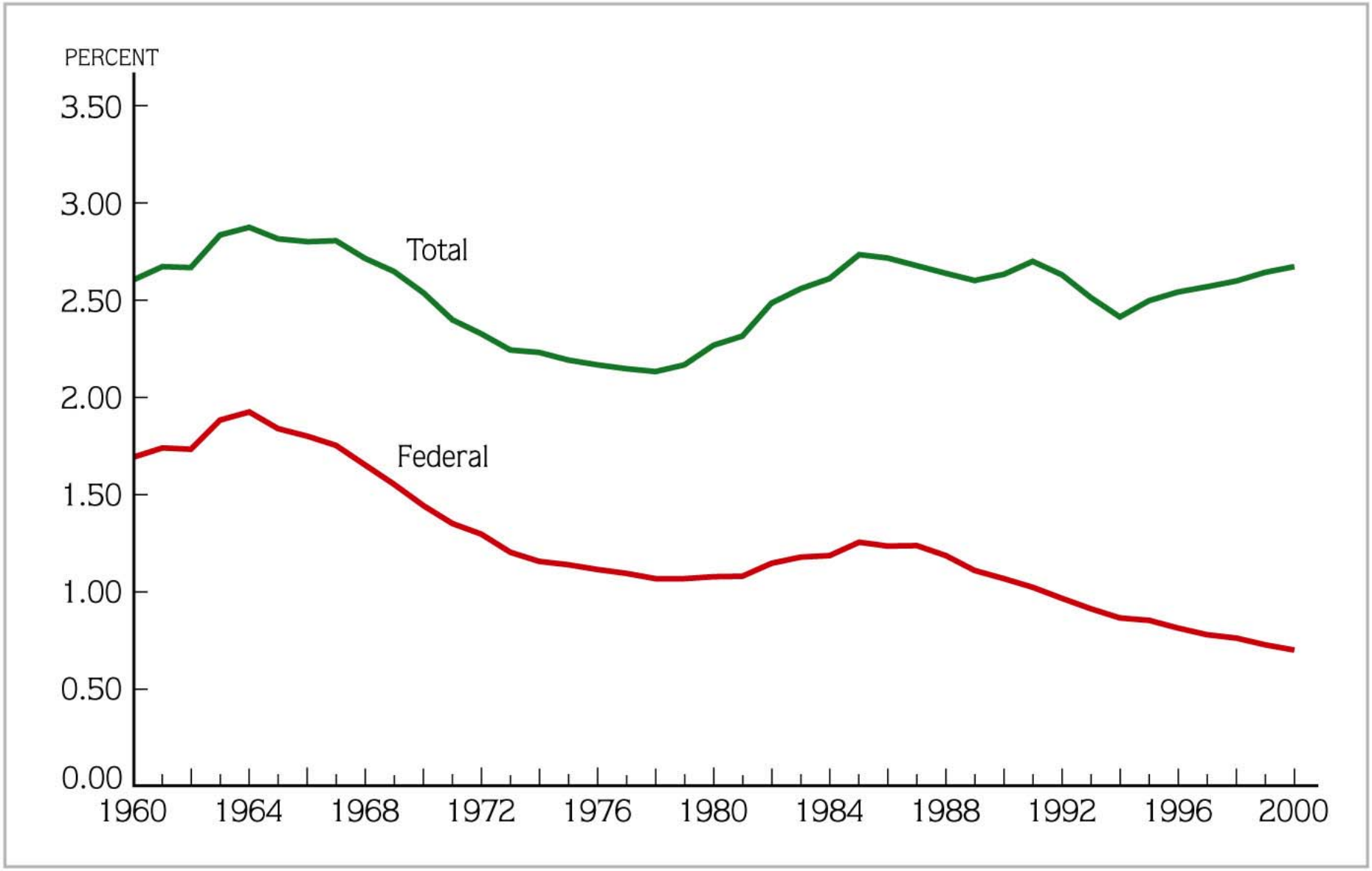


FIGURE 5.4 Federal Spending for R&D as a Fraction of GDP

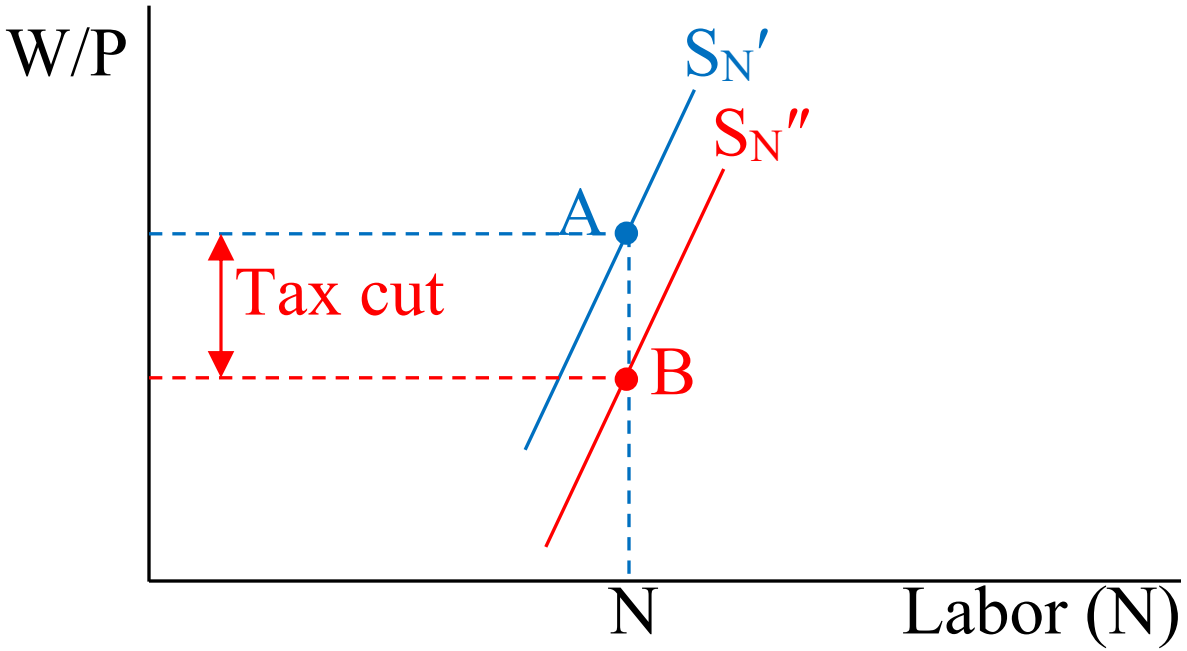
C. Policies to increase the labor supply (S_N)

1. Reduce marginal income tax rates

   a. This policy action eases the disincentives that the income tax has on labor supply, but it also raises people's income.

   b. The result is a slight rise in S_N because the substitution effect raises S_N, but the income effect reduces S_N.

   c. A tax cut shifts the S_N curve down from S_N' to S_N'' by the size of the tax cut.



2. Enact tax reform

   a. This policy action reduces marginal income tax rates but keeps people's income and the government's tax revenue constant by reducing deductions people can take.

   b. The result is a larger increase in S_N than from a simple reduction in marginal income tax rates because the substitution effect raises S_N while there is no income effect on S_N.

   c. Thus, a government should enact tax reform in place of a reduction in marginal tax rates if their objective is to encourage additional labor supply and improve economic growth.

The Neoclassical Growth Revival

A. Sustained technological progress is the key to economic growth in both the Solow and the Endogenous growth models.

B. In the Solow model, the source of technological progress is unexplained.

C. In the Endogenous growth model, technological progress is generated by allocating labor and capital to the production of technology.

D. Evidence from the U.S. suggests that growth rates are consistent with the constant projections of the Solow model. One concern with this finding is that long lags between technology production and higher output growth may not be easily observed in the data.

E. Increases in capital and labor have not produced a large increase in U.S. economic growth.

Labor Productivity and Real Wages

A. Labor productivity is output produced per hour of labor.

B. Labor productivity growth slowed down in the early 1970s but recovered in the mid-1990s to its 1960s' rate. (see Figure 5.8).

C. The labor productivity slowdown and recovery has caused similar pattern in real wage growth. (recall, $MP_L = W/P$) (see Figure 5.7)

D. Potential reasons for the productivity slowdown

   1. The overall labor force quality seems to have worsened, which would decrease labor productivity.
   2. High budget deficits drained the resources available for capital investment.
   3. A reduction in R&D spending slowed technology growth.
   4. Output shifted from the more productive manufacturing sector to the less productive service sector.

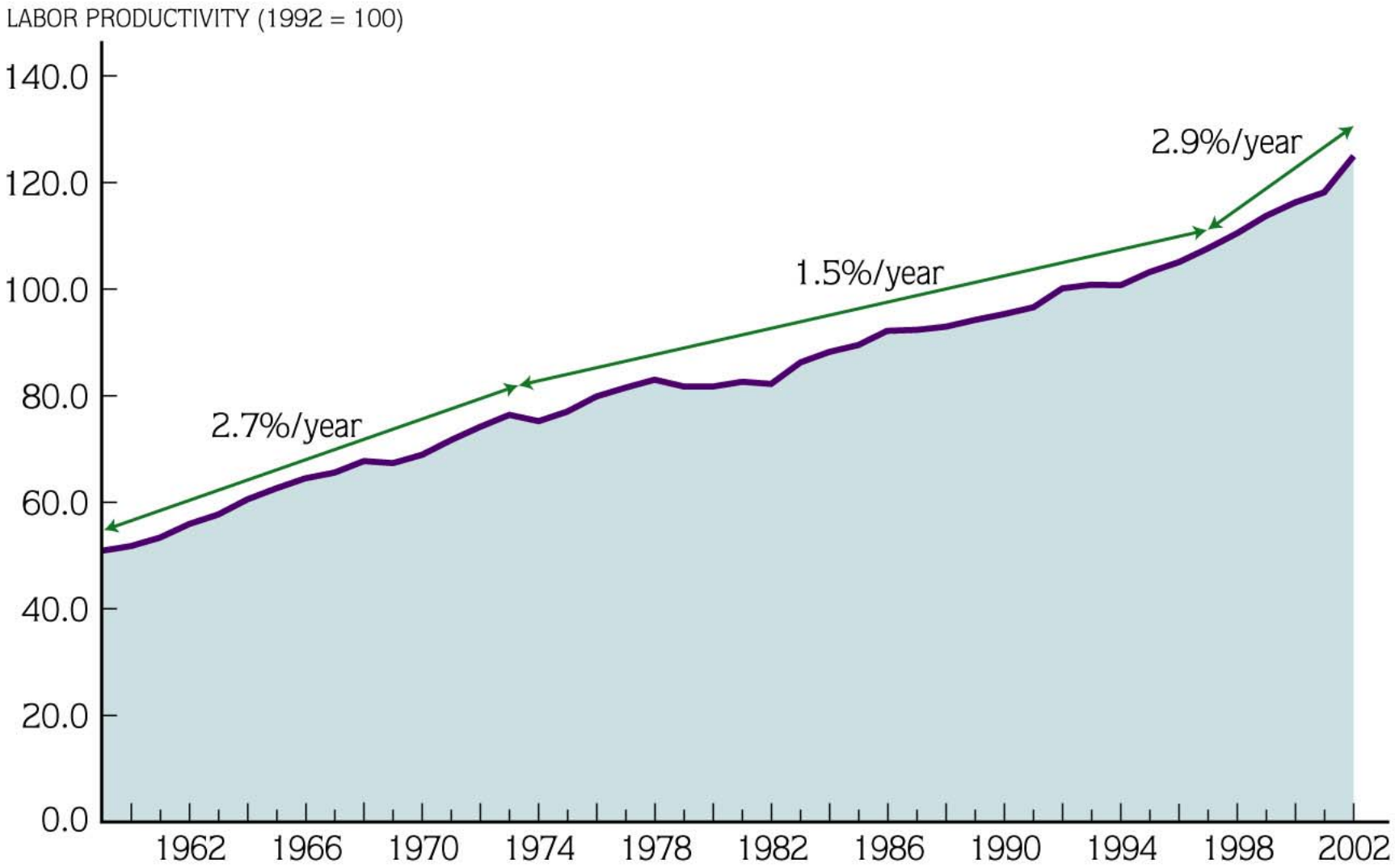


FIGURE 5.8 The Slowdown and Recovery in Labor Productivity Growth

Macroeconomics, 6th Edition

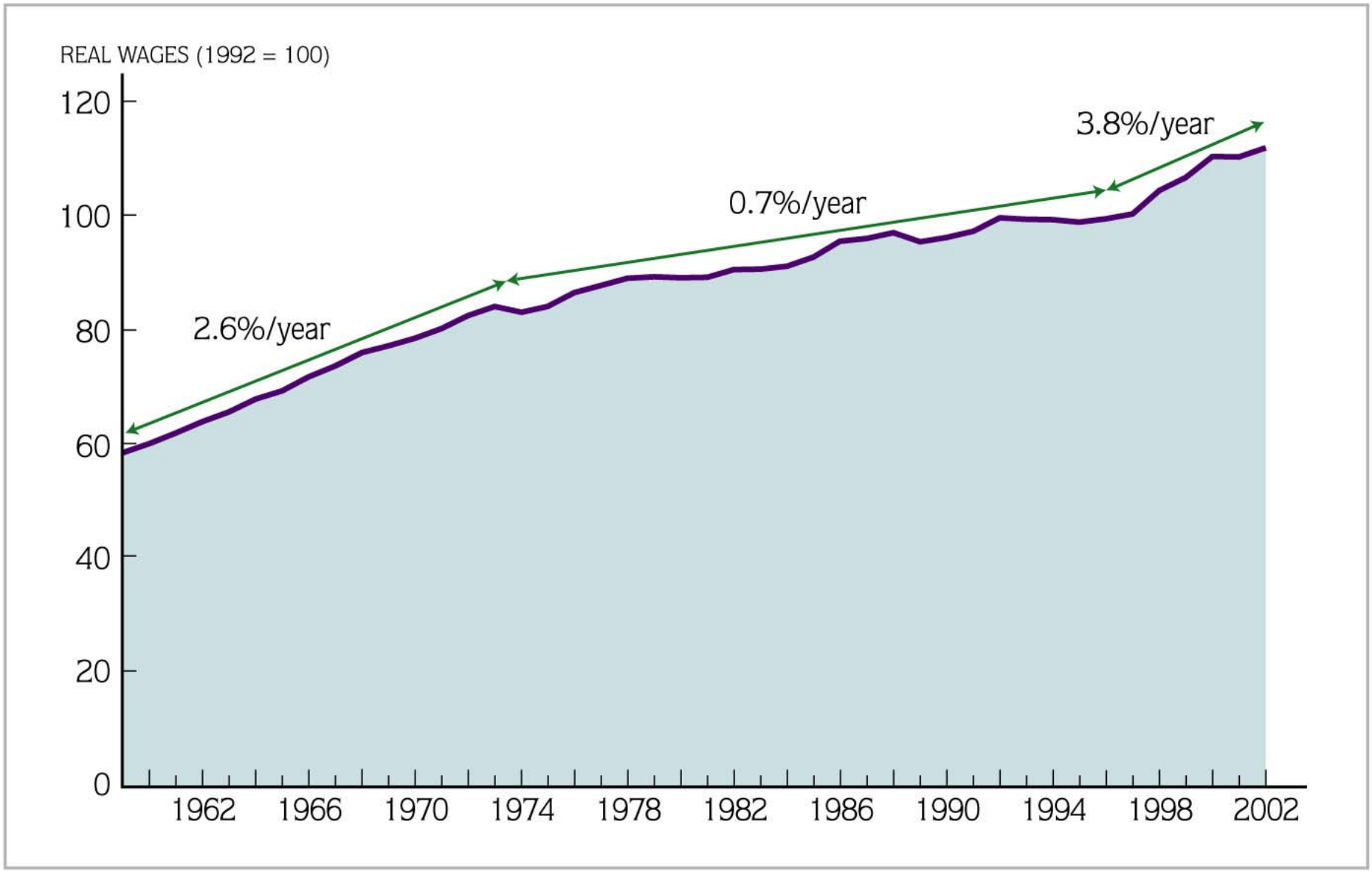


FIGURE 5.7 The Slowdown and Recovery in Real Wage Growth

Productivity and the New Economy

A. The mid 1990s productivity recovery coincided with the birth of the "new economy."

B. Labor productivity growth can be divided into

   1. Improvements in labor force quality.
   2. Growth in capital per hour of labor. (Information technology and other capital)
   3. Technological progress or total factor productivity.

C. Labor productivity growth was around 1.5% from 1973-1995 but increased to around 3.0% from 1996-2000. (see Figure 5.9)

D. Increases in information technology capital are responsible for about 1/3 of rise in labor productivity growth.

E. Technology increases are responsible for 2/3 of the rise in labor productivity growth.

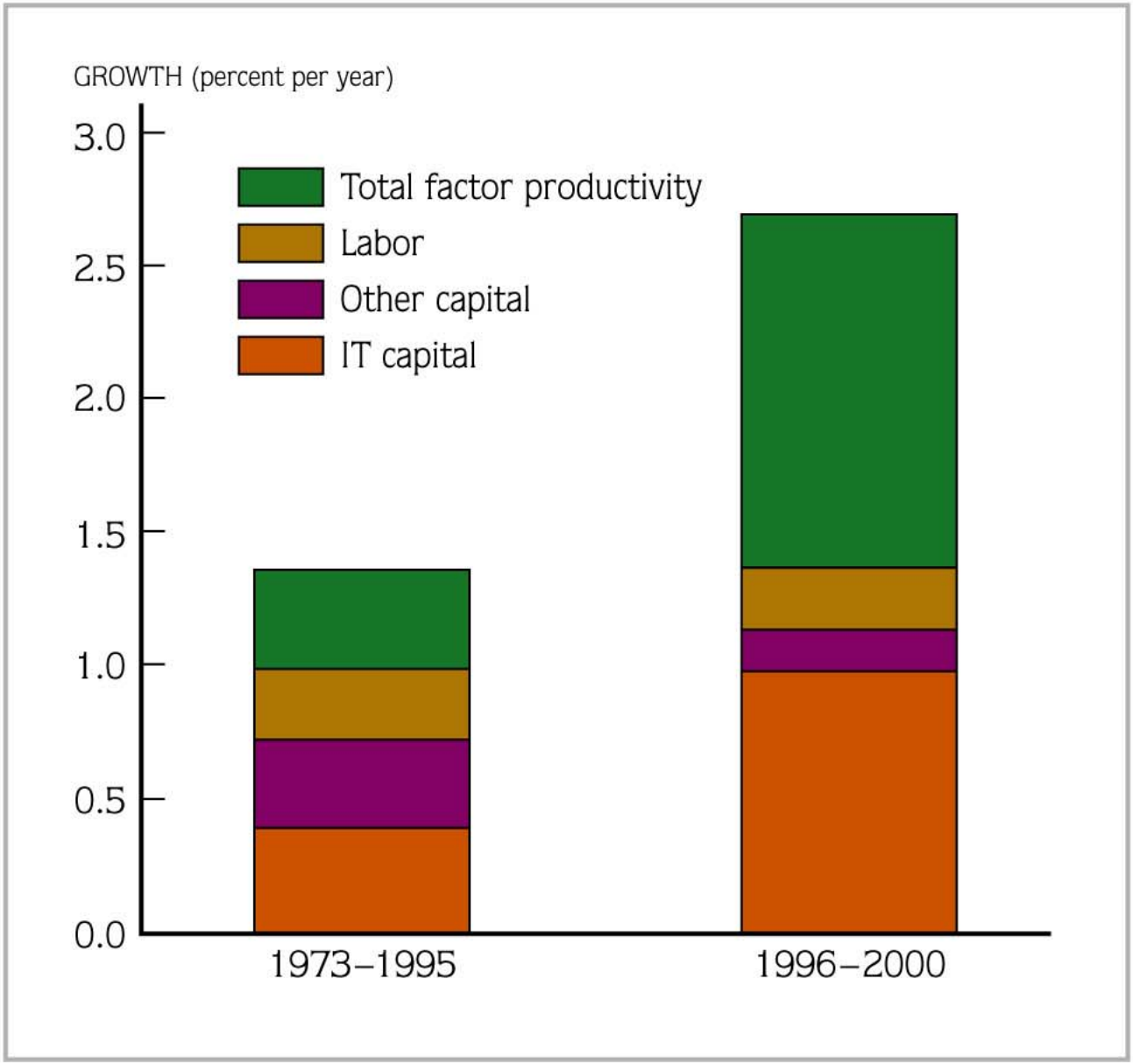


FIGURE 5.9 Productivity Growth in the 1990s