Growth Accounting

Growth accounting is an explanation of economic growth.

What is the contribution of labor growth to economic growth? What is the contribution of capital accumulation to economic growth? What is the contribution of technical change to economic growth?

Growth accounting measures each contribution.

Solow Residual Measure of Technical Change

Solow [1] puts forward an approach to growth accounting based on microeconomic theory.

One first measures the contribution of labor growth and the contribution of capital accumulation to economic growth.

The contribution of technological progress is then measured by the residual—the economic growth not explained by labor or capital.

The Effect of Labor Growth on Output

With other things held constant, output (national product) Y grows by the marginal product of labor MP_L times labor growth ΔL:

$$\Delta Y = MP_L \Delta L. \tag{1}$$

In market equilibrium with profit maximization, the marginal product of labor is the real wage,

$$MP_L = w. \tag{2}$$

Growth Rates

Equivalently, we can express (1) in terms of growth rates.

Dividing (1) by Y gives

$$\begin{aligned} \frac{\Delta Y}{Y} &= \frac{MP_L \Delta L}{Y} \\ &= \frac{w \Delta L}{Y} \text{ by (2)} \\ &= \frac{wL}{Y} \frac{\Delta L}{L}. \end{aligned}$$

Here wL is the real income of labor, the real wage times labor. Since national income equals national product, Y is also the national income. Hence

$$\frac{wL}{Y}$$

is the labor share of national income.

In words,

$$\text{output growth rate} = \text{labor share} \times \text{labor growth rate}.$$

The right-hand side is the contribution of labor to output growth.

A reasonable value for the labor share is $\frac{3}{4}$. So for labor to grow 2% raises output by $1\frac{1}{2}$%.

The Effect of Capital Growth on Output

Exactly the same reasoning applies for capital.

With other things held constant, output (national product) Y grows by the marginal product of capital MP_K times capital growth ΔK:

$$\Delta Y = MP_K \Delta K.$$

In market equilibrium with profit maximization, the marginal product of capital is the real interest rate,

$$MP_K = r.$$

Growth Rates

Equivalently, we can express the output growth from capital growth in terms of growth rates:

$$\frac{\Delta Y}{Y} = \frac{rK}{Y}\frac{\Delta K}{K}.$$

Here rK/Y is the capital share of national income. In words,

$$\text{output growth rate} = \text{capital share} \times \text{capital growth rate},$$

the contribution of capital to output growth.

If all inputs are classified as either labor or capital, then the labor share plus the capital share must add to one.

As a reasonable value for the labor share is $\frac{3}{4}$ a reasonable value for the capital share is $\frac{1}{4}$. So for capital to grow 4% raises output by 1%.

Solow Residual Measure of Technical Change

The contribution of input growth to output growth is the sum of the contributions of the different inputs.

Solow's residual measure of technical change [1] is the unexplained rate of output growth: the growth rate of output less the contribution from the inputs.

Consider the numerical illustrations above. If the contribution of labor to the output growth rate is $1\frac{1}{2}\%$ and if the contribution of capital to the output growth rate is 1%, then the total contribution of input growth to output growth is $2\frac{1}{2}\%$.

If the output growth rate is 6%, then the residual is

$$6\% - 2\frac{1}{2}\% = 3\frac{1}{2}\%.$$

Solow's interpretation is that technological change has raised output growth by $3\frac{1}{2}\%$.

Using economic data, Solow finds that technical change is a key determinant of economic growth, especially for the growth of real national income and product *per capita*.

References

[1] Robert M. Solow. Technical change and the aggregate production function. *Review of Economics and Statistics*, 39:312–320, August 1957.