Growth Accounting

Gallina Vincelette (PRMED)
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JVI, Vienna
Objectives of Growth Accounting

• The objective of growth accounting is to decompose the economic growth rate of a country into contributions from different factors: capital, labor, and productivity

• Growth accounting is an empirical tool and specific assumptions need to be made to provide a framework for interpretation of economic data

• In the most basic version, an aggregate production function serves as a framework
The Production Function

• Neoclassical production function output at time $t$, $Y_t$, is a function of the economy’s capital stock, $K_t$, its labor force, $L_t$, and the economy’s total factor productivity, $A_t$

• In a Cobb-Douglas specification this is:

$$Y_t = A_t \times K_t^\alpha \times L_t^{1-\alpha}$$

with $\alpha$ being the capital share of income

By assumption, output changes can only be caused by changes in the capital stock, the labor force, or changes in total factor productivity
Growth Accounting at Work

- Taking logarithms and differentiating, rewrite the Cobb-Douglas function as:

\[ \ln Y_t - \ln Y_{t-1} = \ln A_t - \ln A_{t-1} + \alpha (\ln K_t - \ln K_{t-1}) + (1 - \alpha) (\ln L_t - \ln L_{t-1}) \]

\[ \text{GDPgrowth} = \text{TFPgrowth} + S_K \times \text{Capgrowth} + (1 - S_K) \times \text{Laborgrowth} \]

- Real value added growth
- Estimated as residual
- Capital share of income
- Capital stock growth
- Labor share of income
- Labor force growth
Changes in Capital

• Consider the effect on output of a change in the capital stock from its current value $K_t$ to a value $(K_t + \Delta K)$—an increase in the capital stock by a proportional amount $\Delta K/K_t$.

• The proportional increase in output from this change in the capital stock is:

$$\frac{\Delta Y}{Y_t} = \alpha \frac{\Delta K}{K_t}$$

• E.g. assume $\alpha = 0.5$ and proportional change in the capital stock of 3%, then the proportional change in output would be:

$$\frac{\Delta Y}{Y_t} = 0.5 \times 3\% = 1.5\%$$
Changes in Labor

• Consider the effect on output of a change in the labor force from its current value $L_t$ to a value $(L_t + \Delta L)$—an increase in the labor force by a proportional amount $\Delta L/L_t$.

• The proportional increase in output from this change in the labor force is:

$$\frac{\Delta Y}{Y_t} = (1 - \alpha) \frac{\Delta L}{L_t}$$

• E.g. assume $\alpha = 0.5$ and proportional change in the labor factor of 1%, then the proportional change in output is:

$$\frac{\Delta Y}{Y_t} = 0.5 \times 1\% = 0.5\%$$
Changes in TFP

- Consider, the effect on output of a change in total factor productivity.
- A proportional increase in total factor productivity produces the same proportional increase in output.

\[ \frac{\Delta Y}{Y} = \frac{\Delta A}{A} \]

- If the proportional change in total factor productivity is 2%, then the proportional change in output would be:

\[ \frac{\Delta Y}{Y} = 2\% \]
All three together

- If we consider a real-world situation in which all three—the capital stock, the labor force, and total factor productivity are changing—then the proportional growth rate of output is:

\[
\frac{\Delta Y}{Y_t} = \alpha \frac{\Delta K}{K_t} + (1 - \alpha) \frac{\Delta L}{L_t} + \frac{\Delta A}{A_t}
\]

- contribution of capital to the growth of output
- contribution of labor to the growth of output
- contribution of TFP to the growth of output
Caveats and limitations

- Total factor productivity calculated as residual
  
  Note that measurement errors in the variables measuring labor and capital are mechanically imputed to TFP

- Growth accounting is a descriptive tool
  
  Does not provide insight into nature of TFP growth (technological, structural, and/or institutional change)

- Depends to some extend on assumption of independence between employment growth, capital accumulation, and productivity growth
Use

- Use growth accounting with care for descriptive purposes
- Refrain from “over-interpretation”, for e.g. TFP as dependent variable in regressions is questionable
- Apply reality checks when measuring output, capital stock, labor force, and capital share of income
- Cross check with other types of analysis when possible