Growth Accounting

Origins and framework

- Effort first tried by Solow in late 1950s to decompose growth of GDP into components attributable to labor-force growth, capital-stock growth, and growth in "total-factor productivity."
    - We have no direct data on productivity, so it must be inferred as the part of GDP growth that cannot be explained through growth in inputs.
    - This is called the "Solow residual."
- Consider Cobb-Douglas approximation to production function with A brought outside of L term
    - $Y = AK^{\alpha}L^{1-\alpha}$ (With Cobb-Douglas, we can just define this A to be the old one to the $1/(1-\alpha)$ power to reconcile with the usual Harrod-neutral form
    - $\ln Y = \ln A + \alpha \ln(K) + (1-\alpha)\ln L$
    - $\frac{\dot{Y}}{Y} = \alpha\frac{\dot{K}}{K} + (1-\alpha)\frac{\dot{L}}{L} + \frac{\dot{A}}{A}$
      $\frac{\dot{A}}{A} = \frac{\dot{Y}}{Y} - \alpha\frac{\dot{K}}{K} - (1-\alpha)\frac{\dot{L}}{L}$ defines Solow residual
- We can approximate α as capital's share of GDP
- We can estimate the growth rates of GDP and of capital and labor input
    - Note the difficulty of measuring the capital stock
    - Should labor-force growth be adjusted for increase in human capital? (Probably)
- Growth accounting is the process of estimating all of these growth factors and calculating a Solow residual, which is "unexplained increase in TFP."

Examples of growth accounting

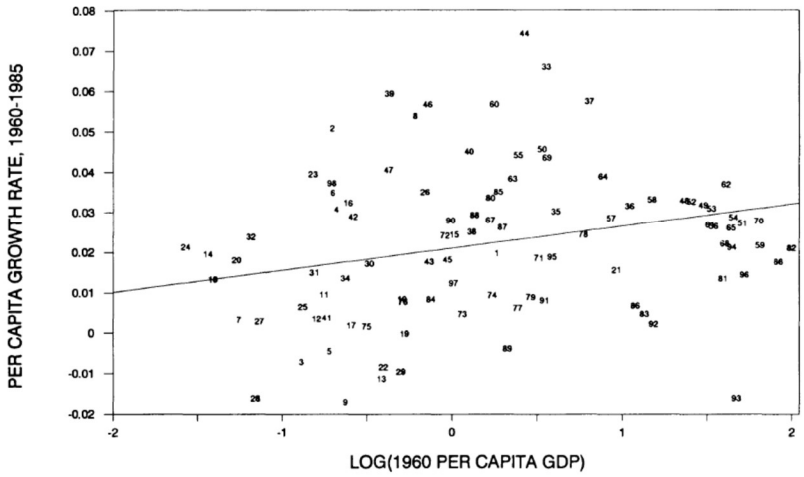
- Denison's table (Coursebook Ch 5, Table 1, p. 6-5)
    - Emphasize general magnitudes of capital, labor, and TFP contributions
    - Dramatic decline in TFP growth after 1973
        - Oil embargo and price increase
        - Globalization, rise of Japanese imports and decline of US manufacturing
        - Common to other Western countries (as we will see)
    - Led to endogenous-growth theory as economists tried to explain the decline in TFP growth
- Maddison's table (Coursebook Ch 5, Table 2, p. 6-6)
    - Differences and similarities across 6 advanced countries
        - Post-WWII "Golden Age" (convergence)

        - Where did Japan's growth come from?
        - All except UK had large decline after 1973.
- Other countries (Coursebook Ch 5, Table 3, p. 6-7)
    - Note differences in TFP growth across countries
- Impact of information technology (Coursebook Ch 6, Table 4, p. 6-8)
    - Solow quip: "Computers are everywhere except in the productivity statistics."
    - Recovery in TFP growth since 1995 fueled by IT
    - Typical technological progression:
        - Productivity effects come decades after the technology is first implemented
        - S curve of adoption and productivity effect

Cross-Country Studies of Growth and Income Differences

Absolute vs. conditional convergence

- Solow and Ramsey models predict that (*ceteris paribus*) poorer countries will grow faster than rich ones and that countries will same parameters will end up with same level of per-capita income.
- Endogenous growth models often predict no convergence: gaps in per-capital income will remain over time even between countries with same parameters.
- Absolute convergence: $g_i(0,t) = \alpha - \beta y_i(0)$
    - Countries that start with higher income at 0 will grow more slowly between 0 and t
    - Plotting growth against initial per-capita income should yield downward-sloping curve.
    - Show states, regions from Barro & Sala-i-Martin (Coursebook, Ch 6, Figure 4, p. 6-19 and following figures)
    - Barro diagram for all countries: p. 21/242 of *JPE* paper
        - No evidence of convergence for large, heterogeneous sample of countries
    - Pritchett's evidence from extrapolating U.S. growth (1.5%) backward to 1870 from current level of per-capita income for poor countries: people could not have survived at the implied levels of income (<$100 per-capita GDP compared with $250 estimate for current cost of sufficient caloric intake to survive)
    - σ convergence vs. β convergence



- Conditional convergence: $g_i(0,t) = \alpha - \beta y_i(0) + \gamma \mathbf{X}_i$
  - Countries with different values of **X** variables will converge to higher or lower growth paths, so convergence is "conditional" on having the same **X**
  - What variables should be in **X**?
    - Table 7 of Coursebook Ch 6 (p. 35) summarizes Sala-i-Martin's evidence from millions of regressions using a large pool of variables that others have proposed.
  - "Institutions" as determinants of growth
    - Democracy, rule of law, absence of corruption, prices reflect scarcity, absence of war, revolutions, coups, and assassinations, educated labor force, etc.
    - Abramovitz's "social capability" or what others have called "social infrastructure"
    - Does growth → wealth → good institutions or do good institutions → growth?
      - Acemoglu et al.: Instrumental variable of colonial survival rates to examine causality
        - Countries in which colonists survived in 1500 got good institutions and strong growth
        - Growth could not have caused the good institutions that far back
  - Other interesting hypotheses:
    - Convergence clubs?
      - Durlauf-Quah diagram on page 28 of coursebook chapter
    - Ashraf & Galor: Genetic diversity encourages growth

- Comin, Easterly, & Gong: Strong intertemporal persistence in technology adoption: 1000BC – 0AD, 0AD – 1500AD, and most of the countries with most advanced technology in 1500AD are richest today.