Beyond the Basic Solow Growth Model, Part 1

Agenda

• The Basic Solow Growth Model.
  ➢ Predictions
  ➢ Shortcomings
• The Growth Accounting Formula.

The Basic Solow Growth Model

• The Basic Solow Growth Model:
  ➢ Y/N depends on v, n-dot, δ, and A.
  ➢ Changes in v, δ, and A lead to changes in the level of Y/N but they affect y-dot only during the transition period.

The Basic Solow Growth Model

• The Basic Solow Growth Model:
  ➢ Assumes countries have similar “technology.”
    • The production function, v, δ, n-dot, and A will be similar.
    • Assumes A is fixed; a-dot = 0.
  ➢ Implies differences in Y/N are only explained because of differences in K/N.

Basic Solow Growth Model Predictions

• Prediction #1: Once the steady state has been achieved, there is no persistent growth in Y/N.

Solow Growth Model

Y/N

(Y/N)k

Y/N

(K/N)k

K/N

Hb/N

S/N

A
Basic Solow Growth Model Predictions

- However, persistent growth in Y/N has continued.

Long-run Economic Growth

- Prediction #2: For any country, growth rates should decline over time as economies approach their steady states.

Basic Solow Growth Model Predictions

- However, growth rates have actually accelerated.
Basic Solow Growth Model Predictions

• Prediction #3: A higher $v$ always raises $Y/N$. And promotes faster $y$-dot during the transition period.

• However,
  ➢ Higher saving and investment don’t always foster faster growth.
  • If capital is misallocated, it can even lower $A$.
  • Investments must be “effective.”
    • India in the 1950s.
    • Housing, booms in “non-productive” assets.

• Prediction #4: Poor countries should always grow faster than rich countries. There should be an inverse correlation between (an initial) $Y/N$ and (subsequent) $y$-dot.

• However,
  ➢ Poor countries have NOT always grown faster than rich ones.
Basic Solow Growth Model Predictions

- Prediction #5: All countries converge to the same Y/N.
  - This is known as “The Convergence Hypothesis.”
  - Also known as Absolute Convergence.

The Convergence Hypothesis

However,
- Convergence hasn’t happened everywhere.
  - Income per capita as % of US has not narrowed.

Basic Solow Growth Model Predictions

- Failures of the Basic Solow Growth Model:
  - Does NOT explain accelerating growth rates.
  - Does NOT explain persistent growth.
  - Does NOT explain why increasing v does not always lead to higher Y/N.
  - Does NOT explain why poor countries don’t always grow faster than rich countries.
  - Does NOT explain non-convergence.
Moving Beyond the Basic Solow Growth Model

• We must think more broadly about how growth rates are determined and what can be done to increase them.

• We do this through the Growth Accounting Formula.

Growth Accounting Formula

• From the production function
  \[ Y = A * f(N, K) = A * N^x * K^{1-x} \]
  \[ y-dot = a-dot + x * n-dot + (1 - x) * k-dot \]

- \( n-dot \) and \( k-dot \) are weighted by the factor’s relative importance in production
  - Where \( x \) is labor’s share of output (70%)
  - And \( 1 - x \) is capital’s share of output (30%)

- Independent of the form of the production function

Growth Accounting Formula

- Growth accounting formula
  \[ y-dot = a-dot + x * n-dot + (1 - x) * k-dot \]

- \( y-dot \) depends on
  - \( a-dot \),
  - \( n-dot \), and
  - \( k-dot \)

- Identifies the contributions of \( N, K, \) and \( A \) to \( y-dot \)

Growth Accounting Formula

- If
  \[ y-dot = a-dot + x * n-dot + (1 - x) * k-dot \]

- Then
  \[ a-dot = y-dot - x * n-dot - (1 - x) * k-dot \]

- Since \( y-dot, n-dot \) and \( k-dot \) can be measured, \( a-dot \) can be calculated.
  - Indirect measurement of \( a-dot \).
  - \( a-dot \) is a residual, called the Solow residual.

Historical Growth Accounting

Sources of Growth

- a-dot accounts for a significant portion of growth, and fluctuations in growth, in developed countries.
  - To permanently increase \( y-dot \) must permanently increase \( a-dot \).
Growth Accounting Formula

- If \( a \cdot \text{dot} = 0 \)
- And \( n \cdot \text{dot} = k \cdot \text{dot} = 1\% 
- Then \( y \cdot \text{dot} = 1\% 
  \begin{itemize}
    \item y\cdot \text{dot} = 0\% + 0.7 \times 1\% + 0.3 \times 1\% = 1\%
  \end{itemize}
- This is a balanced growth path.
  \begin{itemize}
    \item Steady state position
  \end{itemize}

Growth Accounting Formula

- If \( a \cdot \text{dot} = 1\% 
- And \( n \cdot \text{dot} = k \cdot \text{dot} = 1\% 
- Then \( y \cdot \text{dot} = 2\% 
  \begin{itemize}
    \item y\cdot \text{dot} = 1\% + 0.7 \times 1\% + 0.3 \times 1\% = 2\%
  \end{itemize}
- Even though K/N is constant, Y/N increases.
  \begin{itemize}
    \item Production function has shifted upward
  \end{itemize}

Exogenous Technological Change

- A constant \( a \cdot \text{dot} > 0 \) is better than \( a \cdot \text{dot} = 0 \).
  \begin{itemize}
    \item The Solow growth model does not show rising \( Y/N \) unless \( a \cdot \text{dot} > 0 \).
  \end{itemize}

- Cannot adequately explain long-run growth without explaining the determinants of \( a \cdot \text{dot} \).
  \begin{itemize}
    \item Challenge is to explain changes in \( a \cdot \text{dot} \)
      \begin{itemize}
        \item Slowdown in \( a \cdot \text{dot} \) in 1973 – 1995.
        \item Speed up in \( a \cdot \text{dot} \) since 1995.
      \end{itemize}
  \end{itemize}

Nonfarm Business Productivity

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<tr>
<th>Period</th>
<th>Percent per Annun</th>
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<tr>
<td>1951-73</td>
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<tr>
<td>1973-95</td>
<td>1.26</td>
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<tr>
<td>1995-05</td>
<td>2.87</td>
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