The Theory of Economic Growth

Economic Growth

• The Importance of Economic Growth
  – Growth of real GDP per capita
    • A measure of standards of living
    • Small changes make large differences over long periods of time
  – The causes and consequences of sustained increases in natural real GDP per capital
    • Debates over the allocating the pie when it is growing rapidly versus slowly
Economic Growth

• Standards of Living as the Consequence of Economic Growth
  – The Poor United Kingdom
  – Economic Growth: Something for Nothing?

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Economic Growth

• The Production Functions & Growth
  – Introduction to Neoclassical Theory
    • Output growth comes from 2 components:
      – Growth in factor inputs
      – Growth in output relative to growth in factor inputs
  – The Production Function
    • The production function is the relationship between:
      – Output, Y
      – Autonomous growth factor, A, and
      – Factor inputs, K and N

\[ Y = A \times F ( K , N ) \]
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• The Production Function & Growth (con’t)
  – Output per Person and the Capital-Labor Ratio
    \[ \frac{Y}{N} = A \cdot f \left( \frac{K}{N} \right) \]
    • Only 2 sources of growth in output per capita
      – Autonomous growth factor, A, assumed to be fixed
      – Ratio of capital to labor, \( \frac{K}{N} \),
        » Figure 9-1
        » Subject to diminishing returns
    • Reveals sources of growth but does not explain why they are different between countries or over time.
      – Also why \( A(0) \) rather than \( A(1) \)

Figure 9-1
A Production Function Relating per Person Output to per Person Capital Input
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• The Production Function & Growth (con’t)
  – Saving, Investment, and the Growth in Capital per Person
    • Savings
      \[ S + (T - G) = I + NX \]
      or
      \[ S(n) = I \]
      assuming \( NX = 0 \)

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• The Production Function & Growth (con’t)
  – Saving, Investment, and the Growth in Capital per Person (continued)
    • Investment
      \[ I = \Delta K + d \times K \]
      where \( d \) = average depreciation rate
      Now \( I = (K \times \Delta K / K) + d \times K \)
      or \( I = (\Delta K / K + d) \times K \)
      or \( I = (k + d) \times K \)
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• The Production Function & Growth (con’t)
  – Saving and Investment in the Steady State
    • A steady state occurs when $Y$ and $K$ grow at the same rate, implying a fixed ratio of $Y$ to $K$
    • Requires
      \[ y = k = n \text{ with } A = A(0) \]

• When these conditions are true economy stays at a fixed position on the per capita production function

• The Production Function & Growth (con’t)
  – Saving & Investment in the Steady State (con’t)
    • Now
      \[
      I = \left\{ \left( \frac{\delta K}{K} \right) + d \right\} K \\
      I = (k + d) K \\
      I = (n + d) K
      \]
    because $S = I$
    \[
    S = (n + d) K
    \]
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• The Production Function & Growth (con’t)
  – Saving & Investment in the Steady State (con’t)
    If we define
    \[ s = \frac{S}{Y} \]
    then
    \[ s \left( \frac{Y}{K} \right) = n + d \]
    • Savings per unit of capital must equal the growth rate of labor input plus the depreciation rate
    • This is the amount of steady state investment per unit of capital

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• Solow’s Theory of Economic Growth
  – The Harrod-Domar model of economic growth keeps all of these variables constant
    • But each variable is determined by very different factors

  – Solow flipped the equation
    » multiply through by \( K \) then divide through by \( N \)

    \[ s \left( \frac{Y}{N} \right) = \left( n + d \right) \left( \frac{K}{N} \right) \]
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• Solow’s Theory of Growth (continued)

National savings per person,
\[ s \times \left( \frac{Y}{N} \right) \]

= 

Steady-state investment per person,
\[ (n + d) \times \left( \frac{K}{N} \right) \]

– that is how much capital is needed for each additional worker plus how much capital is needed to replace depreciation

Economic Growth

• Solow’s Theory of Growth (continued)

– Graphically

• Per person production function and per person savings function
  » Figure 9 - 2 a

• Steady-state investment per person
  » Figure 9 - 2 b

• Equilibrium
  » Figure 9 - 3
  – Disequilibrium dynamics
**Figure 9-2**
Output, Saving, and Steady-State Investment per Person

**Figure 9-3**
Equilibrium of Saving and Investment in the Solow Growth Model
Economic Growth

- Solow’s Theory of Growth (continued)
  - Effects of a Higher Saving Rate
    - Figure 9-4
    - Equilibrium moves from E(0) to E(1)
    - At E(1)
      - $K(1) / N(1) > K(0) / N(0)$
      - $S / N$ and $Y / N$ are fixed
      - $y = k = n$
    - A rise in the saving rate temporary increase $y$ as $I$ rises enough to raise $K$ and $Y / N$ but then $y = k = n$
      - Long-run versus short-run dilemma

Figure 9-4
The Effect of a Higher Saving Rate on Capital and Income per Person
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- Technology in Theory and Practice
  - Two Types of Technological Change
    - Labor Augmenting Technological Change
      - Makes workers more efficient
      - Effective labor input
    - Neutral Technological Change
      - Makes both workers and capital more efficient
      - Implies autonomous growth factor, A, increase over time
      - Implies production function shifts upward steadily

- The “Solow Residual”
  - We can measure “a” from
    \[ y - n = a + b \times (k - n) \]
  - by solving for “a”
    \[ a = (y - n) - b \times (k - n) \]
  - since y, n, and k can be observed and b can be estimated
  - “a” accounts for nearly 90% of \(\frac{y}{n}\)
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• Major Puzzles with Solow Growth Theory
  – Income per capita varies too much across countries
  – Poor countries do not have a higher rate of return on capital
  – The facts about immigration differ from the model’s implications
  – Convergence has not been uniform

Figure 9-5
A Production Function Relating Per-Person Output to Per-Person Capital Input
Economic Growth

• Endogenous Growth Theory
  – Trying to Endogenize “A”

  – The Interpretation of Capital
    • Returns to capital do not diminish
      – Still a problem is all capital is alike and freely mobile
    • Human capital versus physical capital
      – Physical capital may be mobile but human capital is not

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• Endogenous Growth Theory (continued)
  – The Production of Ideas
    • Rely by monopoly power reinforced by patents and copyrights
    • The concept of ideas helps explain
      – The introduction of new goods
      – The development of better production techniques
      – The development of higher quality
        » Rich countries use ideas and techniques that produce more and better goods per person.
        » Requires the associated investment in physical and human capital
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• Endogenous Growth Theory (continued)
  – Empirical Studies and Policy Implications
    • Faster growth is associated with
      – higher rates of investment
        » either private or government sector
      – relatively low government consumption
      – greater educational attainment
      – greater political stability
      – lower fertility
    • Policy Implications
      – Tax private consumption, restrain public consumption
      – Promote public and private investment

Economic Growth

• CASE STUDY:
  The Economic Miracle of the Four Tigers
  – Growth rates, 1960 - 1990
    • Philippines, about 2% per year
    • China, Japan, Indonesia, Malaysia, Thailand, 3 - 5%
    • Hong Kong, Korea, Taiwan, Singapore, > 6%
      » Figure 9 - 6
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• CASE STUDY: The Economic Miracle of the Four Tigers (continued)
  – Growth in Factor Inputs or in Multifactor Productivity?
    • Extensive growth, growth in factor inputs
      – Rapid capital accumulation
      – Rapid increase in labor force
    • Intensive growth, growth in multifactor productivity
      – Very strong
    • Conclusion: both
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• CASE STUDY:

The Economic Miracle of the Four Tigers
  – Did Public Policy Play a Role?
    • Market-promoting policies
      – Encourage free markets, minimize government
      – Provide infrastructure
      – Promote education and income equality
      – Encourage foreign investment and exports
    • Market-interfering policies
      – Subsidies to investment and exports
      – Import barriers and capital controls

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• CASE STUDY:

The Economic Miracle of the Four Tigers
  – Should Policy Promote Investment and Exports?
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• Conclusion: Are There Secrets of Growth?
  – Probably not but
    • A favorable institutional infrastructure
    • Political and social stability
    • “Capital” deepening
    • Minimizing diversion
    • Openness to foreign trade and capital flows
    • Climate
    • Luck
  – We still have a lot to learn