Lecture 2
Economic Growth: Theory and Empirical Patterns
(Based on Chapter 2 of Perkins et al.)

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Recap

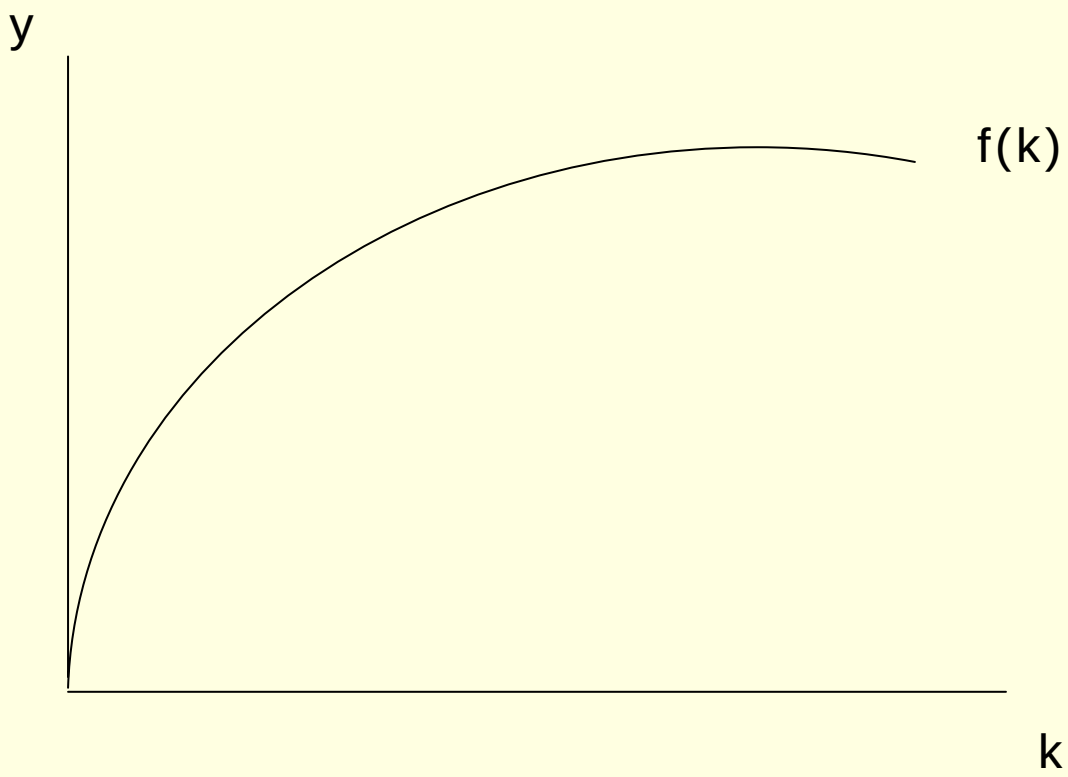
- Basic growth model.
  - Growth comes through addition to capital stock and stock of labour force.
- Harrod-Domar growth model.
  - Growth comes through savings.
  - Restrictive assumptions.
    - Constant coefficient production function.
    - Constant capital-output ratio.

Solow Growth Model …. 1

- Neo-classical production function.
  - Allows substitution between labour and capital based on availability.
  - Production function.
    - $Y = F(K, L)$
    - $Y/L = F(K/L, 1)$
    - $y = f(k)$, $y = Y/L$, $k = K/L$

Solow Growth Model …. 2

- Assumption: Diminishing returns to capital.



Solow Growth Model …. 3

- We know:
  - $\Delta K = sY - \delta K$ [1]
    - $\Delta K/K = (sY/K) - \delta$ [2]
  - $\Delta k/k = \Delta K/K - \Delta L/L$ [3]
    - $\Delta K/K = \Delta k/k + \Delta L/L$ [4]
  - $\Delta L/L = n$ [5]
    - $\Delta K/K = \Delta k/k + n$ [6]

Solow Growth Model …. 4

- [2] + [6]
  - $(sY/K) - \delta = \Delta k/k + n$ [7]
  - $\Delta k/k = (sY/K) - \delta - n$ [8]
  - $\Delta k = (sY/K)k - \delta k – nk$ [9]
  - $\Delta k = (sY/K)(K/L) – (\delta + n)k$ [10]
  - $\Delta k = (sY/L)– (\delta + n)k$ [11]
  - $\Delta k = sy – (\delta + n)k$ [12]

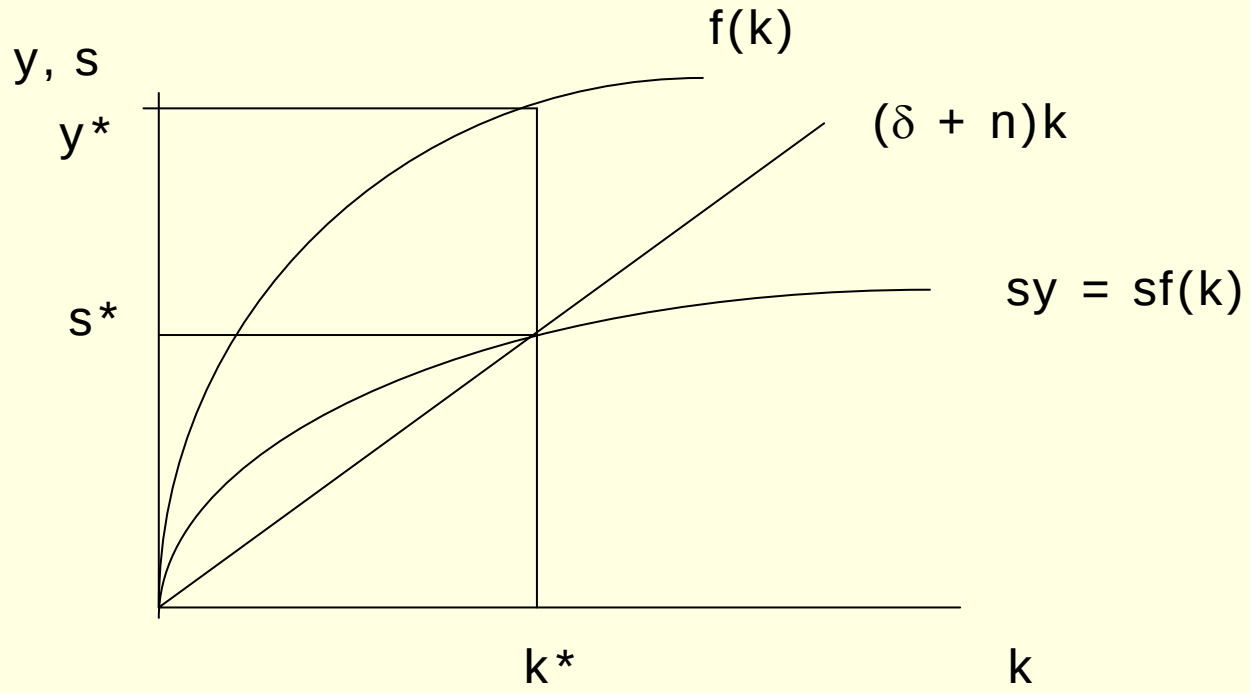
- Basic equation [12].

Solow Growth Model …. 5

- Implications of basic equation.
  - Δk is positively related to savings (or investment) per labourer.
    - $d\ \Delta K/ds > 0$
  - Δk is negatively related to population growth.
    - $d\ \Delta K/dn < 0$
  - Δk is negatively related to the depreciation rate.
    - $d\ \Delta K/d\ \delta < 0$

Solow Growth Model …. 6

- Solow model.
  - $y = f(k)$
  - $\Delta k = sy - (\delta + n)k$



Solow Growth Model …. 7

- We know:
  - Amount of savings available = sy
  - Amount of savings required to account for depreciation and population growth = $(n + \delta)k$

- Steady state.
  - $sy = (n + \delta)k$
    - k constant
    - y constant
    - s constant

Solow Growth Model …. 8

- $sy > (n + \delta)k$
  - Capital deepening.
  - Accelerated growth.
  - Rise in output per labourer.

- $sy < (n + \delta)k$
  - Decline in capital per labourer.
  - Decline in growth.
  - Decline in output per labourer.

Solow Model …. 9

- Implication of Solow model.
  - High k implies that a high level of investment is required to maintain the capital-labour ratio.
- Problem.
  - Investment may crowd out consumption.
- Golden rule.
  - Consumption at steady state
    - $c(k^*) = f(k^*) – (n + \delta)k^*$
  - Maximisation of consumption.
    - $MPK(k^{**}) = n + \delta$

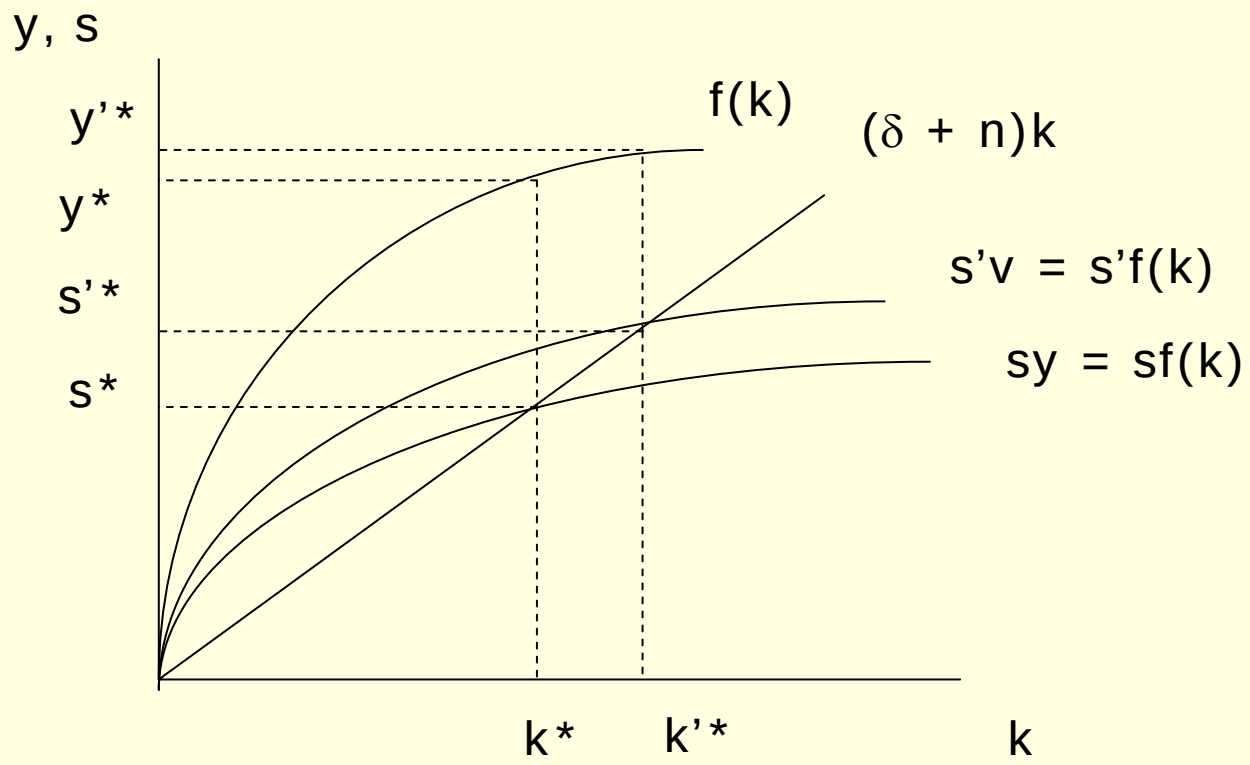
Solow Growth Model …. 10

- Implication of shape of f(k) curve.
  - A country with low capital stock can benefit more from adding to its capital stock than a country with large capital stock.
    - If a developing country saves it can grow faster than a developed country and eventually catch up with iit.
      - Barro and Sala-i-Martin.

- What happens if the following change in the Solow model?
  - Savings rate
  - Population growth
  - Technology

Solow Growth Model …. 11

- Increase in savings rate.
  - Compare with Harrod-Domar model.

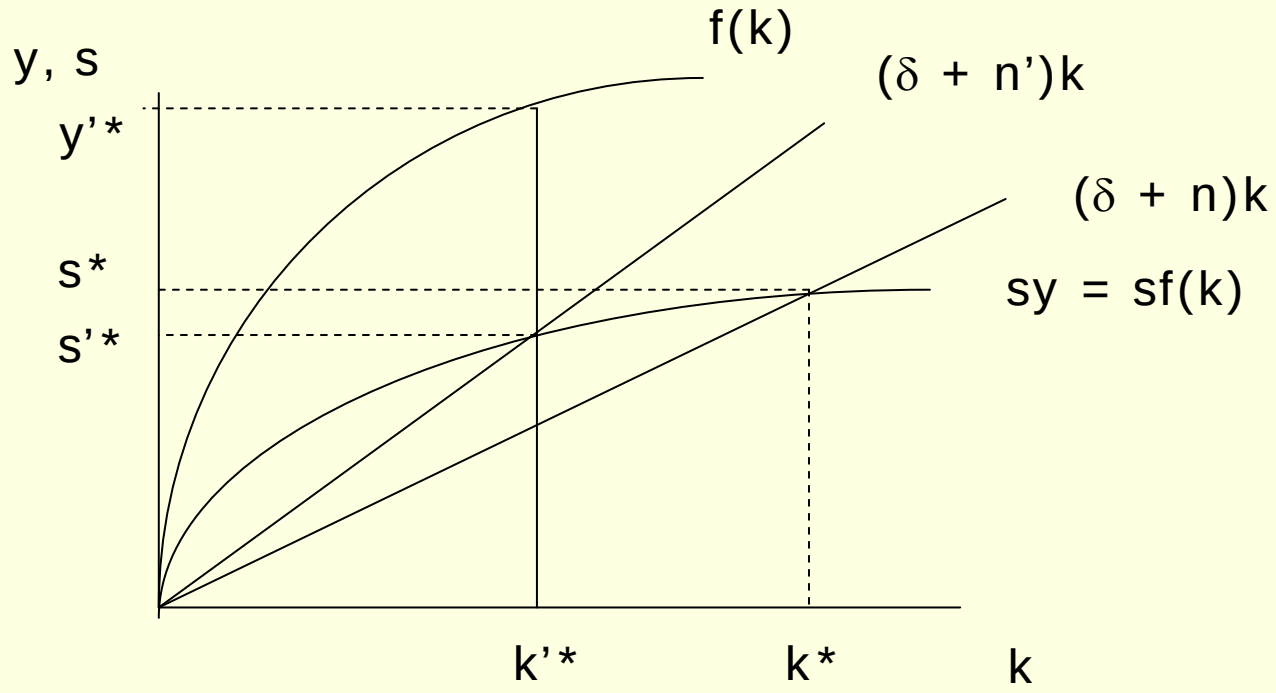


Intuition …. Rise in Savings Rate

- Rise in savings / investment per worker.
- Rise in capital per worker.
- Rise in growth rate.
  - Rise in growth rate less than proportional to rise in capital per worker.
    - Decreasing returns to scale.
      - Compare with Harrod-Domar model.
- Economy moves to a higher {k, y} steady state permanently.

Solow Growth Model …. 12

- Rise in growth rate of population.
  - Compare with Harrod-Domar model.



Intuition …. Rise in Population Growth

- Fall in savings / investment per worker.
- Fall in capital per worker.
- Fall in growth rate.
  - Compare with Harrod-Domar model.
- Economy moves to a lower {k, y} steady state permanently.

Implications

- Two identical countries may have different growth rates if they differ.
  - Different savings rates.
    - East Asia vs. Africa. (True / False?)
      - Ando and Modigliani (AER, v. 53, n. 1, p. 55-84)
      - Ando and Modigliani (AER, v. 54, n. 2, p. 111-113)
  - Different rates of growth of population.
    - China vs. India (True / False?)

- The country with the lower steady state growth rate can catch up, but it may take years.

Puzzle

- The US has very low savings rates.
  - Is it low or high relative to EU?
- The US has higher population growth than the EU.
- The US grows faster than the EU.

Solution

- Technological change.