ALTERNATIVE THEORIES OF ENDOGENOUS GROWTH

EE 462 Development Macroeconomics

Semester 1/2015

Topics

- The AK Model
- The Lucas Model
- Externalities and AK Models

Introduction

- In previous lectures, both Solow and Romer Models have the implication that government policies, such as subsidies to research or taxes on investment, have *level effects* but no long-run growth effects.
  - That is, these policies change the growth rate only *temporarily*, and cannot increase the long-run growth rate of the economy.
- Moreover, in Romer model, technology change in endogenous in the model, but without exogenous population growth, per capita income growth eventually stops.
  - Hence, Romer model is sometimes referred to as "semi-endogenous growth" model.

The "AK" Model

- Assume a Cobb-Douglas production function in which $\alpha = 1$:

  $Y = AK$ where $A > 0$

- This model does not exhibit diminishing returns to capital.
- The accumulation of capital per capita can be written as:

  ➔ $\Delta k =$

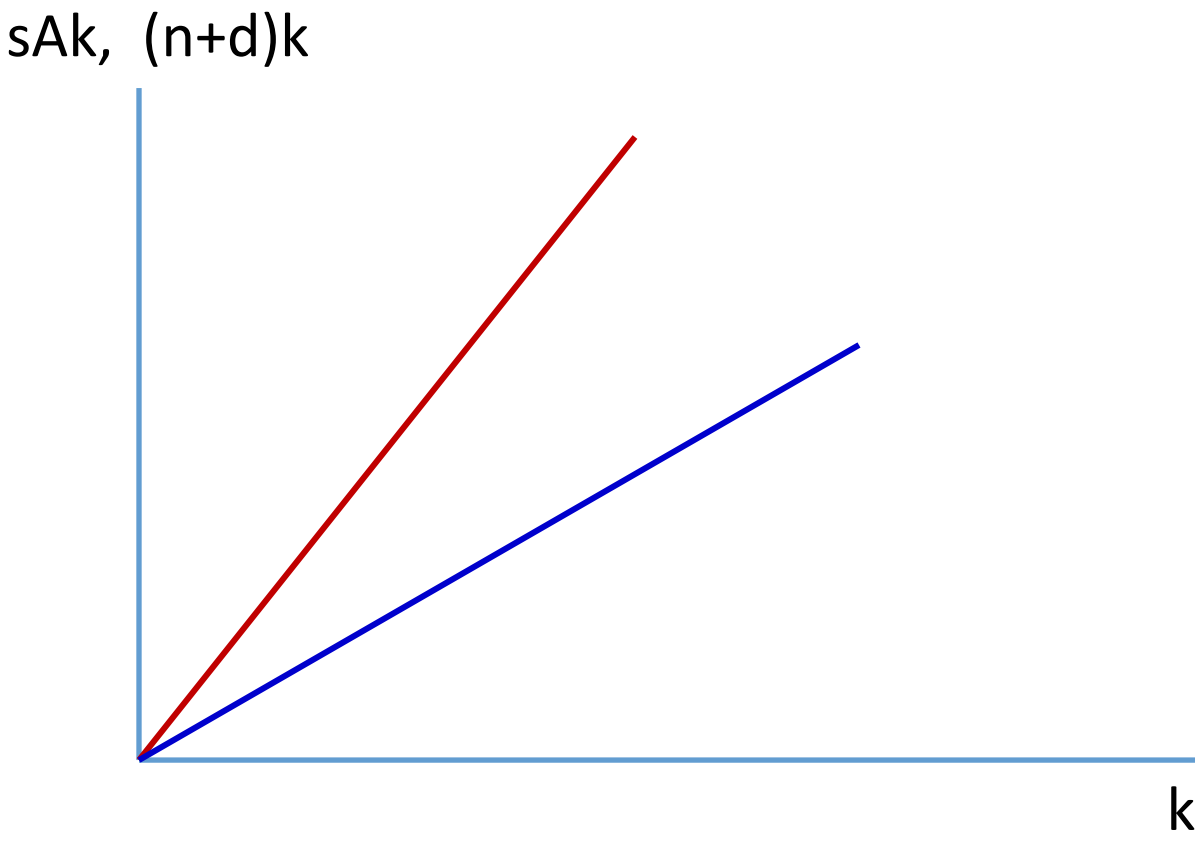
  ➔ $\Delta k/k =$

➢Since sA is a linear function of k, it never crosses (n+d)k curve.

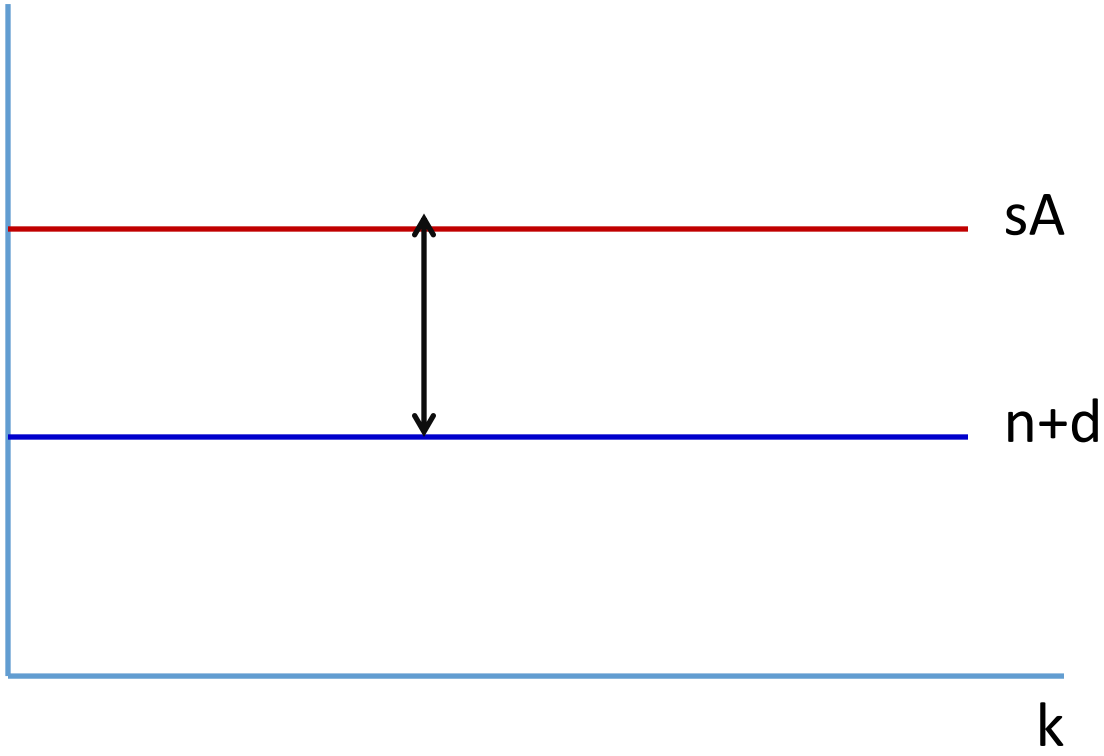
➢There is ***no convergence*** in the long run.

➢That it, there is no steady-state level of capital per capita in this model.

Solow Diagram of The AK Model



Transitional Dynamics: AK Model



Growth Implications from AK Model

- For simplicity, assume that the population size is one (L=1), and population does not grow (n=0).
- The capital accumulation equation is:

$$\Delta K = sAK - dK \rightarrow \Delta K/K =$$

  - Since $\frac{\Delta Y}{Y} = \frac{\Delta K}{K}$, $\frac{\Delta Y}{Y} =$.
  - That is, the output growth rate is always equal to sA – d.
  - If *s* increases, the growth rate increases.
  - It implies that government can subsidize investment by giving tax break, then government can <u>permanently</u> increase the economy's growth.

The Lucas (1988) Model

- Lucas (JME, 1988) defines human capital as the skill embodied in workers.
- The production function is given by:

$$Y = AK^{\alpha}(hL)^{1-\alpha}$$

where L = total workers; h = human capital per person

u = time spent on working

$1-u$ = time spent accumulating skill

- Human capital accumulation can be written as:

$$\Delta h = (1-u)h$$

➔ $\frac{\Delta h}{h} =$

Lucas Model (cont'd)

- Physical capital accumulation is defined as usual: $\Delta K = sY + d$.
- Rewrite the production function in terms of per effective worker:

$$y_e = Ak_e^{\alpha} \qquad (A > 0)$$

- The growth rate of physical capital per effective worker is:

$$\frac{\Delta k_e}{k_e} = \frac{\Delta K}{K} - \frac{\Delta h}{h} - \frac{\Delta L}{L}$$

$$\frac{\Delta k_e}{k_e} =$$

➔ $$\Delta k_e =$$

- At the equilibrium in the long run,
  - Capital per effective worker is:
  - Output per effective worker is:
- Note: This simplified version of Lucas model is similar to the Solow Model with augmented labor technology.

Lucas Model (cont'd)

- In the long run, there is no change in physical capital per effective worker. Thus, the growth rate of physical capital per worker can be written as:

$$\frac{\Delta k_e}{k_e} = 0 \rightarrow 0 = \frac{\Delta K}{K} - \frac{\Delta L}{L} - \frac{\Delta h}{h}$$

$$\rightarrow \frac{\Delta k}{k} =$$

- Main driver for growth is the growth rate of human capital.
  - Policies that promote knowledge accumulation will result in higher growth rate of output.
- 1-u can be thought of as the production of knowledge.

Externalities and AK Models (1)

- In this model, technological development is seen as a by-product of economic development.
  - The accumulation of knowledge may occur because of an *externality*.
  - "Learning by doing" approach
- Consider the production function:

$$Y = BK^{\alpha}L^{1-\alpha} \qquad \text{-- (1)}$$

  - This production exhibits constant returns to capital and labor.
  - B can be seen as the level of technology, and each firm takes technology B as a *given constant*.

Externalities and AK Models (2)

- However, the accumulation of capital generates new knowledge about production in in the economy as a whole.
- So, a technology function can be written as:

$$B = AK^{1-\alpha} \qquad \text{-- (2)}$$

where A is a constant number (A > 0).

➢ An accidental by-product of the accumulation of capital by firms in the economy is the improvement of the technology that firms use to produce.

- Substitute B in equation (1), and we have:

$$Y = \qquad \text{-- (3)}$$

➢ If we normalize the population to one, then we have the AK model.

Externalities and AK Models (3)

- In summary, this model deals with the increasing returns to scale (which is required in endogenous growth model) by using the externalities approach.
- It is assumed that the accumulation of knowledge is an accidental by-product (i.e. externality) of some other activity in the economy, such as capital accumulation.
- Note: we need to distinguish between *private returns* to capital and *social returns* to capital.
  - Society benefits from capital accumulation, but individual firms do not take this effect into account.