MACROECONOMICS

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Course Material Developed by Department of Economics,

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Week 5

Economic growth I

Economic growth

- Increase of Y in time
- Growth: the long run tendency, the trend
- Sources, differences among countries
- Growth is exponential
  $Y_t = (1 + g)^t Y_0$
- In the long run relatively small differences in the average rate of growth can mean a lot

Facts of growth

- Most countries have been growing steadily since the industrial revolution. Average rate in the developed countries are in the range of 2-3 pervent annually
- Cross section analysis of many countries shows positive correlation between the rate of investment and the level of per capita uotput. More investment means higher output. No correlation exists between investment rate and the rate of growth

Facts of growth

- Cross section analysis of many countries shows negative correlation between the rate of population growth and the level of per capita uotput. Countries with higher population growth are typically poorer. Overall growth rate can still be high due to high population growth, but the living standards are lower

Facts of growth

- No general convergence exists among the countries of the world with respect of their achieved levels of GDP per capita
- The group of developoed countries show significant similarity with respect to their level and growth rate of per capita income. Among these countries convergence seems to be concluded. The group of underdevoloped countries show significant dissimilarities among each other as well as with the developed ones

Facts of growth

- The countries outside the developed group are heterogenous, there is example for most everything. Some show successful catch up, some are hopelessly lag behind
- Difference between the wealthiest and the poorest is big and growing. The main reason is the stable secular growth performed by the developed countries

Solow growth model

- Concentrates on the saving-investment (capital accumulation) process
- Has predictions about most of the growth facts listed above
- It was developed as an aggregate (without a micro bse) model. It lacks full description of individual decision making. They are substituted with rule of thumb routines
- Modern versions (ours) refer to micro behavior

Consumer

- There is no decision on labor supply. Population and the labor force is the same, N. Everyone spends one unit of time working
- Population grows at a constant rate n (can be negative as well)

$$N' = (1 + n)N$$

Consumer

- Aggregate income of all consumers is Y. We assume government away, therefore GDP equals total income of consumers. They do not make labor supply decision, therefore there is no need ro separate income into labor and non-labor income
- Part of consumer income is consumed, the rest is saved. There are many periods, the model is dynamic
- Consumption-saving decision is a rule of thumb
  C = (1 – s)Y
- s is the savings rate. It is an exogenous constant. All consumers save the same portion of their income. Therefore aggregate savings is S = sY
  Y = C + S

Production

- We have a standard neoclassical production function. Labor supply is constant and it is employed. Dynamics of production depends on accumulation of capital.

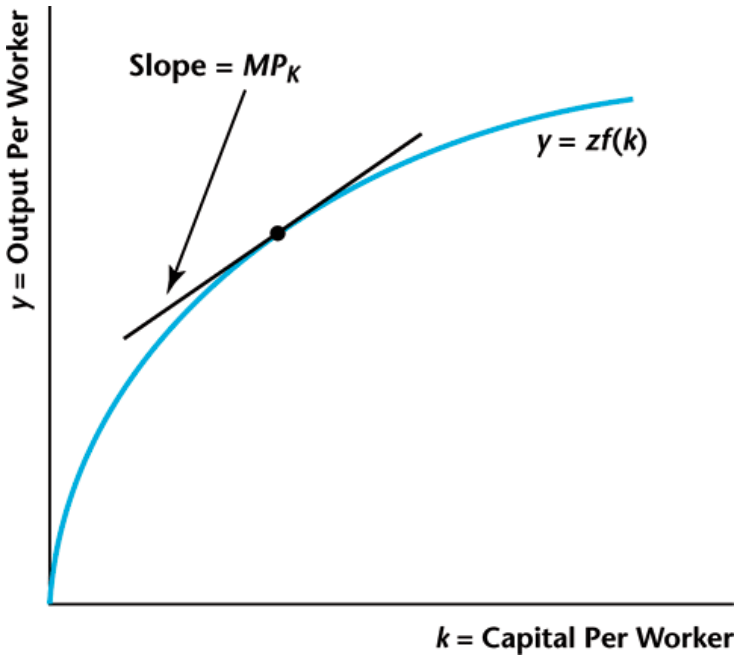
$$Y = zF(K, N)$$

On a per capita basis:

$$\frac{Y}{N} = zF\left(\frac{K}{N}, 1\right) \quad \equiv z\, f(k), \quad \text{where} \quad k = K/N$$

$$y = zf(k), \quad \text{where} \quad y = Y/N$$

Per capita production function



$$f'(k) = MP_K$$

Accumulation of capital and equilibrium

$$K' = (1 - d)K + I$$

- Current peridod demand for capital: *I*
- Current period supply of capital (savngs): S
- Equilibrium on the market for capital. Consumers save just as much what the investors want to invest. S = I
- This automatically establishes equilibrium on the market for goods: C = Y – S, S = I, Y = C + I,
- Output = spending

Substituting

$$K' = sY + (1 - d)K$$

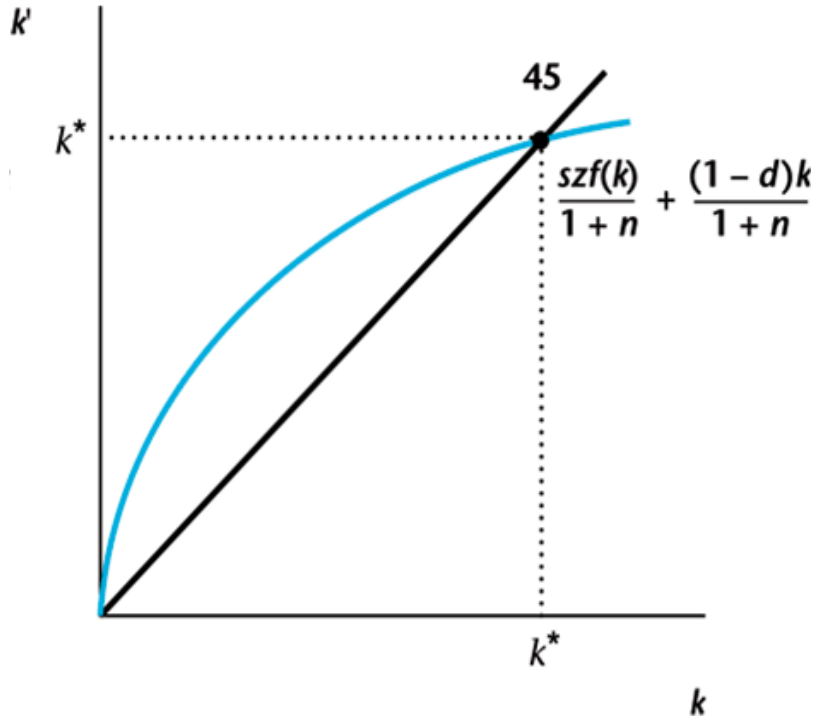
$$K' = szF(K, N) + (1 - d)K$$

Dividing by N' = (1 + n)N

$$k' = \frac{szf(k)}{1 + n} + \frac{(1 - d)k}{1 + n}$$

Gives capital per capita in the next period as a function of capital per capita in the previous period

Time path of K towards steady state



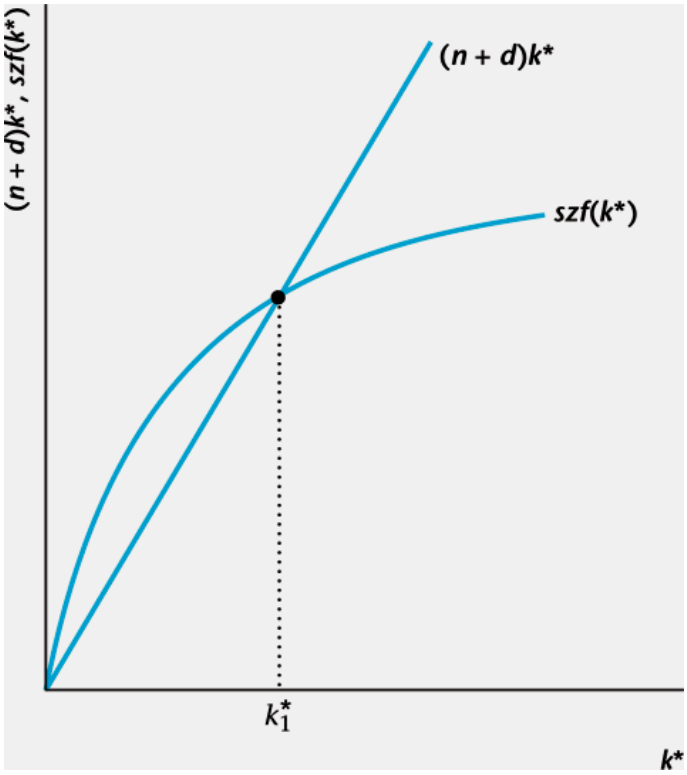
Steady state

$$k' = k = k^*$$

$$szf(k^*) = (n + d)k^*$$

- In the steady state capital accumulation is just enough to cover for depreciation and for providing new labor (due to population growth) the existing level of capital. k does not change
- Long run equivalent of the equilibrium in a dynamic system. A state of a dynamic model in what the variables either grow at the same constant rate, or they are constants
  k' = k = k* constant. If **z and s are constants**:
  y = f(k*) constant
- N grows at a rate n, therefore K and Y also grows at a reate n in steady state

I = szf(k*) = (n + d)k*

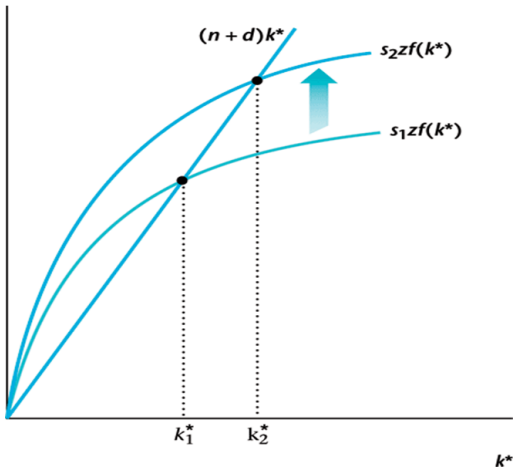


Features

- If z is constant, there is no increase in living standards (per capita output) in seady state
- Towards the steady state capital accumulation increase per capita output, however, due to decreasing returns this has its limits
- In steady state only aggregate output grows as population grows

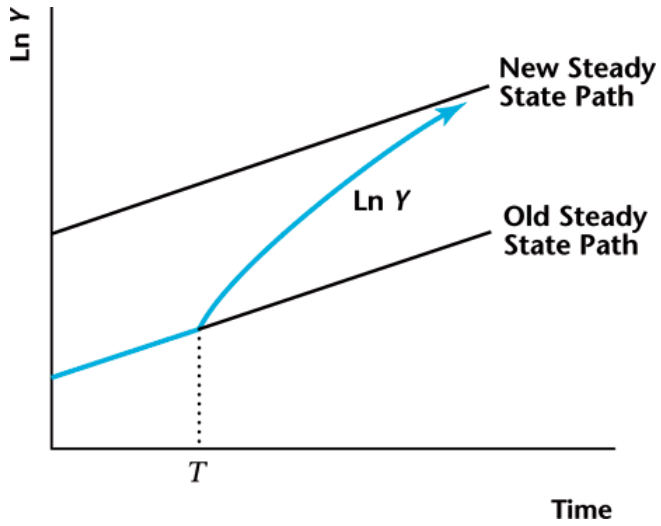
Effect of an increase in s in steady state

$$szf(k^*) = (n+d)k^*$$



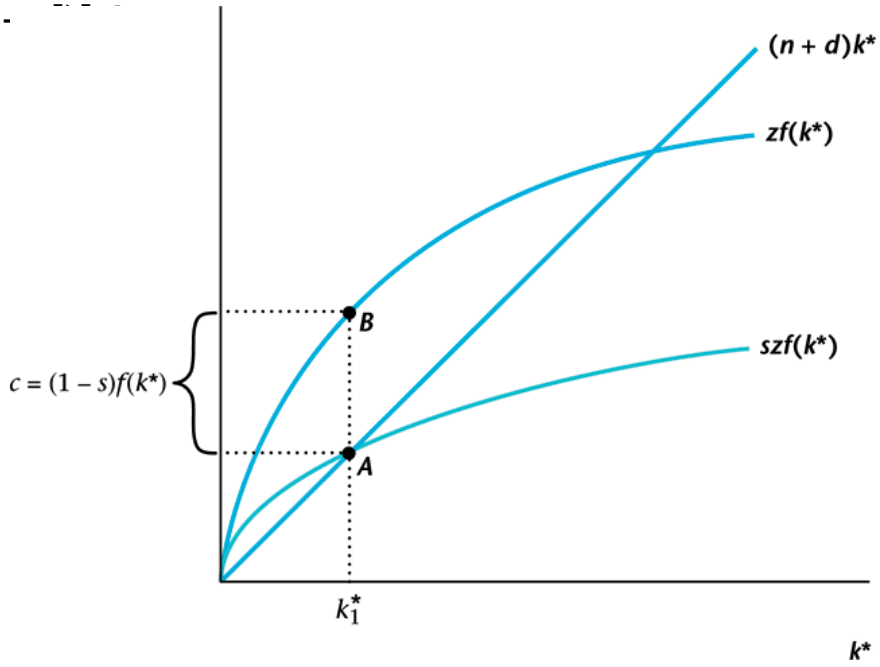
- An increase of s increases the value of capital per head in steady stare. Therefore, output per capita becomes larger. Countries with higher investment are wealthier.
- Rate of growth of output remains the same. High investment does not accelerate growth.
- Rate of growth increases temporarily only

An increase in s



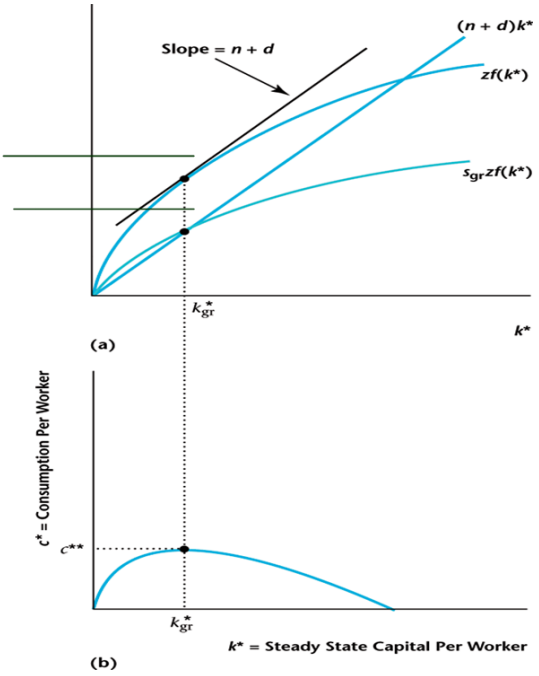
Per capita consumption in steady state

C* = zf(k*) – (n



The golden rule of accumulation

Max C*

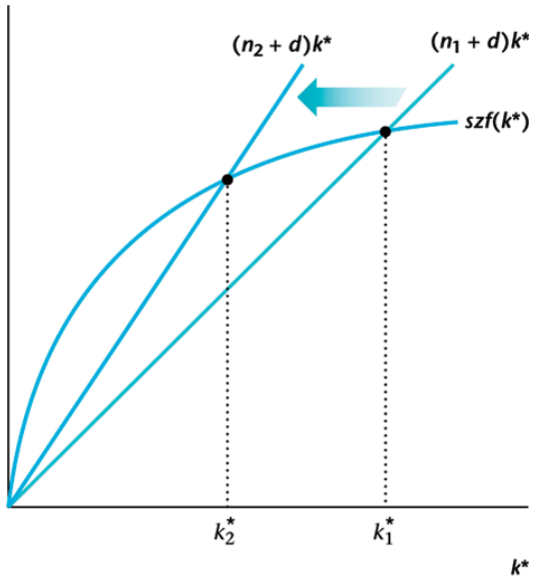


- **max C* = zf(k*) – (n + d)k***
- **MP_k = n – d**
- With **MP_k given, k can be determined. Given k, s can be determined from the steady state equation.**
- **If** s_{gr} is set exogenously (by a national planner for example) then after a while maximum level of consumpion is reached
  in szeady state

Economic policy

- MP_k can be estimated, d calculated from statistics, a guess for golden rule s can be given
- Should the government try to determine it?
- Inter generational redistribution
- Why sould the government know better than market participants?
- Lack of information, market failures

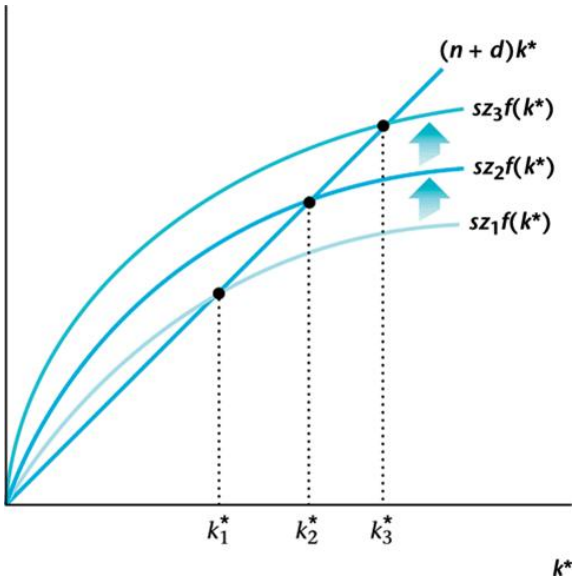
An increase of n in steady state



An increase in n

- Increase of n decreases capital per head in steady state, therefore output per capita is smaller. Countries with high population growth are poor
- Rate of growth is not effected. It is still n
- Output at he national level is higher, of course, as n is larger

Increase of z



- Important prediction of the model: secular (contimuous) growth in the living standards (per capita output) is made possible by growth of z (TFP) only
- Change of z is not expained in the model. The Solow growt model is n exogenous growth model

Growth accounting

- $Y = zK^{\alpha}N^{1-\alpha}$
- $\ln Y = \ln z + \alpha K + (1 - \alpha)N$
- $\mathrm{Ln}Y_{t+1} - \ln Y_t = \ln z_{t+1} - \ln z_t +$
- $+ \alpha(\ln K_{t+1} - \ln K_t) + (1 - \alpha)(\ln N_{t+1} - N_t)$
- a and (1 – a) are shares of income going to capital and labor from total aoutput