ECON10003
INTRODUCTORY MACROECONOMICS
SEMESTER 1, 2021

REVIEW SESSION 4

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Economic Growth

- Economic growth focuses on an aggregate production function approach
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- $Y_t = A_t f(K_t, L_t)$
- C-D
  $Y_t = A_t K^{\alpha}_t L^{(1-\alpha)}_t$

$0 < \alpha < 1$

(1) MP_L & $MP_K > 0$ — $\frac{\partial Y_t}{\partial L_t} > 0$, $\frac{\partial Y_t}{\partial K_t} > 0$

(2) MP_L + MP_K are diminishing — $\frac{\partial^2 Y_t}{\partial L_t^2} < 0$, $\frac{\partial^2 Y_t}{\partial K_t^2} < 0$

More input raises output but at a diminishing rate

(3) Constant returns to scale —

$f(K, L) = Y$

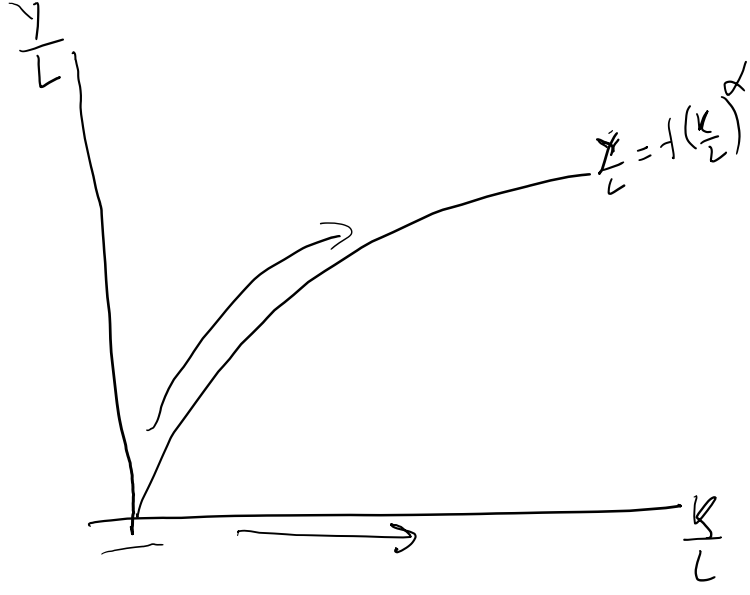
$\Rightarrow f(xK, xL) = xY$

Implication of CRS:

constant per capita $\left(\frac{Y_t}{L_t}\right) = \frac{f(K_t, L_t)}{L_t} = f\left(\frac{K}{L_t}, 1\right)$

Cobb-Douglas:

$$\frac{Y_t}{L_t} = A_t \left(\frac{K_t}{L_t}\right)^{\alpha}$$



- Solow-Swan Growth Model

$$\Delta \frac{K_t}{L_t} = \theta \frac{Y_t}{L_t} - (d+n)\frac{K_t}{L_t}$$

saving; replacement investment

Steady State: $\Delta \frac{K_t}{L_t} = 0$

$$\frac{Y_t}{L_t} = \frac{Y_{t+1}}{L_{t+1}} = \frac{(1+g)Y_t}{(1+n)L_t}, \quad g = n$$

$$\theta \frac{Y_t}{L_t} = (d+n)\frac{K_t}{L_t}$$

* $\frac{Y_t}{L_t}$ + $\frac{K_t}{L_t}$ are constant
* output grows at the rate of population growth
* Economy approaches a SS $\rightarrow \left(\frac{K}{L}\right)^*$
* Long run growth arises due to productivity growth

- Convergence debate

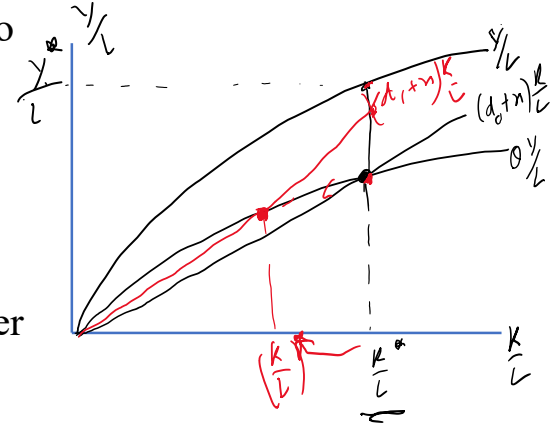
- Growth Accounting

$$\%\Delta Y_t = \alpha\,\%\Delta K_t + (1-\alpha)\%\Delta L_t + \%\Delta A_t$$

$$\%\Delta A_t = \%\Delta Y_t - \alpha\,\%\Delta K_t - (1-\alpha)\%\Delta L_t$$

$d_1 > d_0$

1. In the Solow-Swan model discussed in lectures, an increase in the rate of depreciation of capital stock leads, in equilibrium, to



a) an increase in capital per worker and output per worker.

b) a decrease in capital per worker and output per worker.

c) an increase in capital per worker but no change in output per worker.

d) no change in capital per worker but an increase in output per worker.

2. Which of the following production functions does not feature constant returns to scale?

a) $Y_t = K_t^{0.3} L_t^{0.7}$

b) $Y_t = 0.6K_t + 0.4L_t$

c) $Y_t = (K_t - 1)^{0.6} L_t^{0.4}$

d) $Y_t = 6K_t + 4L_t$

CRS: $y = f(K, L) \Rightarrow f(2k, 2L) = 2f(K, L) = 2y$

$2k^{0.3} 2L^{0.7} = 2(K^{0.3} L^{0.7}) = 2Y_t$

3. Suppose two countries have the same production function and identical rates of population growth and depreciation and share the same technology. However, Country B has a relatively higher rate of saving than Country A. According to the Solow-Swan model,

$y = A K^{\alpha} L^{1-\alpha}$

$s = \theta Y/L$

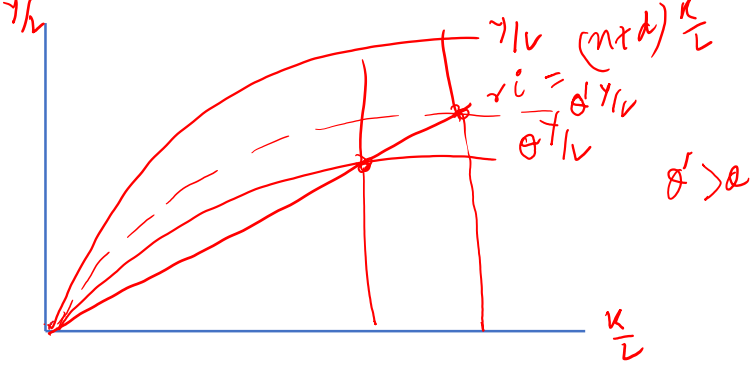
$\dot{k} = (n+d)\frac{K}{L}$

a) Country B will have a lower long run level of per capita income than Country A.

b) Country B will have the same long run level of per capita income as Country A.

c) Country B will have a higher long run level of per capita income than Country A.

d) whether or not Country B has a higher level of per capita income than Country A depends on whether the long run rate of economic growth is higher in Country B than in Country A.



$\theta' > \theta$

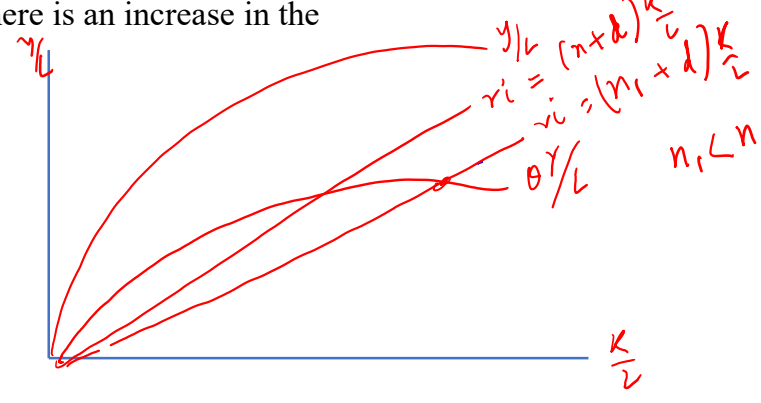
4. In the context of the Solow-Swan model studied in this subject, which of the following statements is correct?

a) An increase in the proportion of income saved has negative effect on the growth in per capita income in the long run. ✗

b) A fall in the rate of population growth raises the steady-state capital-labour ratio.

c) An improvement in technology has no implications for the economy's steady-state capital labour ratio.

d) An increase in per capita income is only possible if there is an increase in the economy's total factor productivity.



5. **(a)** Imagine two countries both of which are in 'steady state' equilibrium growth and both of which have the same (constant) values of A, d and n but different levels of θ. **(i)** Will one country have a higher level of Y/L than the other? Explain your answer. **(ii)** Will one country have a higher rate of growth of Y/L than the other? If so, explain how this occurs (be sure to identify what economic processes or 'mechanisms' are involved). If not, explain why not.

Answer: **(a)** (i) Yes, the one with the higher theta will have a (higher equilibrium K/L and so a higher Y/L.

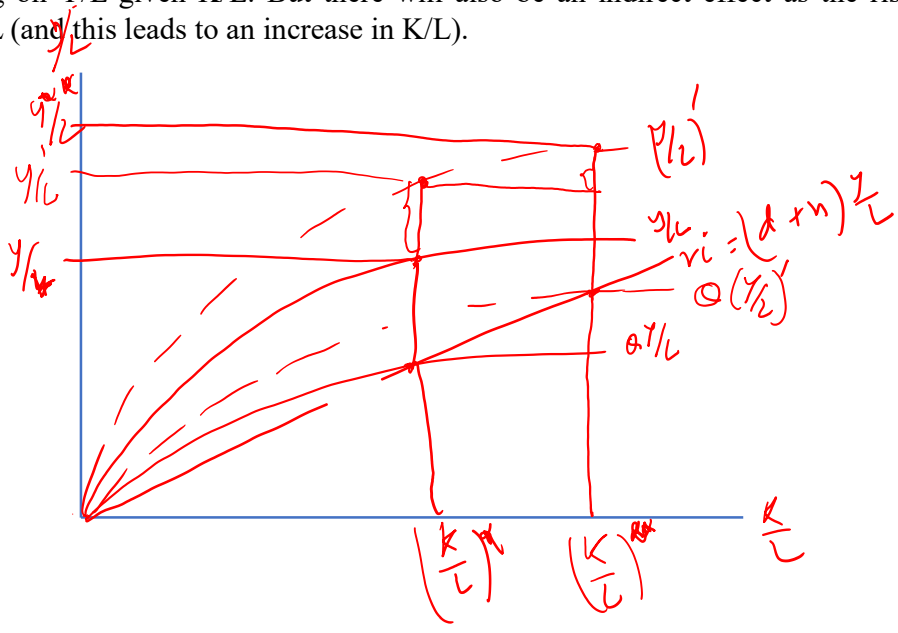
(ii) No, one country will not have a higher rate of growth of Y/L than the other. This is because since A is constant and the same and since they are in the steady state K/L will be constant in each country and Y/L will be constant in each country and not growing.

(i) $\theta_A > \theta_B \Rightarrow \left(\frac{y}{L}\right)_A > \left(\frac{y}{L}\right)_B$

(ii) No, they both in SS.

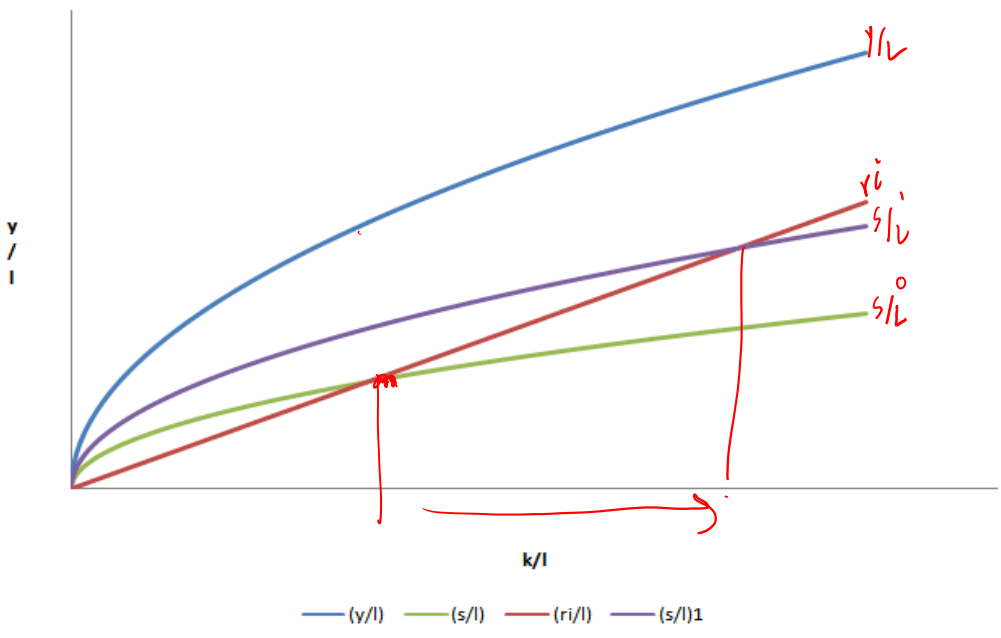
(b) Imagine an economy initially in 'steady state' equilibrium and that (cet par) the level of A changes so that it is now higher than it was before. Will this lead to a rise in the equilibrium level of Y/L? If so, explain how this occurs (be sure to identify what economic processes or 'mechanisms' are involved). If not, explain why not.

Answer: **(b)** Yes, equilibrium Y/L will rise. There will be a direct effect via a rise in A itself impacting on Y/L given K/L. But there will also be an indirect effect as the rise in A raises S/L (and this leads to an increase in K/L).



(c) Can higher savings rate guarantee sustained higher economic growth for ever? Using Solow-Swan growth model explain your answer.

Answer:



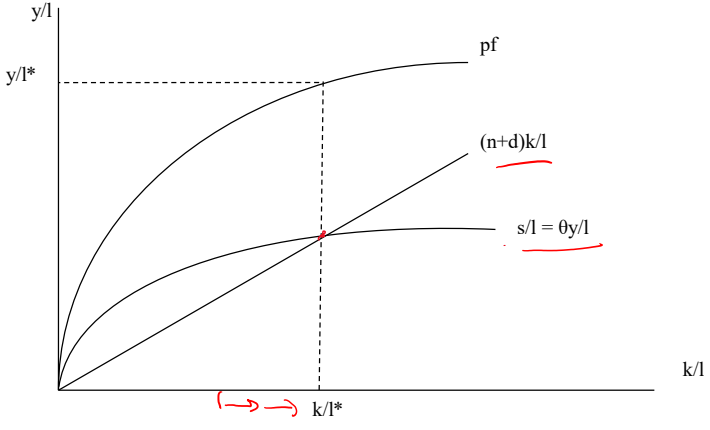
Higher saving will cause a temporary period of growth as the economy moves from its initial steady-state (A) to its new steady-state (B).

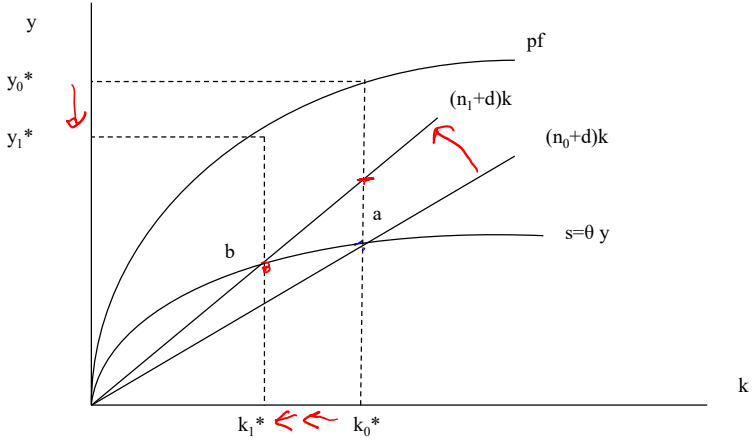
However, once at the new steady-state, growth in per capita GDP ceases. Therefore, it is not true, at least in the context of the Solow Swam model, that higher saving can sustain higher economic growth.

6. Use the information below to answer the following questions:

"Starting on January 1, 2016, all Chinese couples are allowed to have two children. This marks the end of China's one-child policy, … By the year 2050, commission projections expect the universal two-child policy to result in an extra 30 million working-age people…"

a) Using the Solow-Swan model describe the steady state level of per capita output in China before the full effect of 'allowance to have two children' takes place.




y
pf
y_0*
y_1*
$(n_1+d)k$
$(n_0+d)k$
a
b
$s=\theta y$
k
k_1*
k_0*

b) What would happen to the steady state level of per capita output in China in 2050? Explain your answer using the same model.

The original steady-state is shown by point a with its associated steady-state levels of per capita capital and income given by, respectively, k_0^* and y_0^*.

Consider now the implications of an increase in the rate of population growth. At the existing steady-state per capita capital stock, the higher rate of population growth means more resources need to be found to offset the effects of the higher population; hence the replacement investment line rotates to the left.

Given the current steady-state level of per capita income, the saving that is now generated is insufficient to cover the needs of replacement investment. As a result, the per capita capital stock contracts until a point is reached (point b) at which saving once again provides sufficient resources for replacement investment.

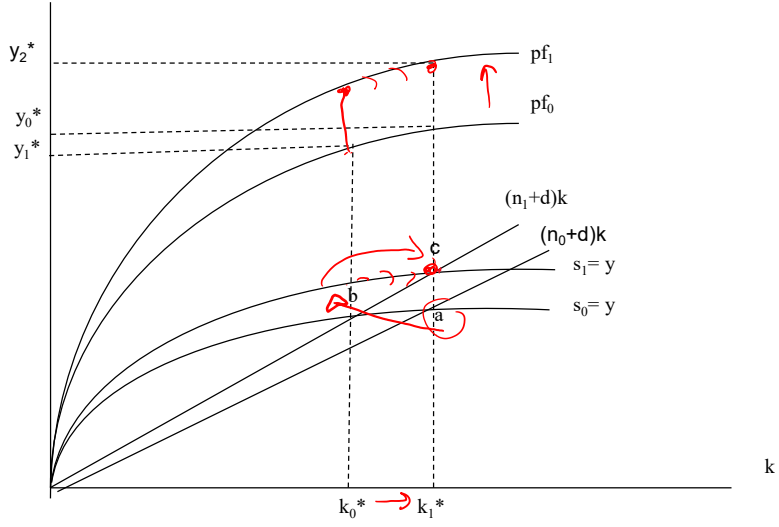
A new steady-state is reached (k_1* and y_1*), at which the saving produced from the steady-state level of income, y_1*, is equivalent to replacement investment.

Note that this level of steady-state income is below the level associated with the original level of population growth rate $n_{0.}$

To conclude, all else remaining unchanged, an increase in the rate of population growth implies a lower steady-state capital stock and hence a lower level of per capita income.

c) Depending on your answer in part (b) what other measure would you suggest to accompany the 'two children policy' for next three decades to ensure maintaining Chinese economic growth?

Following from part (b) at point b, growth will cease, the per capita capital stock will not change as saving provides just enough resources for replacement investment, not enough for any growth to the per capita capital stock. In the long run, *with a given level of total factor productivity*, the economy will be at this steady-state with zero growth.



If Chinese growth needs to be maintained there will be a need for an increase in productivity (reflected in an increase in total factor productivity).
This will shift the production function upwards to pf_1 as a given per capita capital stock will now yield more per capita income.
At the existing level of per capita capital, k_0*, saving, now given by the new saving function

$$s_1 = \theta y$$

provides more resources than those needed for replacement investment. As a consequence, the per capita capital stock grows as the economy moves towards a new steady-state (point c).
During this transition phase to the new steady-state, per capita income also grows (moving from y_1* to y_2*).
Note that once at the new steady-state, *without further growth in total factor productivity*, growth will once again stop.