Economics 101b; Fall 1999; Problem Set 3

Due in class September 28, 1999

1. Suppose that the economy is well-described by the Solow growth model, with the diminishing-returns-to-capital parameter $\alpha = 1/3$, the depreciation rate $\delta = .04$, the population growth rate n=.02, and the rate of increase of the efficiency of labor g=.02.

a. Suppose that the national savings rate s = 0.24, 24%. What is the steady-state capital output ratio?

b. Suppose that increased investment incentives and a large government budget surplus boost the savings rate s to 32%. What is the steady-state capital output ratio?

c. Suppose that in the year 2000 the efficiency of labor E is $10,000 a year. What is the level of GDP per worker in 2000 if the economy is on the steady-state growth path given in (a)? What is the level of GDP per worker in 2030 if the economy remains on the steady-state growth path given in (a)?

d. How much, in percentage terms, is the steady-state growth path given in (b) above the steady-state growth path given in (a)?

e. At approximately what rate will the capital output ratio converge towards its new steady state value in the year in which the savings rate is changed?

f. At approximately what rate will output per capita grow in the year in which the savings rate is changed?

2. Suppose that the economy is well-described by the Solow growth model, with the diminishing-returns-to-capital parameter $\alpha = 1/4$, the depreciation rate $\delta = .04$, the population growth rate n=.02, and the rate of increase of the efficiency of labor g=.02.

a. Suppose that the national savings rate s = 0.24, 24%. What is the steady-state capital-output ratio? If the efficiency of labor in year 2000 is equal to $20,000 a year, what is the steady-state growth path level of output per worker in 2000? What is the steady-state growth path level of consumption per worker in 2000?

b. Suppose that the national savings rate s = 0.32, 32%. What is the steady-state capital-output ratio? If the efficiency of labor in year 2000 is equal to $20,000 a year, what is the steady-state growth path level of output per worker in 2000? What is the steady-state growth path level of consumption per worker in 2000?

c. Can you explain why your level of consumption per worker in case (b) was different from your level of consumption per worker in case (a)? Was it lower or higher

3. Suppose that population growth depends on the level of output per worker, so that:

(1) n = (.0001) x [(Y/L) - $200]

the population growth rate n is zero if output per worker equals $200, and that each $100 increase in output per worker raises the population growth rate by 1% per year.

Suppose also that the economy is in its *Malthusian* regime, so that the rate of increase of the efficiency of labor E is zero and output per worker is given by:

(2) $$\frac{Y_t}{L_t} = \left(\frac{s}{n+\delta}\right)^{\frac{\alpha}{1-\alpha}} E_0$$

with the diminishing-returns-to-investment parameter $\alpha = .5$, with the depreciation rate $\delta = .04$, and with the efficiency of labor $E_0 = \$100$.

a. Suppose that the savings rate s is equal to .08, 8% per year. Graph (on the same set of axes) steady-state output-per-worker (Y/L) as a function of the population growth rate n from equation (2) and the population growth rate n as a function of output-per-worker (Y/L) from equation (1).

b. Where do the curves cross? For what levels of output per worker Y/L and population growth n is the economy (i) on its steady-state path, and (ii) at its Malthusian rate of population growth?

c. Suppose that the savings rate were to rise by an infinitesimal amount--say by one-hundredth of one percentage point, from .08 to .0801. Calculate approximately how the equilibrium position of the economy would change. By how much--and in which direction--would steady-state output per worker change? By how much--and in which direction--would the population growth rate change?

4. Suppose that the economy is well described by the Solow growth model, with the diminishing-returns-to-investment parameter $\alpha = 1/2$, the depreciation rate $\delta = .03$, the population growth rate n=.01, and the rate of increase of the efficiency of labor g=.01. Suppose that the savings rate s = 20 and that in year 2000 the efficiency of labor E is $10,000.

a. What is the steady-state capital-output ratio?

b. What is the steady-state level of output per worker Y/L in 2000?

c. Suppose that actual output per worker in 2000 is $35,000. Is output per worker above or below its steady-state value?

d. Using the approximation that each year the economy closes a fraction:

$(1-\alpha) \times (n + g + \text{delta})$

of the gap between its current level of output per worker and its steady-state value of output per worker, calculate (approximately) what output per worker will be in 2001.

e. Using the same approximation, what (approximately) will output per worker be in 2010?

f. Do you think the above approximation formula works well when we project far into the future? Why or why not? (Phrase your answer in terms of *economics*.)

5. Suppose somebody who hasn't taken any economics courses were to ask you why humanity escaped from the Malthusian trap--of very low standards of living and slow population growth rates that nevertheless put pressure on available natural resources and kept output per worker from rising--in which humanity found itself between the year 8000 B.C.E. and 1800. What answer would you give? (One paragraph only, please!)

6. Suppose somebody who hasn't taken any economics courses were to ask you why it is that some countries are so very, very much poorer than others in the world today. What answer would you give? (One paragraph only, please!)