

Economics 101b; Fall 2003; Problem Set 3

Due in section September 16, 2003

1. Many project that by the middle of the twenty-first century the population of the United States will be stable. Using the Solow growth model, what would such a downward shift in the growth rate of the labor force do to the growth of output per worker and to the growth of total output? (Consider both the effect of zero population growth on the steady-state growth path, and the transition from the "old" positive population growth to the "new" zero population growth steady-state growth path.)

2. 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!)

3. Today it appears that because of the computer revolution the rate of growth of the efficiency of labor in the United States has more than doubled, from 1 percent per year to about 2.5 percent per year. Suppose this increase were to be permanent. And suppose the rate of labor force growth were to remain constant at 1 percent per year, the depreciation rate were to remain constant at 3 percent per year, and the American savings rate (plus foreign capital invested in America) were to remain constant at 20 percent per year.

Assume that the efficiency of labor in the U.S. in 2004 is \$16,500 per year, and that the diminishing-returns-to-capital parameter a is $1/3$.

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

b. How would such a permanent acceleration in the rate of growth of the efficiency of labor change your forecast of the level of output per worker in 2040?

4. How would your answer to (3) be different if a were $1/2$? If it were $2/3$?

5. 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? (Two paragraphs only, please!)

6. Suppose we have our standard growth model with $s = 20$ percent, $n = 1$ percent, $g = 1$ percent, and d (depreciation) = 3 percent. Suppose also that the current level of the efficiency of labor E is \$10,000 per year and the current level of capital per worker is \$50,000. Suppose further that the parameter a in the production function:

is equal to 1: $a = 1$.

a. What can you say about output per worker in this economy? What would you project output per worker to be at some point in the distant future?

- b. Suppose the savings rate s is not 20 percent but 15 percent. How would that change your projections of the future growth of output per worker?
- c. What effect does growth in the efficiency of labor have on output per worker when $a = 1$?
- d. Why aren't the normal Solow model tools of analysis and rules of thumb much use when $a = 1$?

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

$$(1) \quad n = (.0001) \times [(Y/L) - \$200]$$

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. Thus output per worker is given by:

with the diminishing-returns-to-investment parameter $a = .5$, with the depreciation rate $d = .04$, 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? What are the equilibrium values of output per worker and population growth?
- c. Suppose you were to raise the savings rate by a very small amount. What would happen in the short run and the long run to output per worker? To the rate of population growth?