

ECON 101B: FALL 2006: PROBLEM SET 3

Due at start of lecture, September 19, 2006

1. 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 1.0 percent per year before 1995 to about 3.0 percent per year since. Suppose this increase were to be permanent. 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 2006 is \$18,500 per year, and that the diminishing-returns-to-capital parameter α is 1/2.

- What is the change in the steady-state capital-output ratio because of this acceleration in efficiency-of-labor growth? What is the new steady-state capital-output ratio?
- 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?
- How would your answers to (a) and (b) be different if α were 1/3? If it were 2/3?

2. Suppose—in the Malthusian model with natural resources—that population growth depends on the level of output per worker, so that:

$$n = (.00002) \times [(Y/L) - \$400]$$

That is, the population and labor force growth rate n is zero if output per worker equals \$400, and that each \$100 increase in output per worker raises the population growth rate by 0.2% per year. Suppose also that the natural-resources parameter β in the production function:

$$Y = K^\alpha (E_L L)^{1-\alpha-\beta} (E_R)^\beta$$

is 0.2. Suppose also that $g_L = 0$.

- If $g_R = 0.2\%$ per year, what is the steady-state rate of population growth? If it is 0.4% per year? 1% per year?
- How long does it take the population to double for each of the efficiency-of-using-resources growth rates above?
- By what multiple does the population grow in a millennium for each of the efficiency-of-labor growth rates in (a) above?

3. Suppose that you misestimate the capital stock—think that its rate of growth is lower than it actually is—but otherwise understand the parameters and the growth rates of the base-camp Solow growth model. How will your conclusions about the sources of economic growth be off?

4. Let us suppose that the price of capital goods in terms of output-in-general P_K varies, so that the law of motion for the capital stock in the Solow growth model is not:

$$\frac{dK_t}{dt} = sY_t - \delta K_t$$

but is instead:

$$\frac{dK_t}{dt} = \frac{sY_t}{P_{K_t}} - \delta K_t$$

Derive the steady-state balanced-growth capital-output ratio $(Y/L)^*$ for this model in which the price of capital goods varies.

5. Suppose that you have this augmented price-of-capital-goods-varies model, with a steady-state balanced-growth output-per-worker given by:

$$\left(\frac{Y}{L}\right)^* = \left(\frac{s}{P_K(n+g+\delta)}\right)^{\left(\frac{\alpha}{1-\alpha}\right)} E$$

And suppose that richer countries have lower prices of capital goods according to:

$$P_K = \left(\frac{Y}{L}\right)^{-\eta}$$

Solve for the steady-state capital-output ratio in terms of s , n , g , δ , and α —that is, eliminate the parameter η from the right hand side.

6. Using your answer from (5), suppose that $\eta=1/3$. Now consider the three cases of α equal to 0.25, 0.5, and 0.75. Suppose that something happens in the economy to permanently increase the savings rate from 20% to 21%. By what proportional fraction does steady-state output-per-worker increase relative to its previous steady-state balanced-growth path?

7. Write a paragraph explaining to somebody who hasn't taken this course how human populations could increase from 170 million in year 1 to 500 million in year 1500 without there being any noticeable increases in life expectancy or median material standards of living.

8. Take a look at

http://en.wikipedia.org/wiki/List_of_countries_by_GDP_%28PPP%29_per_capita_per_hour — the wikipedia page for “List of countries by GDP (PPP) per capita per hour.”

Select some countries that were once ruled by Communist governments and compare them to neighboring countries that were lucky enough to escape Communist rule. How big a shadow do you guess having a Communist government imposes on a nation on average, even today?

9. Take a look at the 2006 *Economic Report of the President* at

<http://www.gpoaccess.gov/eop/index.html>. Read pages 36-37 and 43-46. How would you translate the arguments made by Eddie Lazear and his colleagues about the long-run growth rate of the American economy into concepts introduced in this course?

10. We have cautioned you that the Solow growth model is—especially in its focus-on-the-steady-state-growth-path version—a *long run* model. What do we mean by that?