14.75J 9/18/2003
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Problem Set 4
Due: Thurs Nov 6 in class

This is essentially the same as problem set 2 except part B has been removed and part A has been shortened slightly (the changes are in bold type).

This problem set is about process, not the answers that you get in the end. You will have to make decisions about how to approach certain questions, the important thing is to explain clearly what you decided to do and why. The problem set is based on class lectures and chapter 3 of the textbook. You are going to use the same data that you used in problem 2 of problem set 1, at http://devdata.worldbank.org/dataonline/ as well as data from http://libraries.mit.edu/get/uncommon and analyze it in Excel (or a similar program if you have another one you prefer.)

Part A: Generating the data

1. Choose 3 countries to study, 2 developing and 1 developed. Try to choose countries where the data goes back at least 30 years.

2. Get data on the trends over time of population, labor force, GDP, investment, savings, and foreign capital investment. Transform any nominal variables into real values. **Choose two of these variables** to analyze the trend of over time (using graphs and words).

3. Calculate the average population growth rate, n, over the time period.

4. Create a variable that represents the stock of capital for each year. Not the investment (the flow), but the stock. If you can't find a variable that gives you this information, calculate it in the following way:

K_t is the initial capital stock plus net investment each year, and the initial capital stock is the sum of net investments over the last 10 years. The equations for this are:

$$K_t = \left(\sum_{s=0}^{t} I_{ns}\right) + K_0$$

where

$$K_0 = \sum_{s=-10}^{-1} I_{ns}$$ and I_{nt} is net investment in year t.

Net investment is gross investment minus depreciation.

If the value of net investment is not available, you can calculate depreciation GNP- NNP (Gross National Product – Net National Product).

If neither net investment or NNP are available then you can assume a depreciation rate of 5% and make the calculation using I_{gt}, gross investment. Then you use the sum over the last 5 years instead of the last 10 for initial stock, so your calculations look like this:

$$K_0 = \sum_{s=-10}^{-1} I_{gs} ,$$

$$K_1 = K_0(1-.05) + I_{g1},$$

$$K_{t+1} = K_t(1-.05) + I_{gt}$$

5. If the level of savings for each year is available, use that to calculate the average savings rate (savings/GDP) over the time period. If saving is not available directly, calculate it by subtracting consumption from GNP. If that is not available, then use investment instead. (Because investment is approximately equal to savings.)

Part C: Technological Change

Assume the production function is $Y_t = K_t^{\alpha}(A_t L_t)^{1-\alpha}$

1. Find α. To do this, find the fraction of output accounted for by payments to labor. Calculate payments to labor by multiplying the labor force times the wage, then divide by net output. The result of that calculation will give you $1-\alpha$. If the data you need to make that calculation is not available, assume that $\alpha = \frac{1}{3}$. (**Be careful here, the wage data in the UN common database is in different units for different countries at different times, be sure to read the footnotes.)**

2. Write the production function in per capita terms, using lower-case letters to represent the per capita values.

The equation for technological change is then

$$\frac{A_{t+1} - A_t}{A_t} = \frac{1}{1-\alpha}\left[\frac{y_{t+1} - y_t}{y_t} - \alpha\frac{k_{t+1} - k_t}{k_t}\right]$$

Use this to calculate technological change over the period.

3. Draw the Solow model diagrams in terms of efficiency units of output and capital. This means that you will divide through by $A_t L_t$. Call the rate of technological change *g*.

4. Can you provide a logical interpretation for each of these graphs? Do the countries seem to be following the Solow model with technological change—are they either at the steady state or moving towards it? Did adding technological change to the model lead to more logical results?