THE UNIVERSITY OF ILLINOIS AT CHICAGO
ECON 534: Econometrics I
AUTUMN 2011

Prof. George Karras

Homework #1: Absolute Convergence

Homework #1 deals with the econometrics of "absolute" convergence in per capita income, i.e., convergence under the assumption of an identical steady-state across countries. This unrealistic assumption will be relaxed in Homework #2. It is used here because (i) it implies a simple bivariate regression model, and (ii) it was employed in the empirical growth literature until very recently resulting in a lot of confusion and misunderstanding.

0. THEORY. Neoclassical growth theories (the Ramsey or Solow growth models, for example) predict convergence in income per capita across countries: the rate of growth of per capita income is negatively related to the level of initial income, so that poor countries tend to grow faster than rich ones. However, endogenous growth theories (the Lucas or Romer growth models, for example) predict no convergence. The neoclassical model implies (see equation (15) in "A Contribution to the Empirics of Economic Growth" by Mankiw, Romer, and Weil (MRW), *Quarterly Journal of Economics*, May 1992):

$$\ln(y_T) - \ln(y_0) = (1 - e^{-\lambda T}) \ln(y^*) - (1 - e^{-\lambda T}) \ln(y_0), \qquad (0)$$

where y is GDP per adult, T is the terminal year, 0 the initial year, λ is the rate of convergence, and y^* is the steady-state y. Neoclassical theory predicts that $\lambda > 0$ and thus $(1 - e^{-\lambda T}) > 0$.

1. DATA. Consider the data in the Appendix of MRW. Using the software of your choice, input the series y1960 (GDP/adult in 1960) and y1985 (GDP/adult in 1985) for the 98 countries of the non-oil sample. These are the countries for which the sample variable N equals 1 in the appendix. Do *not* input data for the countries for which $N = 0$. In RATS your program should look like this (the last line is optional):

```
allocate 98
data(unit=input,org=obs) / y1960 y1985
2485 4371
1588 1171
1116 1071
... etc...
879 2159
9523 12308
1781 2544
print / y1960 y1985
```

2. ESTIMATION. To test the predictions of the neoclassical theory, rewrite equation (0) above in linear regression form:

$$growth_i = \beta_0 + \beta_1 \ln y1960_i + \varepsilon_i, \qquad I = 1,2,...,98, \tag{1}$$

where the variables are $growth = \ln(y_{1985}) - \ln(y_{1960})$ and $\ln y1960 = \ln(y_{1960})$, the parameters (both assumed to be constant) are $\beta_0 = (1 - e^{-\lambda T})\ln(y^*)$ and $\beta_1 = -(1 - e^{-\lambda T})$, and ε is the error term.

(a) Using the software of your choice, construct the variables *growth* and *lny1960*. The RATS code should look like

```
set lny1960 = log(y1960)
set growth = log(y1985) - log(y1960)
```

(b) Suppose ε satisfies the classical assumptions ($E\varepsilon_i = 0$ and $E\varepsilon_i^2 = \sigma^2$, for all *i*; and $E\varepsilon_i\varepsilon_j = 0$, for $i \neq j$). Using the software of your choice, obtain the OLS estimates of β_0, β_1, and σ^2. In RATS the linear OLS command takes the general form:

```
linreg dep.variable
# constant indep.variable#1 indep.variable#2 ...etc...
```

Note that here there is only one independent variable.

(c) In addition assume that ε_i is normally distributed. Test the null hypothesis $H_0 : \beta_1 = 0$ against the alternative $H_1 : \beta_1 \neq 0$. Also construct a 95% confidence interval for β_1. Based on your findings, is the neoclassical growth model supported? The endogenous growth model? What is the value of λ, the rate of convergence, implied by the OLS estimate of β_1?

Running RATS on ICARUS: You may complete the homework using the software of your choice on any computer you wish. If you decide to use RATS on ICARUS, you may find the following information useful. First, after you complete all your RATS instructions, add the final line

```
end
```

and save the file giving it any name you wish. An example would be hw1.rat. Then, to execute on ICARUS, give the following command:

```
rats hw1.rat hw1.out
```

and the output file will be named hw1.out. For full credit, the answers to each homework must be accompanied by an output file. Highlight the relevant information.