Applied Economics
Regression Model in gretl
Application: Economic Growth

Create a file .inp in gretl to answer each one of the questions.

We will replicate many of the results in "A contribution to the empirics of economic growth" by Mankiw, Romer, and Weil published in *The Quarterly Journal of Economics* in 1992 (MRW). The file mrw.gdt contains the data used in the paper. The data set includes real income, government and private consumption, investment, and population for 121 countries.

The paper considers three different groups of countries: 98 non oil producers countries, 75 intermediate, and 22 OCDE countries. We focus on **intermediate countries** which are the countries with more reliable data.

1. First, MRW estimate the basic Solow model (see the notes). The reference equation for the first part of the analysis is:

$$ln\left(\frac{Y}{L}\right) = a + \frac{\alpha}{1-\alpha} ln(s) - \frac{\alpha}{1-\alpha} ln(n+g+\delta) + \varepsilon$$

   where Y/L is the income per worker, s is the investment rate, n the population growth rate, g is the rate of technological progress and δ is the depreciation rate.

   i) Estimate this equation using OLS, assuming $g + \delta = 5\%$, and without imposing any restriction on the coefficients. Use as dependent variable the logarithm of the output in 1985. Are the coefficients significant at a 5% level? Do investment and population rates explain an important part of the variability of the output?

   ii) Test the hypothesis that the coefficients are equal in magnitude and opposite in signs (as the theory predict).

   iii) Estimate again the equation of the Solow model imposing the coefficients of $ln(s)$ and $ln(n + g + \delta)$ to be equal in magnitude and opposite in signs. Which is the implicit value for α?

2. In the second part, MRW estimate the augmented Slow model, by including the stock of human capital. The new reference equation is:

$$ln\left(\frac{Y}{L}\right) = a - \frac{\alpha+\beta}{1-\alpha-\beta} ln(n+g+\delta) + \frac{\alpha}{1-\alpha-\beta} ln(s_k) + \frac{\beta}{1-\alpha-\beta} ln(s_h) + \varepsilon$$

   where s_k is the investment rate in physical capital, and s_h the rate of human-capital accumulation.

   MRW use the percentage of the working-age population in secondary school as a proxy for the rate of human-capital accumulation.

i) Estimate the new reference equation without restricting the coefficients. Is the human-capital measure significant? Has the goodness of fit measure changed significantly?

ii) Test the hypothesis that the sum of the three slopes is equal to zero (as the theory predicts).

iii) Estimate the restricted model and compute the implicit values for α and β.

3. MRW also use the regression analysis to study the idea of convergence in the framework of the Solow model

i) First, they analyze unconditional convergence. Unconditional convergence implies negative correlation between the growth rate and the initial level of income. In this exercise we use the output per capita in 1960 as the reference year.

Estimate the unconditional convergence equation: $g_{85\_60} = \beta_0 + \beta_1 ln\left(\frac{Y_{1960}}{L_{1960}}\right) + u$,

where g_{85_60}, the growth rate between 1985 and 1960 is given by $ln\left(\frac{Y_{1985}}{L_{1985}}\right) - ln\left(\frac{Y_{1960}}{L_{1960}}\right)$.

Interpret the results. Is there any evidence of unconditional convergence?

ii) Then, they analyze conditional convergence. We add investment and population growth rates into the previous equation. Interpret the results? Is there any evidence of conditional convergence?

iii) Finally we analyze conditional convergence in the augmented Solow model. In this case we need to add education to the equation in the previous question. Interpret the results. Is there any evidence of conditional convergence?

iv) Estimate the last model imposing that the sum of the slopes is zero. Which is the implied convergence rate in this model (assume that $n + g + \delta = 0.06$)?