Manufacturing Productivity in the United States.

Open Excel. Open the file 'S:\teff\450\arcview\manuf.xlsx.' The data cover the quinquennial Census of Manufactures years 1982, 1987, 1992, 1997, 2002, and 2007. The original data are county-level, but I have aggregated them up to the Labor-Market-Area (LMA). Some LMAs are missing for 2002 and 2007.

A manufacturing production function gives the relationship between output and input

$$Output = fn(Inputs)$$

In many studies employing the Census of Manufactures, output is value-added, and three different inputs are considered: capital, production labor hours, and number of non-production employees. A production worker is one who is directly engaged in the fabrication of a product and who is paid an hourly wage. A non-production worker is typically employed in technical, purchasing, marketing or transportation positions in a manufacturing plant, and is paid an annual salary. Capital is the summed payments to all non-labor inputs, and can be considered as the value of non-labor inputs.

$$Value\ Added = fn(Capital\ services, production\ Labor\ Hours, nonproduction\ Employees)$$

Economists specify the production function in a specific functional form. One of these is the Cobb-Douglas production function:

$$V_i = A_i K_i^{\alpha_K} H_i^{\alpha_H} N_i^{\alpha_N} \quad \text{(Eq. 1)}$$

In the above equation, the data in the spreadsheet provide information for *V* (value added in manufacturing), *K* (value of capital services), *H* (production labor hours), and *N* (non-production labor hours). The *i* subscript indicates that the value for each of these variables changes for each LMA. The variable *A* indicates the technological level of each LMA: the higher the value of *A* for an LMA, the more output it is able to produce for a given amount of input. But we don't know the value of *A*, nor do we know the function's parameters (the exponents α_K, α_H, and α_N). The parameters are scalars—unlike the data values, they do not vary from one LMA to another. We can use regression to estimate the parameters by linearizing the Cobb-Douglas production function:

$$\ln(V_i) = \hat{\alpha}_0 + \hat{\alpha}_K \ln(K_i) + \hat{\alpha}_H \ln(H_i) + \hat{\alpha}_N \ln(N_i) + \varepsilon_i \quad \text{(Eq. 2)}$$

The carats over the estimated parameters indicate that they are estimates from a regression. The first term $\hat{\alpha}_0$ is the regression intercept. The last term ε_i is the regression residual.

Productivity is the ratio of output over an input. Total factor productivity is the ratio of output over some function of all inputs. The technological variable in Equation 1 provides a measure of the total factor productivity of an LMA:

$$A_i = \frac{V_i}{K_i^{\alpha_K} H_i^{\alpha_H} N_i^{\alpha_N}} \quad \text{(Eq. 3)}$$

We can use our regression results in Equation 2 to estimate total factor productivity:

$$A_i = \exp(\hat{\alpha}_0 + \varepsilon_i) \quad \text{(Eq. 4)}$$

Assignment

For your assignment you will use some of the methods you learned in previous weeks.

1. Save the file 'S:\teff\450\arcview\manuf.xlsx' to the computer on which you are working. Conduct a regression of the linearized Cobb-Douglas production function for two of the four census years. For each year, use the estimated residuals and the estimated intercept term to create a total factor productivity measure for each LMA. Save your total factor productivity measures as a column in the worksheet for that year.
2. In ArcGIS, open the theme 'S:\teff\450\arcview\lma.shp.' Add the xls file containing your total factor productivity measures, then add the worksheets in which you have your total factor productivity figures saved. Join your total factor productivity files with the lma.shp attribute table. Export visually meaningful maps that will tell the story about your total factor productivity measures.
3. Next Monday, your group will present your findings. A good presentation will compare the two years and try to use the information from previous classes (on demographics and occupations) to explain results.