Homework 11: Growth and Debt

36-402, Advanced Data Analysis

Due at 11:59 pm on Monday, 29 April 2013

An important and controversial question in macroeconomics and political economy is whether high levels of government debt causes the economy to grow more slowly or even shrink. There are several plausible-sounding reasons why it might[1]; some economists claim that there is a threshold level of debt, perhaps around 90% of GDP, above which growth rates plummet.

Against this, there are other reasons why high levels of debt might *not* cause growth to slow, at least not always[2]. In particular, since "high levels of government debt" are defined relative to the size of the economy, as a high ratio of debt to GDP, slow growth itself might cause higher levels of government debt.

This week's data set contains information on GDP and government debt for a selection of countries since World War II. For each country and year, we should have the GDP (nominal, i.e., not adjusted for inflation or differences in exchange rates) and the size of government debt (also nominal). Unfortunately, one or both values may be missing for some countries in some years.

1. (10) The data set contains a variable, `growth`, which is the annual growth rate in real (inflation-adjusted) GDP for each country and year. It also contains a variable, `ratio` which is the ratio of government debt to GDP. Make a scatter-plot with `growth` on the vertical axis and `ratio` on the horizontal. Describe the patterns you see, if any.

2. (15) Run a nonparametric regression of `growth` on `ratio`, and plot the resulting curve. Describe and interpret the curve. Does it suggest an abrupt slowing of growth above some threshold level of debt?

3. (10) Since changes in government debt levels might take some time to affect economic growth, we would like to compare growth in year $t + 1$

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[1] High levels of government borrowing might "crowd out" investing in the private sector, by using up available savings and/or raising the interest rates at which businesses can borrow; capitalists might anticipate that the debt will either be paid off through high taxes or discharged through inflation, and prefer to spend their money on luxuries now, rather than invest and see the investment go away later; high levels of debt might lead to lower confidence that the government generally knows what it's doing, making investment seem too risky; etc.

[2] A depressed economy has unused resources, so government employment needn't lead to crowding out; the things government spends money on (roads, schools, hospitals, basic research, honest markets) increase the value of private investments; governments which can borrow large sums are receiving a market endorsement of their willingness and ability to pay their debts; etc.

to `ratio` in year t. Create a new variable, `growth.lead1`, which records for each country/year the *next* year's GDP growth, with NAs in the right places when it is not available. Describe, in words, how your code works. Add `growth.lead1` to the data frame.

Hints: Make sure that you do not confuse growth rates from different countries (so that, e.g., the last year for Austria gets a growth rate from Belgium). You may find Recipes 14.7 (and 6.6) from *The R Cookbook* helpful.

4. (10) Plot `growth.lead1` against `ratio`, and do a nonparametric regression of the former on the latter. Describe the results, and compare them to those of Problem 2.

5. (15) Economic growth rates tend to be rather persistent over time within countries. Estimate an additive model where `growth.lead1` is predicted from `growth` and `ratio`. Is the partial response to the previous year's growth nearly linear? Should it be? Compare the partial response function for debt to the curves from problems 2 and 4.

6. (10) Create a new variable, `growth.lag1`, which represents the *previous* year's growth rate (with NAs in appropriate places), and add it to the data set. Plot it against `ratio` and fit a nonparametric regression. Does `ratio` do a better job of predicting `growth` or `growth.lag1`?

7. (15) Estimate an additive model in which the current year's `ratio` is predicted by last year's `ratio`, last year's `growth`, and the current year's `growth`. (You may have to create a new column.) Describe the partial response functions, and whether any predictor variables could be dropped.

8. (15) Explain what we would have to assume for the model in Problem 5 to give us an unconfounded estimate of the causal effect of government debt on future economic growth; be as specific as possible. (You may want to draw some DAGs, and include them in your write-up.) Comment on how plausible those assumptions are, and on what might go wrong if the assumptions fail.