Washington University
Department of Economics

Fall 2009
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Economics 518B

Homework #4
Testing Money-Income Causality
Due: Tuesday 10/13

Related papers:

- Sims, C.A., 1972, Money, Income, and Causality, *American Economic Review* 62, 540-552. RP
- Stock, J. and M. Watson, 2002, Vector Autoregressions, *Journal of Economic Perspectives* 15, 101-115. RP

This assignment is related to the (in)famous "St. Louis regression" and the Sims (1972), "Money, Income, and Causality" article. For the assignment, you will obtain data from the St. Louis Fed database located at

http://www.stls.frb.org/fred/

The first series you will obtain is "Real Gross National Product in Chained 2000 Dollars", which can be found using the Gross Domestic Product and Components link. The data are available from 1947:1 and are quarterly. The second series you will obtain is "St. Louis Adjusted Money Base, Seasonally Adjusted", which can be found using the Monetary Aggregates/Adjusted Money Base Data links. The third series you will obtain is the Consumer Price Index For All Urban Consumers: All Items. The data are available from 1950:01 and are monthly (some series are available longer, but just use 1950:01 on). You will have to convert the money base and CPI data to quarterly data. The best (easiest) method I can think of is to write a very simple GAUSS program to do this. Explain how you choose to convert your data to the quarterly frequency.

In his article, Sims uses nominal quantities and looks at both M1 and the Money Base. Also, Sims does not account for the nonstationarity in the time series. You will account for the nonstationarity in two ways. In the first case, you will difference the data. In the second case, you will remove a linear time trend from the levels.

1. Open EViews and create a new workfile. Select quarterly frequency and dates 1950:1 to the latest date for which data are available. Import the money base and GNP data into the file, naming the series "mb", "cpi", and "gnp", respectively. Type "genr lmb=log(mb)", "genr lp=log(cpi)", "genr lm=lmb-lp", and "genr ly=log(gnp)". To convert to first differences, type "genr dlm=d(lm)" and "genr dly=d(ly)". Save workfile as "hw4.wf1".

a. To determine the lag order for the Grager-Causality regressions, follow a backwards selection procedure for the significance of a lag in a VAR regression. In particular, use 12 quarters (3 years) for a maximum order. Then, select Estimate VAR from the Quick menu. Type in "dlm dly" for endogenous variables. Change the sample to "1953:2 2006:1" (or whatever the latest date is). (Your adjusted sample length should always be the same.) Initially set lag intervals to "1 12". Click OK. Scroll down to the bottom to see the log likelihood value for the bivariate system (this is at the very bottom, after the log likelihood values for each equation). Record the log likelihood value. Click Estimate. Change the lag intervals to "1 11". Click OK. Again, record the log likelihood value. The LR statistic is $2*(ll_p - ll_{p-1})$ and has a $\chi^2(4)$ distribution (there are four constraints imposed when you reduce the VAR(p) order by one). Use the critical value of 9.49 to determine significance at the 5% level. If your statistic for p=12 does not exceed the critical value, click estimate. Change the lag intervals to "1 10". Click OK. Record the log likelihood value. Now, calculate the LR statistic for p=11. Keep reducing the order of the model until a statistic is above the critical value. Write up what your LR statistics are for each case. [Note: I have been made aware that some newer versions of EViews produce strange results, including negative LR stats. This is impossible. The log likelihood for the more general model must be at least as large as the log likelihood for the restricted model. Make sure this is the case before conducting the LR tests. If not, use a different version of EViews or another program.]

b. Now you can run the Granger Causality tests. Suppose you found the LR statistic was significant for p=10. Then, select Estimate Equation from the Quick menu, set sample period to "1953:2 2006:1" (or latest date), and type "dly c dlm(-1 to –10) dly(-1 to -10)". To test Granger causality of money on income, select View/Coefficient Tests/Wald… and type "c(2)=c(3)=c(4)=c(5)=c(6)=c(7)=c(8)=c(9)=c(10)=c(11)=0". Print output. Then, test income on money by typing "dlm c dly(-1 to –10) dlm(-1 to –10)" and typing the same thing as above for the Wald test. Discuss your results.

c. Go back and re-estimate the VAR(p) regression. Click Impulse and choose display type multiple graphs. Choose the accumulated responses option, if available. [If not, print as table, import table into Excel, and calculate cumulated responses.] Print output. Click Impulse again and reverse the ordering to "dly dlm". Print output. How do the IRFs compare? Give an economic interpretation of the IRFs. Select View/Residuals/Correlation matrix. Write down the correlation between the two shocks. Does this explain the similarity/differences between your IRFs? Why?

d. If you have an old version of EViews, click Impulse again. In newer versions of EViews, click View and select Variance Decomposition. Select Table and Variance Decomposition and Periods "25". Print output. Reverse the ordering and print output. Interpret your results. Do you think an RBC (real business cycle) person would approve of these results? Discuss.

2. Type "genr t=@trend(1950:1)" and repeat steps a. through d. using lm and ly (and their lags) instead of the first differences in all of the regressions and always include t as an exogenous regressor in estimation, including in the single equation regressions used to test for granger causality. Also, do not use cumulated impulse responses.

3. Estimate a VAR(2) model using lm and ly and including t as an exogenous regressor. Print output. Open GAUSS. Enter in your parameter estimates for the companion F matrix of the state-space representation of a VAR(2) model (don't worry about the time trend). What is the companion F matrix for a VAR(2) model look like in general (write up F with the VAR(2) parameters, 1's, and/or 0's in the elements). Type "eig(F)" and "abs(eig(F))". Is the VAR(2) model of lm and ly stable?

4. Write a brief discussion comparing your results to Sims's. Are your results different? If so, can you say why? You might run a few key regressions using the shorter sample used in his paper. Also, read the Stock and Watson (2002) paper in the reading package. Summarize what the paper says about how to identify effects of monetary policy on output and what those effects are.