Time Series Econometrcs, Fall 2009
Prof. Petr Zemčík

HOMEWORK ASSIGNMENT ONE

The empirical assignments 1 and 2 are the same for people sharing assigned countries. Feel free to consult with students who have the same country but submit your own work.

1. [3 points] **ARMA estimation**

Download the GDP series for your country from the file TSF09_HW1_DATA.xlsx whose zipped version is available on the course website at
http://home.cerge-ei.cz/petrz/Econometrics/TS2009.html

Estimate the chosen time series with an ARMA model by using the Box-Jenkins methodology:

a. Visual inspections of data → data transformations → stationarity
Plot original time series and decide what kind of transformation to use in order to achieve stationarity. Usually one considers converting data into real terms, taking natural logarithm, differencing, or detrending time series. Describe the chosen transformation.

b. Identification of ARMA process
Plot the sample ACF, PACF and consult the Q-statistics (use the TSP command BJIDENT) for your series. Based on these plots choose the proper number of lags of the ARMA model. If your plots suggest several potential ARMA models, use the parsimonious one. If the choice of the proper number of lags seems impossible, it suggests your data is most likely non-stationary and you should go back to the step 0 and consider some other or additional transformation or different choice of the time span.

c. Estimation of the chosen ARMA process
To estimate the ARMA process use the TSP command BJEST.

d. Diagnosis of residuals
Plot the sample ACF, PACF, and Q-statistics of the residuals of the model. The residuals should be a white noise. Otherwise something is wrong either with the identification (go back to step 1) or with the data transformation (go back to step 0).

e. Summarize your findings. Make sure you include computer printouts.

2. [3 points] **Conditional Heteroskedasticity**

Download the CPI series for your country from the file TSF09_HW1_DATA.xlsx whose zipped version is available on the course website at
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a. Use differences in (natural) logs to calculate inflation. Estimate the resulting time series by an AR(P) model using Box-Jenkins methodology (see Problem 1).

b. Test the residuals for conditional heteroskedasticity using the LM and Ljung-Box tests. If you reject H0 in any of the two tests, estimate the inflation by an AR(P)-GARCH(p,q) model. Use GARCH command in TSP. For example an AR(1)-GARCH(1,1) model is estimated by a command: ARCH (NOMEAN,NAR=1,NMA=1) Y C Y(-1). Also look at the help examples. If you do not reject H0, estimate an AR(P)-GARCH(p,q) model anyway as an exercise.

c. Test the residuals from your AR(P)-GARCH(p,q) model for conditional heteroskedasticity.

d. Summarize your findings. Make sure you include computer printouts.

3. [1 point] Consider the following two equation linear rational expectations model.

$$y_t = \alpha E_t y_{t+1} + x_t + u_t,$$

$$x_t = \gamma x_{t-1} + \delta + v_t.$$

The variable y_t is endogenous, α is a structural parameter and δ and γ are policy parameters. The terms v_t and u_t are random variables that are independently distributed through time and have zero mean.

a. Write down the value of y_t as a function of the expected value of all *future* values of x_t, of the current values of x_t and u_t and of the parameters of the model.

b. What restriction must you place on the parameter α to guarantee the uniqueness of a rational expectations equilibrium for this model?

c. Describe the value of x_{t+s} as a function of *past* realizations of the policy shocks v_{t+z}, $z = 1, ..., s$, of the value of x_t and of the parameters of the model.

d. Using your answers to parts a, b, and c, write down the unique rational expectations equilibrium of the model. That is, find an expression for y_t as a function of x_t, u_t and the parameters of the model.

4. [1 point] Enders, Chapter 1, Problem 6a.

5. [2 points] Enders, Chapter 1, stability conditions for nth-order systems, p. 30. Show that the conditions hold for a 2nd-order difference equation $y_t = a_1 y_{t-1} + a_2 y_{t-2}$ by relating characteristic roots α_1 and α_2 to autoregressive coefficients a_1 and a_2.