Assignment 2

Econ 8375 - Econometrics II

Due December 10, 2018

(by e-mail in `pdf`)

1. Consider estimating the following nonlinear smooth-transition autoregressive (STAR) model

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + \theta[\beta_0 + \beta_1 y_{t-1}] + \varepsilon_t \tag{1}$$

where

$$\theta = \frac{1}{1 + \exp(-\gamma(y_{t-1} - c))} \tag{2}$$

and where the constants c and γ are the threshold and the smoothness parameters, respectively. The Stata `.do` file contains the code to estimate this model via nonlinear least squares. In addition, you will also find the code to estimate Equation 1 using a grid search with the usual OLS command `reg`.[1]

   (a) Run the first part of the code and estimate Equation 1 via nonlinear least squares.

   (b) Familiarize yourself with the `.do` file and understand line-by-line what the code is doing.

   (c) Run the second part of the code and see how the estimates of the grid search compare with the ones obtained using nonlinear least squares.

[1] The grid search is just a procedure to estimate a coefficient (e.g., c or γ) by creating a grid and estimating the model many times for different values of the coefficient. Then the selected value is the one that minimizes the residuals sum of squares, the same as in OLS.

(d) Using nonlinear least squares fix $c = 5$ and estimate the value of γ.

(e) Using the grid search fix $c = 5$ and estimate the value of γ. (optional)

(f) Using nonlinear least squares estimate both, c and γ.

(g) Using the grid search to estimate both, c and γ. (optional)

2. Consider the following VAR model

$$y_t = a_{10} + a_{11}y_{t-1} + a_{12}z_{t-1} + e_{1t} \qquad (3)$$
$$z_t = a_{20} + a_{21}y_{t-1} + a_{22}z_{t-1} + e_{2t} \qquad (4)$$

(a) Following the simulation exercise in Section 8.1.2 of the class notes, simulate this VAR for $a_{10} = 0$, $a_{20} = 0$, $a_{11} = 0.2$, $a_{12} = 0.4$, $a_{21} = 0.3$, and $a_{22} = 0.6$.[2]

(b) Graph both of the simulated series.

(c) Use the command `var` to estimate back the original Equations 3 and 4. Explain the differences between the estimates and the true values used in the simulation.

(d) Check if the AIC and the SBIC actually select one as the optimal lag length.

(e) Check the stability conditions of the two-equation model.

(f) Obtain and interpret the Impulse Response Functions. Make sure you impose the correct restrictions on the B matrix.

(g) Test if z Granger causes y.

(h) Simulate the model again, but this time for $a_{10} = 0$, $a_{20} = 1$ $a_{11} = 0.2$, $a_{12} = 0.4$, $a_{21} = 0.8$, and $a_{22} = 0.6$.

(i) Graph both of the simulated series.

(j) Use the command `var` to estimate back the original Equations 3 and 4.

(k) Check the stability conditions of the two-equation model.

(l) Test for unit roots in each of the series.

[2] Use your birthday (day and month) as the seed for one of the white noise processes.

(m) Use the AIC and the SBIC to obtain the optimal lag length for a two equation model.

(n) Test if the variables are cointegrated.

(o) If they are cointegrated, estimate a vector error correction model with the optimal lag length. Write down the estimated model and interpret the results.