Introductory Econometrics

Tutorial 11

<u>PART A:</u> To be done before you attend the tutorial. The solutions will be made available at the end of the week.

1. Do you agree or disagree with the following statement: 'Seasonality is not an issue when using annual time series observations'. Briefly explain.

2. Define the following, and in each case explain that if you inspect the correlogram of a sample of time series observations from that process, what you would expect to see.

   (a) a covariance stationary process

   (b) a white noise process

   (c) a mean reverting process

   (d) a trend stationary process

   (e) a random walk

3. Download the Eviews workfile named *retail.wf1* from Moodle. This file contains quarterly growth rates in UK retail sales (seasonally adjusted) from 1989Q2 to 2017Q2. Denote this time series by *ret* and run the following OLS regression:

$$ret_t = \beta_0 + \beta_1 ret_{t-1} + u_t. \tag{1}$$

   Plot the resulting residuals. Do they look like realisations of a white noise process? Formally check whether the residuals from this regression are serially correlated by use of the Breusch-Godfrey test (use 4 lags). Briefly explain.

Do not forget to bring your answers to PART A and a copy of the tutorial questions to your tutorial.

<u>Part B:</u> This part will be covered in the tutorial. It is still a good idea to attempt these questions before the tutorial.

The purpose of this tutorial is to understand why serial correlation can appear in the error term and practice detecting and correcting for this problem when using data.

1. Let

$$y_t = c + \varphi_1 y_{t-1} + u_t, \text{ with } |\varphi_1| < 1 \text{ and} \tag{2}$$

$$u_t = \rho u_{t-1} + e_t, \text{ with } |\rho| < 1 \text{ and} \tag{3}$$

$$e_t \sim i.i.d(0, \sigma^2).$$

   (a) Show that (2) may be rewritten as

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + \alpha_2 y_{t-2} + e_t,$$

   where

$$\alpha_0 = (1-\rho)c, \ \alpha_1 = (\varphi_1 + \rho), \ \alpha_2 = -\rho\varphi_1.$$

   (b) What is the implication of the result in part a)? Briefly explain.

2. *A dynamically well-specified model is the one with no evidence of serial correlation in its errors.* Consider the data on US real GDP (US_gdp.wf1):

   (a) Create the quarterly GDP growth rate using logarithmic transformation and differencing. Denote the series by *dlgdp*.

   (b) Truncate the sample such that you consider data ranging from *1955q1 to 2017q2*. Estimate the following OLS regression:

$$dlgdp_t = \beta_0 + \beta_1 dldgp_{t-1} + \beta_2 dlgdp_{t-2} + u_t. \tag{4}$$

   To change the sample, select *sample* from the workfile toolbar. In the dialogue box that appears type *1955q1 2017q2* and click on *OK*. Notice that the sample (but not the range) has now changed in the status window. *Do not change the workfile range in the status window.*

   (c) Inspect the time plot and the correlogram of the residuals associated with the estimated model. Is there any visual evidence that the dynamics of the model is not specified well?

   (d) Test for autocorrelation in the errors of model (4) by using the *Breusch-Godfrey* test (include 8 lags for this test). Discuss your results.

3. *We can use the usual econometric tools in a dynamically well-specified model.* Early warning systems are very useful for policy makers. In economics, variables which can give us advanced warning that the economy may be slowing down in 3 months to a year ahead are very useful. Such variables are called "leading indicators". The "interest rate spread", which is the difference between long term and short term interest rates, is believed to be a leading indicator. When the spread becomes very small or even negative, it means that confidence in the long-term prospects of the economy is low, which warns of a possible low growth period or even a recession ahead. The data file used in previous question *US_gdp.wf1* contains quarterly observations on the real U.S. Gross Domestic Product (gdp), the U.S. 3-Month Treasury bill interest rates (ir_3m) and the U.S. 20-Year Government bond yields (ir_20y) for the period 1954Q1 to 2017Q2. You have already created *dlgdp*.

   (a) Switch the sample back to 1954Q1 to 2017Q4 and generate a new variable called $spread = ir\_20y - ir\_3m$. Is *spread* white noise? Is it mean-reverting? Does its correlogram suggest that *spread* is stationary?

   (b) In order to investigate the leading indicator property of *spread*, use data from *1955q1 to 2017q2* to estimate the following model:

$$dlgdp_t = \beta_0 + \beta_1 dldgp_{t-1} + \beta_2 dlgdp_{t-2} + \beta_3 spread_{t-1} + \beta_4 spread_{t-2} + u_t,$$

   and test for the joint significance of $spread_{t-1}$ and $spread_{t-2}$ at the 5% level of significance. What are the null and alternative hypotheses? What is the restricted model? What is the test statistic and its distribution under the null? Perform the test and state your conclusion.

   (c) Drop the lag of *spread* that is least significant and reestimate the equation. Using this estimated equation, explain the dynamic effect of a 1 percentage point *decrease* in the spread between long-term and short-term interest rates on the growth rate. In particular, how long does it take for this change to start affecting the growth rate, and what is the long-run effect of this change on the growth rate?

   (d) Some economists believe that because central banks (the Federal Reserve Bank in the case of US) have become more sophisticated in implementing monetary policy after the mid-1980s, the informativeness of the *spread* as a leading indicator has faded. Create an appropriate dummy variable to help you determine that the lag of *spread* has become insignificant since 1986Q1.