Assignment #8

feedback session for this assignment: 15-02-2021

General remarks: This assignment deals with a bivariate application of the Engle/Granger two-step method. There are two main things to look out for. First, please note that Task 2.3 uses a different table for the DF critical values than Task 1.4. This is intended. Second, in Task 3.2, please make sure that you actually drop overnight returns from the analysis.

1. Loading data and preliminary analysis

The file `data_abx.xlsx` contains data on a Canadian Stock (ABX, Barrick Gold Corporation), which is traded on the Toronto Stock Exchange and the New York Stock Exchange simultaneously. The data set includes the first two hours of trading, ranging from 01-01-2004 to 31-03-2004, sampled at 5 minute intervals.
The first column of the data matrix consist of the time series of the ln home market (TSX) prices, the second contains the ln foreign market (NYSE) prices, the ln CAD/USD exchange rate is included in the third column, and in the last column you find a dummy variable indicating the first observation of a day (indicator = 1 if it is the first observation of the day, otherwise zero).

1. Load the data into your program.
2. Convert the NYSE price series into Canadian dollars.
   Hint: Remember that our series are in natural logs.
3. Plot the home market and the converted foreign market price series into one graph and interpret it.
4. Perform a Dickey-Fuller test (case 2) on both series. Interpret your results.
   Hint: Critical values are listed in Table B.6 on page 763 in Hamilton's *Time Series Analysis*.
5. Which cointegration vector would you suggest from the graph in task 1.3?

2. Engle-Granger Method, Step 1: Auxiliary Regression

1. In order to estimate the normalized cointegration vector, run a regression of the TSX ln-prices (y_{1t}) on the NYSE ln-prices (y_{2t}) in Canadian dollars and back out the estimated parameter and the residual series $\{\hat{\varepsilon}_t\}$. Include a constant in your regression.
2. What is the estimated cointegration vector? What does *normalized* mean in this context?
3. Test the residual series for stationarity using a Dickey-Fuller test for case 1. Interpret and report the result.
   Hint: Critical values are listed in Table B.9 on page 766 in Hamilton's *Time Series Analysis*.

3. Engle-Granger Method, Step 2: VECM Estimation

1. Create ln-return series for the prices as:

$$\Delta y_{1t} = y_{1t} - y_{1t-1} \qquad \text{and} \qquad \Delta y_{2t} = y_{2t} - y_{2t-1}.$$

2. Since we want to exclude overnight returns from our estimation, the first observation of each day has to be deleted. To do so, make use of the first day indicator. You have to apply the same selection to the residual series to keep both series at the same dimension.

3. Estimate the VECM using the residual series as the error correction term (i.e. the matrix of the two ln-return series is the dependent variable matrix, the regressor matrix consists of ones (constant), the residual series and the first lag of both ln-return series):

$$\begin{aligned} \Delta y_{1t} &= a_{10} + \gamma_1 \hat{\varepsilon}_{t-1} + a_{11}\Delta y_{1t-1} + a_{12}\Delta y_{2t-1} + u_{1t} \\ \Delta y_{2t} &= a_{20} + \gamma_2 \hat{\varepsilon}_{t-1} + a_{21}\Delta y_{1t-1} + a_{22}\Delta y_{2t-1} + u_{2t} \end{aligned} \tag{1}$$

4. Back out the estimated parameters and write Equation (1) using the respective parameter estimates. Interpret your results (especially $\hat{\gamma}_1$ and $\hat{\gamma}_2$).