Homework 9

Eco 4306 Economic and Business Forecasting
Spring 2018
Due: Tuesday, May 3, before the class

Problem 1

Obtain monthly time series for Crude Oil Prices: West Texas Intermediate (WTI), code `MCOILWTICO` on FRED, and the monthly time series for US Regular Conventional Gas Price, code `GASREGCOVM` on FRED.

(a) Create a time series plot for the two log prices $\log p_t^{GAS}$ and $\log p_t^{OIL}$ for the sample 1995M1:2018M3.

(b) Perform unit root tests to determine whether $\log p_t^{GAS}$ and $\log p_t^{OIL}$ are $I(0)$ or $I(1)$.

(c) Determine the number of lags to include in cointegration analysis using Schwarz information criterion sample 1995M1:2010M12.

(d) Run the Johansen's trace and maximum eigenvalue cointegration tests for $(\log p_t^{GAS}, \log p_t^{OIL})$ using the number of lags from (c). Use plots from (a) as a guide to determine the specification of the deterministic components in the cointegration test (i.e. whether to use Case 2, Case 3, of Case 4 cointegration test).

(e) Interpret the results of the tests in (d).

(f) Based on your results in (d), use the sample 1995M1:2010M12 sample to estimate the VEC model

$$\Delta \log p_t^{GAS} = \gamma_1 z_{t-1} + \kappa_{11}\Delta \log p_{t-1}^{GAS} + \ldots + \kappa_{1p}\Delta \log p_{t-p}^{GAS} + \phi_{11}\Delta \log p_{t-1}^{OIL} + \ldots + \phi_{1p}\Delta \log p_{t-p}^{Oil} + \varepsilon_{1,t}$$
$$\Delta \log p_t^{OIL} = \gamma_2 z_{t-1} + \kappa_{21}\Delta \log p_{t-1}^{GAS} + \ldots + \kappa_{2p}\Delta \log p_{t-p}^{GAS} + \phi_{21}\Delta \log p_{t-1}^{OIL} + \ldots + \phi_{2p}\Delta \log p_{t-p}^{OIL} + \varepsilon_{2,t}$$

where the number of lags p is the same as in (c) and (d), and $z_{t-1} = \log p_{t-1}^{GAS} - \beta_1 \log p_{t-1}^{OIL} - \beta_0$ is the error term measuring the deviation in period $t-1$ from the long run equilibrium.

(g) Are γ_1 and γ_2 statistically significant? Are the signs of γ_1 and γ_2 in the estimated VEC model in (f) consistent with error correction mechanism that moves the system back to the long run equilibrium, whenever there is a disruption and $z_{t-1} \neq 0$?

(h) Reestimate the VEC model with a restriction $\gamma_2 = 0$. Recall that to do so in the VEC restriction window you need to enter `B(1,1)=1, A(2,1)=0`.

(i) What is the intuition for imposing the restriction in (h)? Explain how under this restriction $\log p_t^{GAS}$ and $\log p_t^{OIL}$ will change over time in response to a disruption such that $z_{t-1} > 0$.

(j) Use the restricted VEC model from (h) to create a sequence of one month ahead forecasts for the period 2011M1:2018M3. Report the RMSE for the forecast of the gas price, p_t^{GAS}.

(k) Create a correlogram for $\Delta \log p_t^{GAS}$ in the 1995M1:2010M12 sample. Use it to identify a suitable AR or MA or ARMA model. Estimate this AR/MA/ARMA model.

(l) Create a sequence of one month ahead forecasts for p_t^{GAS} for the period 2011M1:2018M3 using the model from (k). Report the RMSE for the forecast of the gas price, p_t^{GAS}.

(m) Compare the RMSE of the forecast for p_t^{GAS} from (j) based on the VEC model, and the forecast for p_t^{GAS} from (l) based on the AR/MA/ARMA model.

(n) Construct the forecast errors and then their squares for both the VEC and the AR/MA/ARMA model; use them perform the test for equal predictive ability similar to the one in lec13slides.pdf.

(o) Based on your results in (n), is there any advantage to using the VEC model to forecast the price of the gas, instead of using a simple univariate AR/MA/ARMA model?