

### EXERCISE 5

We are going to see if the yield curve is a useful predictor of year-of-year growth in real GDP. Read the article “Does the Yield Curve Signal Recession?” by Joseph G. Haubrich that appeared in Federal Reserve Bank of Cleveland’s Economic Commentary on April 15, 2006. I want you to go to the FRED database on the Federal Reserve Bank of St. Louis website and download the following series for the period of time 1962Q1 – 2011Q4: Real GDP (GDPC1); Interest rate on 10-year Treasury Note (DGS10); and Interest rate on 3 month Treasury Bill (TB3MS). In the case of the latter two variables, they are observed monthly, so you are going to have to convert them to quarterly averages. The SAS procedure PROC EXPAND will help you do this. (NOTE: I want this entire exercise done in SAS.) For this exercise we are going to take the in-sample period to be 1962Q1 – 2003Q4 and the out-of-sample period be 2004Q1 – 2011Q4. make the in-sam;op

- (a) Let  $y$  = the year-over-year growth rate of real GDP. That is,  
$$y = [\log(\text{real GDP}(t)) - \log(\text{real GDP}(t-4))] * 100.$$
 Plot this time series **using the entire span of the data** and, **using the in-sample data only**, determine the series stochastic order of the series using an ADF test.
- (b) Let  $x = \text{spread}(t) = \text{DGS10}(t) - \text{TB3MS}(t)$  where  $\text{DGS10}(t)$  and  $\text{TB3MS}(t)$  are quarterly averages of the constituent monthly values. Plot this time series **using the entire span of the data** and, **using the in-sample data only**, determine the series stochastic order of the series using an ADF test.
- (c) If both series are  $I(1)$ , use both the Engle-Granger and Phillips-Perron single equation tests to determine if they are co-integrated. If one or both of the series (is/are)  $I(0)$ , then the two series cannot be co-integrated. If this latter situation is the case then state so.
- (d) If the series are not cointegrated then, **using the in-sample data only**, build an appropriate equal-lag-length VAR on the stationary forms of  $y$  and  $x$ . If the series are cointegrated then, **using the in-sample data only**, build an appropriate ECM for the  $y$  and  $x$  series.
- (e) Recall that the target variable is  $y =$  year-over-year growth in real GDP. **Using the in-sample data only**, build a Box-Jenkins model for the stationary form of  $y$ . This model is going to be your benchmark forecasting model.
- (f) Using the above Box-Jenkins model of  $y$  and an appropriate bivariate model for  $y$  and  $X$  (it could be either an equal-lag-length VAR or an ECM), run an out-of-sample forecasting experiment to generate one-step-ahead forecasts of the  $y$  series using these competing models and report the out-of-sample MSE and MAE of the models.
- (h) Use the Diebold-Mariano test to determine if the MSEs and MAEs of the competing models are statistically significant or not.