

## ECON 4115/5115 Outline of Lecture Notes

### Chapter 10. Dynamic Regression Models

- The previous two methods (ETS and ARIMA) were pure time series forecasting models.
- Sometimes you want to include additional explanatory variables (i.e., X's).
- The dynamic regression model is:

$$y_t = \beta_0 + \beta_1 x_{1,t} + \cdots + \beta_k x_{k,t} + \eta_t$$

where  $\eta_t$  follows an ARIMA( $p, d, q$ ) process.

- The first step is to first difference non-stationary variables:

$$y'_t = \beta_0 + \beta_1 x'_{1,t} + \cdots + \beta_k x'_{k,t} + \eta'_t$$

where  $\eta'_t$  follows an ARMA( $p, q$ ) process,  $y'_t = y_t - y_{t-1}$ , and  $x'_t = x_t - x_{t-1}$ .

- The model above can be estimated in R using: *ARIMA*( $y \sim x + pdq(p, d, q)$ ).
- If you are unsure of ( $p, d, q$ ), you can specify as: *ARIMA*( $y \sim x$ ).
- Forecasts with a dynamic regression model require predicting future  $x_t$ 's and  $\eta_t$ .
- See R script #16 for a forecasting application using a dynamic regression model.