Second test in Macro-econometrics

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1. Facts about integration and cointegration.[11 points]

   (a) What is a first-order integrated (I(1)) variable?

   (b) Try and provide an example for a non-stationary process/variable that is *not* I(1).

   (c) When are two time-series variables said to be cointegrated?

   (d) What do econometricians mean when they talk about the 'super-consistency' of the estimator in a cointegrating regression?

2. An error-correction system. [12 points] The dynamic behavior of two macroeconomic aggregates X and Y follows a VAR(1) model

$$\begin{bmatrix} X_t \\ Y_t \end{bmatrix} = \begin{bmatrix} 1.1 & -0.2 \\ -0.2 & 1.4 \end{bmatrix} \begin{bmatrix} X_{t-1} \\ Y_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix}.$$

   (a) Write the model in the error-correction form $\Delta x_t = \mathbf{\Pi} x_{t-1} + \varepsilon_t$ for $x = (X, Y)'$, and particularly determine the matrix $\mathbf{\Pi}$. This impact matrix should have a rank of 1. Can you confirm this?

   (b) Try and find a factorization of $\mathbf{\Pi} = \alpha\beta'$. Provide the cointegrating vector β. [Hint: we assume that explosive roots and unit roots other than one are not present in this system.]

   (c) We find another macroeconomic variable Z that follows the AR(1) model $Z_t = 0.5Z_{t-1} + \varepsilon_t$. Provide the characteristic polynomial and its root (zero) to show that this variable is stable.

   (d) Now suppose we are joining all three variables into a big system

$$\begin{bmatrix} X_t \\ Y_t \\ Z_t \end{bmatrix} = \begin{bmatrix} 1.1 & -0.2 & 0 \\ -0.2 & 1.4 & 0 \\ 0 & 0 & 0.5 \end{bmatrix} \begin{bmatrix} X_{t-1} \\ Y_{t-1} \\ Z_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \end{bmatrix}.$$

   Try to re-write it in its error-correction form. What is the rank of the impact matrix $\mathbf{\Pi}$ now?

3. Panels [12 points] Someone wishes to estimate classical Phillips curves in a panel of 19 eurozone countries for annual data 2000-2015. [Some of these countries joined the eurozone later, as we know, but we do not take this issue into account.] The available variables are a rate of CPI inflation π_{it} and an unemployment rate u_{it}. Two classical functions are targeted, the static model

$$\pi_{it} = \beta_0 + \beta u_{it} + \varepsilon_{it}$$

and the dynamic Phillips curve

$$\pi_{it} = \beta_0 + \beta_1 \pi_{i,t-1} + \beta_2 u_{it} + \varepsilon_{it},$$

in both cases assuming the errors consisting of a country *effect* and an idiosyncratic error, i.e. $\varepsilon_{it} = \alpha_i + \upsilon_{it}$.

(a) *A priori*, would you choose a fixed-effects or a random-effects approach here? Why?

(b) It turns out that a Hausman test rejects for the static model. Which model/estimator does this suggest?

(c) What is the problem if you use the same estimator for the dynamic version? What can you do to resolve this problem?

(d) Try and provide an economic interpretation of the effects α_i in this application.