Ph.D. Econometrics II
Heinz School, Carnegie Mellon University
90-907, Fall 2001

Midterm

Instructions You may use any books, notes, calculators, and other aids you like. You may not converse, nor may you cooperate.

Please complete all questions.

Each question is worth one third.

Please show all relevant work.

Please interpret your results in plain English.

1. Consider the system:

$$\begin{aligned} Y_1 &= X_1\beta_1 + \epsilon_1 \quad (1) \\ Y_2 &= X_2\beta_2 + X_3\beta_3 + \epsilon_2 \quad (2) \end{aligned}$$

   X_3 is unobserved. Discuss the (asymptotic) bias in estimating β_1, β_2 by the following methods: equation-by-equation OLS and SUR.

   In each, discuss how your answer differs if $X_1 = X_2$, if there are/are not cross-equation restrictions between β_1, β_2 and if $Cov(X_2, X_3) = 0$.

   In class, I presented SUR as an unalloyed good. Comment in light of your answer here.

2. Here are some structural equations:

$$\begin{aligned} Y_1 &= X_1\beta_1 + Y_2\alpha_1 + \epsilon_1 \quad (3) \\ Y_2 &= X_2\beta_2 + Y_1\alpha_2 + \epsilon_2 \quad (4) \end{aligned}$$

   Suppose you are interested in the effect of X_1 on Y_1.

   Can you use IV,2SLS,3SLS to estimate the β, α? Why/why not?

   You decide to regress Y_1 on X_1 to find out the effect of X_1 on Y_1, leaving out Y_2. A critic complains that there is omitted variables bias (from omitting Y_2). Discuss, pointing out in what sense(s) (if any) you are right and the critic is right.

3. Consider the system:

$$\begin{aligned} Y_1 &= Y_2\alpha_1 + \epsilon_1 \quad (5) \\ Y_2 &= X_1\beta_1 + \epsilon_2 \quad (6) \end{aligned}$$

   Suppose $\overline{Y_1}, \overline{Y_2}, \overline{X_1} = 0$. That is, we have subtracted the mean from each variable, so that we can ignore intercepts.

   Suppose X_1 is exogenous. Suppose $Cov(\epsilon_1, \epsilon_2) > 0$.

   If I run OLS on the first equation, will $\hat{\alpha}_{1,OLS}$ be (asymptotically) an over or under estimate of α_1?

   I run equation-by-equation OLS on:

$$\begin{aligned} Y_1 &= X_1\pi_1 + v_1 \quad (7) \\ Y_2 &= X_1\pi_2 + v_2 \quad (8) \end{aligned}$$

$$\begin{aligned} \hat{\pi}_1 &= 1 \\ \hat{\pi}_2 &= 2 \end{aligned}$$

$$\hat{V}\begin{bmatrix} \hat{\pi}_1 \\ \hat{\pi}_2 \end{bmatrix} = \begin{bmatrix} 0.25 & 0.10 \\ 0.10 & 0.50 \end{bmatrix}$$

Provide an estimate and standard error for α_1.

How is your estimator related to α_{IV}?