ECO 82800

Panel Econometrics

Final Exam

25 May 2017, 9:30am – 11:30pm

This exam is a closed-book, closed-notes exam. Calculators without matrix functions are allowed. The exam consists of seven questions, most of them with parts. Points per question are as indicated; parts are weighted equally. The total is 102 points. Budget your time. You may answer the questions in any order, but *label them clearly and keep parts of a question together*.

1. (21 points)

a. Define the model that is the basis for the Hausman-Taylor estimator.

b. Describe the instrument matrix that Breusch, Mizon and Schmidt proposed as a substitute for the Hausman-Taylor instrument matrix.

c. Motivate why the instruments in the BMS matrix are proper within the context of the HT estimator.

2. (15 points)

a. What are the Null and Alternative Hypotheses of the LLC (Levin, Lin and Chu) test?

b. What are the Null and Alternative Hypotheses of the IPS (Im, Pesaran and Shin) test?

c. What paradigm shift is reflected in the difference between the LLC and IPS tests?

3. (21 points)

Let I denote real gross investment of a firm; let F be the real value of the outstanding shares of the firm; and let K be the real value of the capital stock. We are interested in the model

$$I_{it} = \beta_0 + \beta_1 F_{it} + \beta_2 K_{it} + \mu_i + v_{it}$$

where there might be serial correlation in v_{it}, captured as $v_{it} = \rho v_{i,t-1} + \epsilon_{it}$. The following table provides estimates of a random effects model without and with this serial correlation feature.

	Model 1		Model 2	
	Estimate	S.E.	Estimate	S.E.
β_0	-57.863	29.904	-44.381	26.975
β_1	0.110	0.011	0.095	0.008
β_2	0.308	0.017	0.320	0.026
σ_μ	87.359		74.517	
σ_v or σ_ϵ	53.752		41.482	
ρ	n.a.		0.672	

a. Both of these sets of estimates are generated with FGLS. So, prior to doing the GLS step, several parameters must be estimated first, including ρ. How would you propose to estimate ρ?

b. Especially in panel data with a small T, μ_i and $\rho v_{i,t-1}$ might capture the same thing and thus are difficult to distinguish. Explain why. And is this evident in this table?

c. Based on these results, by how much do you predict I to rise when K increases by 10 units?

4. (20 points)

Consider a sample of data defined as $\{(y_{it}, X_{it}), i = 1, \dots, N, t = 1, \dots, T\}$ where X_{it} is a vector of k variables not including a constant term. Let the regression model be written as $y_{it} = X_{it}'\beta + \lambda_i' F_t + v_{it}$, where λ_i and F_t are $m \times 1$ vectors of parameters for $i = 1, \dots, N$ and $t = 1, \dots, T$, respectively. Let us designate this model as M.

a. Show that the familiar two-way fixed effects model is a special case of model M.

b. Show that a model that explains y_{it} by means of X_{it} and a time trend t is a special case of model M with $m = 2$.

c. In what way is model M with $m = 2$ more flexible than a model that explains y by means of X and a time trend (as in part b)?

d. How does one estimate model M with $m = 3$?

5. (25 points)

Consider the model $y_{it} = \delta y_{i,t-1} + \mu_i + v_{it}$ for $i = 1, \dots, N$ and $t = 1, \dots, T$. Presume that y_{i0} is observed for all i. Assume that $\mu_i \sim iid(0, \sigma_\mu^2)$ and $v_{it} \sim iid(0, \sigma_v^2)$. Define $\Delta y_{it} = y_{it} - y_{i,t-1}$. Let A_i be the instrument matrix for observation i (stacking over all applicable t) that is constructed in preparation of GMM estimation. Let the matrix A stack these A_i matrices for all i.

a. Write down the Arellano-Bond instrument matrix A_i. What dimensions does it have?

b. Motivate why this instrument matrix is appropriate.

c. An initial Arellano-Bond estimator is given by

$$\hat{\delta}_{(1)} = \left(\Delta y_{(-1)}' A (A'(I_N \otimes G)A)^{-1} A' \Delta y_{-1}\right)^{-1} \Delta y_{(-1)}' A (A'(I_N \otimes G)A)^{-1} A' \Delta y$$

Derive this matrix G. What dimensions does it have?

d. Arellano and Bond have suggested a two-step estimator $\hat{\delta}_{(2)}$ that builds on information gained with the aid of the first-step estimator $\hat{\delta}_{(1)}$. Explain why this two-step estimator might be preferred in some circumstances.

e. Explain what contribution did Windmeijer make to the literature on the Arellano-Bond estimator.