ECONOMICS TRIPOS Part IIB

Wednesday 6 June 2007 9 to 12

Paper 10

THEORY AND PRACTICE OF ECONOMETRICS II

You should answer **two** *questions from Section A and* **one** *question from Section B.*

Answers from **each** *Section* **must** *be written in a separate booklet.*

Write your number **not** *your name on the cover sheet of* **each** *booklet*

STATIONERY REQUIREMENTS
20 Page booklet × 2
Metric Graph Paper
Rough work pads
Tags

SPECIAL REQUIREMENTS
Durbin Watson and Dickey Fuller and other tables
New Cambridge Elementary Statistical Tables
Approved calculators allowed

You may not start to read the questions printed on the subsequent pages of this question paper until instructed that you may do so by the Invigilator

SECTION A

1. Discuss each of the following statements.

   (a) 'If we are analysing individual behaviour using large survey datasets we can always find explanatory variables which are not correlated with the unobserved characteristics affecting the individual's decision. Hence the method of instrumental variables can always be used to obtain consistent parameter estimates'.

   (b) 'Economic theory is not powerful enough to provide a set of 'credible' identifying restrictions for any structural model. Fortunately this does not matter for policy purposes, since we can always estimate the reduced form equations'.

   (c) 'Evidence that the disturbances of a regression equation are serially correlated does not imply that the coefficient estimates are biased, and (as in the case of heteroscedasticity) we can always ensure that we compute robust estimates for the standard errors. So there is no reason to regard such evidence as an indication of dynamic misspecification'.

2. Consider the random utility model

$$U_{ij} = \omega' v_{ij} + \beta' x_i + \varepsilon_{ij}, \tag{1}$$

   where U_{ij} denotes the utility of alternative j to individual i, v_{ij} is a $L \times 1$ vector of attributes, x_i is a $K \times 1$ vector of individual characteristics, ω and β are conformable vectors of unknown parameters, and ε_{ij} is a stochastic error term.

   With reference to (1) evaluate the following propositions.

   Proposition 1 *For the multinomial logit model with J alternatives, L attributes, K individual characteristics, and $\varepsilon_i = (\varepsilon_{i1}, ..., \varepsilon_{iJ})'$ distributed i.i.d. Type 1 extreme value, $((J-1) \times K) + L$ mean equation parameters are identified.*

   Proposition 2 *A multinomial probit model has J alternatives, L attributes, K individual characteristics, and $\varepsilon_i = (\varepsilon_{i1}, ..., \varepsilon_{iJ})' \sim N(0, \Sigma_{\boldsymbol{\varepsilon}})$, a maximum of $(J-1)J/2 - 1$ error covariance parameters in the $J \times J$ variance matrix $\Sigma_{\boldsymbol{\varepsilon}}$ are identified.*

   Proposition 3 *An analyst choosing between the multinomial probit and the multinomial logit model faces a trade-off between tractability and the flexibility to represent reasonable substitution behaviour.*

3. A researcher has annual data on stock market returns (ret_t) and dividend yields (div_t) and estimates the following vector autoregressive (VAR) model over the period $1900 - 2002$, i.e., 103 observations:

$$\begin{aligned} ret_t &= \alpha_1 + \alpha_2 div_{t-1} + \alpha_3 ret_{t-1} + u_t^1 \\ div_t &= \alpha_4 + \alpha_5 div_{t-1} + \alpha_6 ret_{t-1} + u_t^2 \end{aligned}$$

and obtains the following estimates:

Coefficient	Estimate	Estimated Standard Error
α_1	-0.0663	0.062
α_2	0.0274	0.013
α_3	0.1671	0.109
α_4	0.8954	0.344
α_5	0.7790	0.073
α_6	0.6224	0.599

(a) Use these results to test for Granger Causality between ret_t and div_t.

(b) On the basis of these results, she decides the VAR model can be reduced to the following system

$$\begin{aligned} ret_t &= \beta_1 + \beta_2 div_{t-1} + v_t^1 \\ div_t &= \beta_3 + \beta_4 div_{t-1} + v_t^2 \end{aligned} \tag{2}$$

which she will estimate by seemingly unrelated regressions (SUR).

(i) Explain why SUR estimation is likely to dominate equation-by-equation least squares here.

(ii) Show that the system (2) implies a univariate $ARMA(1,1)$ representation for ret_t.

(c) She then estimates a univariate $ARMA(1,1)$ process for ret_t over the same period and obtains the following results

$$\begin{aligned} \widehat{ret_t} &= \underset{(0.006)}{0.0649} + \underset{(0.053)}{0.854} ret_{t-1} + e_t - \underset{(0.014)}{0.977} e_{t-1} \\ R^2 &= 0.0499 \quad SBC = -0.336 \quad T = 103 \end{aligned} \tag{3}$$

where estimated standard errors are in parentheses, SBC is Schwarz's Bayesian Criterion defined as

$$SBC = -\frac{2\log(L)}{T} + k\frac{logT}{T},$$

where L is the equation likelihood, k the number of coefficients estimated and T the number of observations.

(TURN OVER for Continuation of Question 3)

(i) Test at the 0.05 level the hypothesis that the coefficients in (3) (apart from the constant) are zero. What does this imply about return predictability?

(ii) For comparison she also estimates an $ARMA(0,0)$ for ret_t over the same period and obtains

$$\begin{aligned} ret_t &= \underset{(0.019)}{0.0621} \\ R^2 &= 0.000 \quad SBC = -0.375 \quad T = 103 \end{aligned}$$

Explain how Schwarz's Bayesian Criterion may be used here as a method of model selection. Which $ARMA$ model is preferred? What does this imply about return predictability?

(d) By noting that the AR and MA coefficients in (3) are of comparable size but opposite signs explain how the unpredictability of the return series implied by the univariate $ARMA$ analysis is consistent with your conclusions about Granger Causality.

4. (a) What do you understand by the terms "average treatment effect" (ATE) and "average treatment effect on the treated" (ATET)? Why might these objects be of interest to policy makers?

(b) Explain why in general ATE and ATET are not identified.

(c) Suppose you are given a random sample of observations on individual wages, covariates and a binary variable which indicates whether the individual has undertaken a particular training course or not.

(i) Explain how the "propensity score" may be used to identify and estimate the ATE and ATET of training on wages.

(ii) What are the limitations of this method?

5. An economist is interested in the relationship between the logarithm of real house prices ($LRHP$) and real average earnings ($LREARN$) in the UK. She has quarterly time series data from 1970Q1 to 2006Q4. Initially she uses only the data prior to 2001, reserving the rest of the data for out of sample predictive testing. She pretests the variables and decides they are both $I(1)$ and then obtains the following results

Dickey Fuller Regressions
Dependent Variable $\Delta(LRHP_t - LREARN_t)$

	Test Statistic	AIC	SBC
DF	−1.5252	248.72	245.94
ADF(1)	−2.4480	269.44	265.27
ADF(2)	−2.9563	271.58	266.02
ADF(3)	−3.3850	272.46	265.51
ADF(4)	−3.4499	271.76	263.42

where AIC and SBC are the Akaike Information and Schwarz's Bayesian Criterion respectively. The Table reports the Dickey-Fuller test statistic from a set of Augmented Dickey Fuller regressions over the sample period $1971Q2 - 2000Q4$. All regressions include an intercept but no trend.
She also obtains the following

$$LRHP_t = \underset{(0.058)}{3.5988} + \underset{(0.073)}{0.8480} LREARN_t + \widehat{u}_t,$$

where estimated standard errors are in parentheses, with the following results for $\widehat{u}_t$

Dickey Fuller Regressions

Dependent Variable $\Delta\widehat{u}_t$

	Test Statistic	AIC	SBC
DF	-1.6657	251.7	250.3
ADF(1)	-2.7144	277.3	274.5
ADF(2)	-3.3491	280.3	275.3
ADF(3)	-3.7397	280.8	276.1
ADF(4)	-3.8003	280.2	273.2

This Table reports the Dickey-Fuller test statistic from a set of Augmented Dickey Fuller regressions over the sample period $1971Q2 - 2000Q4$. All regressions include neither intercept nor trend.

(a) Discuss carefully the evidence for cointegration between house prices and earnings using the evidence presented above.

(b) On the basis of these results she estimates the following error-correction mechanisms (ECM) over the sample period $1970Q4 - 2000Q4$

$$\begin{aligned}
\widehat{\Delta LRHP_t} &= \underset{(0.002)}{-0.0003} + \underset{(0.085)}{0.4972}\Delta LRHP_{t-1} + \underset{(0.087)}{0.2666}\Delta LRHP_{t-2} \\
&\quad + \underset{(0.118)}{0.3905}\Delta LREARN_t - \underset{(0.015)}{0.0589}\widehat{u}_{t-1} \\
R^2 &= 0.57, SC : F(4,112) = 1.23, Het : F(1,119) = 0.11, se = 0.02
\end{aligned}$$

$$\begin{aligned}
\widehat{\Delta LRHP_t} &= \underset{(0.002)}{-0.000} + \underset{(0.085)}{0.5034}\Delta LRHP_{t-1} + \underset{(0.087)}{0.2589}\Delta LRHP_{t-2} \\
&\quad + \underset{(0.119)}{0.3885}\Delta LREARN_t \\
&\quad - \underset{(0.015)}{0.0538}\left(LRHP_{t-1} - LREARN_{t-1} - 3.7205\right) \\
R^2 &= 0.56, SC : F(4,112) = 1.25, Het : F(1,119) = 0.18, se = 0.02
\end{aligned}$$

where SC is a diagnostic for 4^{th} order serial correlation, Het is a diagnostic for heteroscedasticity and se is the estimated standard error of the regression. Assess the theoretical and statistical adequacy of these two specifications. Which is your preferred specification?

(TURN OVER for Continuation of Question 5)

(c) On the basis of the second ECM in (b) she then obtains the following summary statistics for predictions over the period $2001Q1 - 2006Q4$

Based on 24 Observations $2001Q1 - 2006Q4$
Mean Prediction Error 0.079504
Mean Absolute Prediction Error 0.079504

and the following results from estimating this model over various sub-periods

Sample Period	Residual Sum of Squares
$1970Q1 - 2006Q4$	0.058630
$1970Q1 - 2000Q4$	0.046713
$2001Q1 - 2006Q4$	0.004717

Assess the out of sample performance of this specification.

(d) She then re-examines her model over the full sample $1970Q1 - 2006Q4$ and obtains the following results

Dickey Fuller Regressions
Dependent Variable $\Delta(LRHP_t - LREARN_t)$

	Test Statistic	AIC	SBC
DF	0.4775	299.19	296.22
ADF(1)	−0.9700	325.43	320.99
ADF(2)	−1.3414	326.14	320.22
ADF(3)	−1.7797	327.20	319.79
ADF(4)	−1.9803	326.73	317.84

The Table reports the Dickey-Fuller test statistic from a set of Augmented Dickey Fuller regressions over the sample period $1971Q2 - 2006Q4$. All regressions include an intercept but no trend. Over the sample $1970Q1 - 2006Q4$ she obtains

$$\begin{aligned}
\widehat{\Delta LRHP_t} &= \underset{(0.002)}{0.001} + \underset{(0.079)}{0.5457}\Delta LRHP_{t-1} + \underset{(0.081)}{0.2093}\Delta LRHP_{t-2} \\
&\quad + \underset{(0.116)}{0.3612}\Delta LREARN_t \\
&\quad - \underset{(0.015)}{0.0514}\left(LRHP_{t-1} - LREARN_{t-1} - 3.7205\right) \\
&\quad + \underset{(0.018)}{0.0542}DUM_{t-1} * \left(LRHP_{t-1} - LREARN_{t-1} - 3.7205\right) \\
R^2 &= 0.554 \quad SC : F(4, 135) = 0.0724 \quad se = 0.02
\end{aligned}$$

where DUM_t is a variable that is zero for $1970Q1 - 2000Q4$ and one for $2001Q1 - 2006Q4$. How do these results help explain the forecast performance in (c)?

(e) What do you conclude about the ability of the estimated model to explain house prices?

SECTION B

6. 'There is very strong evidence that the shocks which have affected the US economy since World War II have had persistent effects on the level of real GDP. Such a finding is a clear indication that observed fluctuations are not the result of monetary disturbances'. Discuss.

7. The demand for motor vehicles is a derived demand based upon a set of attributes including price, size, and both the fixed and variable costs of motoring. The Department for Transport wishes to evaluate how the demand for motor vehicles is determined by vehicle excise duty which is calibrated to CO_2 emissions. Considering both the use of revealed and stated preference data, discuss how you would go about estimating a series of own and cross elasticities of demand, with particular emphasis on the likely switching behaviour following an increase in vehicle excise duty.

8. 'The problem with the cross sectional approach to growth and convergence is that it is not possible to take account of unobservable or unmeasurable factors that may affect the steady state. Only panel data can overcome this'. With the aid of examples, discuss the advantages and disadvantages of using panel data to investigate growth regressions.

9. How would you expect financial deregulation to affect the response of consumers to changes in income? Does the empirical evidence for the UK and US since the 1970's provide support for your views?

END OF PAPER