AFRICAN ECONOMIC RESEARCH CONSORTIUM

Collaborative Masters Programme in Economics for Anglophone Africa (Except Nigeria)

JOINT FACILITY FOR ELECTIVES (JFE) 2013

JUNE – SEPTEMBER

ECONOMETRICS THEORY AND PRACTICE II

Second Semester: Final Examination

Duration: 3 Hours **Date: Wednesday, September 18, 2013**

INSTRUCTIONS:

1. This examination is divided into two sections: **Section I** and **Section II**. There is one question in Section I which is **compulsory**, and four questions in Section II.
2. Answer **QUESTION 1** from **Section I** and **ANY TWO** questions in **Section II**.
3. You are required to answer **THREE** questions in total. Each question carries twenty marks.
4. Relevant formulae are embedded in the questions wherever they are necessary.
5. You may use an unprogrammable calculator.

Section I:

The Question in this Section is Compulsory

Question 1

Consider the standard Tobit model with given specifications and assumptions:

$$y_i^* = x_i'\beta + \varepsilon_i \qquad i = 1, 2, \ldots, N \qquad (1.1)$$

$$y_i = y_i^*, \qquad \text{if } y_i^* > 0$$

$$y_i = 0, \qquad \text{if } y_i^* \leq 0$$

where $\varepsilon_i \sim NID(0, \sigma^2)$ and independent of x_i. This model is also called a censored regression model since some observations are censored (in this case from below).

(a) Give an example of a real situation when Tobit model or censored regression model is appropriate to use. [**2 marks**]

(b) Using the specification of (1.1), find the probability of $y_i = 0$ given x_i, $\mathrm{P}\{y_i = 0 \mid x_i\}$, and the conditional expectation of y_i given a positive outcome, $E\{y_i \mid y_i > 0\}$.

[**5 marks**]

(c) Explain why the zero values should be included in the estimation of the model.

[**2 marks**]

(d) The Tobit model may also be written in general form as:

$$y_i^* = x_i'\beta_1 + \varepsilon_i \qquad i = 1, 2, \ldots, N \qquad (1.2)$$

$$y_i = y_i^*, \quad \text{if } y_i^* > L$$

$$y_i = L, \quad \text{if } y_i^* \leq L \quad \text{where } L = \text{lower bound.}$$

If the conditional distribution of the latent variable y^* given x is specified, then the model parameters can be consistently and efficiently estimated by maximum likelihood (ML) estimation based on the conditional distribution of the censored y.

Since y is a transformation of y^*, $y = g(y^*)$, the probability density function (p.d.f.) of the censored variable y may be obtain. (i) What is the p.d.f. of the censored variable y? (ii) Derive the first-order conditions for ML estimation of the unknown parameters β and σ^2. Show your work/derivation. [**9 marks**]

(e) What is the main weakness of the Tobit MLE? [**2 marks**]

Section II:

Answer ANY TWO Questions from this Section

Question 2

In their study, Frankel and Rose (1996) used a probit model to examine a variety of potential causes of currency crashes, especially those that add to a country's vulnerability to a crash[1]. They define a *currency crash* as a large change of the nominal exchange rate that is also a substantial increase in the rate of change of nominal depreciation. A binary variable was used to indicate currency crash, where 1 = crash, and 0, otherwise.

[1] Frankel, J. and A. Rose (1996), "Currency crashes in emerging markets: An empirical treatment", *Journal of International Economics* 41, pp. 351-366.

The explanatory variables are classified into four categories: (i) debt composition (expressed as a percentage of total debt); (ii) external variables; (iii) domestic macroeconomic indicators; and (iv) foreign variables. All variables are expressed in percentage. Observations were collected for over 100 developing countries from 1971 to 1992.

The table below shows the estimation results using binary probit model.

Table 2.1 Probit Estimates

Variables	$\partial F(x_i'\beta)/\partial x_{ik}$ **evaluated at sample means**	**|z|**
Debt composition variables		
Commercial bank debt	-0.07	0.57
Concessional debt	-0.10	1.74
Variable-rate debt	0.03	0.21
Short-term debt	0.04	0.34
FDI/Debt	-0.33	2.88
Public sector debt	0.11	1.32
Multilateral debt	-0.03	0.46
External variables		
External debt/GNP	0.03	1.33
Int'l reserves/imports	-0.01	1.99
Current account/GDP	0.10	1.03
Real exchange rate overvaluation	0.05	1.51
Domestic macroeconomics variables		
Government Budget/GDP	0.27	1.90
Domestic credit growth	0.13	4.78
Real output per capita growth	-0.38	3.13
Foreign variables		
Northern growth rate	0.55	0.98
Foreign Interest rate	1.27	4.50
	Wald-Stat	*p*-value

H_0: *Debt Effects* = 0	$\chi^2(7) = 14.2$	$\rho = 0.05$
H_0: *External Effects* = 0	$\chi^2(4) = 8.8$	$\rho = 0.07$
H_0: *Macro Effects* = 0	$\chi^2(3) = 32.9$	$\rho = 0.00$
H_0: *Foreign Effects* = 0	$\chi^2(2) = 21.5$	$\rho = 0.00$
Pseudo- $R^2 = 0.20$		
Critical values: $z_{0.01} = 2.58$; $z_{0.05} = 1.96$		

(a) Specify the binary probit model used in the estimation and its assumptions. [**3 marks**]

(b) (i) Derive the probability that a country will experience a currency crash given the vector of explanatory variables above. [**2 marks**]

(ii) Derive the probability that a country will not experience a currency crash given the vector of explanatory variables above. [**1 mark**]

(c) Derive the log-likelihood equations for ML estimation. [**4 marks**]

(d) Since probit coefficients are not easily interpreted, the marginal effects evaluated at the mean of the data are given in column 2. Derive the expression for the probit marginal effects. [**1 mark**]

(e) Interpret the marginal effects given in column 2. According to the results of the study, what will likely trigger a currency crash? [**6 marks**]

(f) Test the hypothesis that domestic macroeconomic variables together have no effects on the probability of a currency crash. State your null and alternative hypothesis. [**2 marks**]

(g) Comment on the goodness of fit of the estimated model. [**1 mark**]

Question 3

Suppose that absolute convergence holds for a group of countries, $i = 1, 2, \ldots N$, $t = 1, 2, \ldots, T$. The conventional growth model, which uses panel data, is given as:

$$y_{it} = \alpha_i + \delta y_{i,t-1} + \upsilon_{it} \qquad (3.1)$$

where y_{it} is the log of income of the i*th* country in period *t*;

α_i is the individual-specific effects; $\delta = (1 - b)$, $0 < b < 1$, $b > 0$ implies absolute income convergence.

$\upsilon_{it} \sim iid(0, \sigma_\upsilon^2)$ is the disturbance term.

(a) By construction of model (3.1), the individual-specific effect is constant over time but varies over individual; would you estimate this model using the fixed-effects estimator? Why or why not? [**3 marks**]

(b) If the fixed-effects estimator is not recommended to estimate (3.1), what alternative estimators would you use? [**1 mark**]

(c) Anderson and Hsiao suggested two (2) *instrumental variable estimators* to find consistent estimates of δ. Describe one of these estimators and state the necessary condition (moment condition) for consistency. [**5 marks**]

(d) Differentiate between the Anderson-Hsiao estimators and the *generalized method of moments* (GMM) estimators. [**2 marks**]

(e) If you are to use GMM to estimate model (3.1) using the full sample of observations, what are the valid instruments that may be used in the estimation. Define the matrix of instruments, Z_i. [**4 marks**]

(f) GMM imposes too many instruments. What are the problems that one is likely to encounter? [**5 marks**]

Question (4)

Testing for unit root has become standard in pure time series data. An extension to panel data has become of particular interest as well.

(a) Explain the difference between stationarity and non-stationarity in panel data. [**2 marks**]

(b) Why is it important to test for a panel unit root before model estimation? [**3 marks**]

(c) Describe the Levin and Lin panel unit root test. State the null and alternative hypothesis. [**5 marks**]

(d) Describe the Im, Pesaran and Shin panel unit root test. State the null and alternative hypothesis. [**5 marks**]

(e) Consider estimating a growth model for the African continent using panel data where production is in the form of Cobb-Douglas technology:

$$\log Q_{it} = \alpha_i + \pi_1 \log K_{it} + \pi_2 \log L_{it} + e_{it} \qquad (4.1)$$

where the definitions of the variables are conventional. What panel unit root test would you use to test for stationarity of the data? Justify your answer. [**3 marks**]

(f) Below are the results of panel unit root tests on the variables of (4.1) for 35 African countries with t = 5 years using Levin-Lin-Chu procedure and Im-Pesaran-Shin procedure. Would you use the levels or first-differences of the variables in the model estimation? Why? [**2 marks**]

Variables	**Panel Unit Root Tests**	
	Levin, Lin & Chu Stat	*Im, Pesaran & Shin W-Stat*
Log of Output (*Q*)	-1539.90***	-14604.81***
Log of Capital (*K*)	-14.98***	-7866.01***
Log of Labor (*L*)	-11.88***	-1025.34***
***Significant at 1% (Rejects the null of unit root)		
The test equations include individual intercept.		

Question 5

A common assumption in count data models is that, for given x_i, the count variable y_i has a Poisson distribution with expectation $\lambda_i \equiv \exp\{x_i'\beta\}$. Therefore, it follows that the density of the Poisson regression model for a single observation is given by:

$$f(y_i \mid x_i) = \frac{e^{-\exp(x_i'\beta)} \exp(x_i'\beta)^{y_i}}{y_i!} \qquad y = 0, 1, 2, \ldots$$

(a) Give some characteristics of count data. [**3 marks**]

(b) Derive a log-likelihood function, which the Poisson ML estimator maximizes. [**6 marks**]

(c) Derive the expression for the marginal effects, that is, the impact of a change in x_{ik} on the expected value of y_i. [where x_{ik} is a continuous variable.] [**3 marks**]

(d) What are the major deficiencies of the Poisson model? [**3 marks**]

(e) Explain the negative binomial regression model as an alternative to the Poisson model. [**5 marks**]