Friday, May 11th, 2007

Core Preliminary Exam in Agricultural Economics

Purdue University

Directions:

- Please write clearly in large letters. Provide a wide margin around the edges of each page. Use blue or black ink, or bear down if you write in pencil so that the lines are dark. This will ensure that photocopies of your exam will be readable by graders.

- This exam consists of three questions each with multiple parts. Please answer all parts of all three questions.

- On each page, please write the number of the question you are answering, the page number in sequential order, and your identifying exam number.

- You have four hours to complete the exam. Therefore, you should use your time wisely and be sure to allocate time to optimize your ability to display your knowledge to the examining committee. Please write what you know, since partial credit will be given for incomplete answers.

- You may ask questions of the proctor aimed at clarifying the meaning of the question, but questions related to concepts will not be answered.

- You are welcome to disassemble the exam when questions run over onto multiple pages so that you can view the question in its entirety.

GOOD LUCK! DON’T PANIC, JUST THINK!
Question 1

A colleague has come to your office for your advice. She has 40 years of data on hectares planted to cotton in Egypt. In addition, she has data on nominal cotton prices received by Egyptian producers, $p_t$, and an index of (nominal) input prices paid, $z_t$, also by cotton producers. She believes that cotton producers in Egypt behave in a manner that is consistent with profit maximization. In particular, she is attempting to estimate the following model:

$$\ln y_t = \beta_1 + \beta_2 E_t(\ln p_t | \Omega_{t-1}) + \beta_3 \ln z_t + \beta_4 \ln y_{t-1} + \varepsilon_t$$  \hspace{1cm} (1)$$

where $y_t$ is land area planted to cotton, $E(\varepsilon_t) = 0 \ \forall t$, $E(\varepsilon_t^2) = \sigma^2 \ \forall t$, $E_t(\ln p_t | \Omega_{t-1})$ is the expected cotton price at harvest formed at planting time, and based on information, $\Omega_{t-1}$, available at planting time, and where $\ln$ denotes the natural logarithm of the variable in question. For the time being your colleague has decided to use lagged price as an indicator of cotton producers’ expectations about harvest-time cotton prices at the time that cotton planting decisions are made, that is, for now assume that $E_t(\ln p_t | \Omega_{t-1}) = \ln p_{t-1}$.

a. Your colleague wants to know how, at least in part, the equation in (1) may be used to test to see if Egyptian cotton producers are, in fact, behaving in a manner consistent with profit maximization. Can you help her think of such a test involving the parameters of (1)? And if so, can you describe two uniquely different ways in which such a statistical test may be performed by using equation (1)? (Hint: Is there a role here for price homogeneity in the planted hectares equation?)

b. Your colleague has now successfully estimated the model in (1) by using OLS. Another friend has suggested that she should examine the estimated least squares residuals for evidence of autocorrelation. She has done so and has concluded that, in fact, the errors demonstrate significant first-order autocorrelation. In other words, the following model might be more appropriate in this case:

$$\ln y_t = \beta_1 + \beta_2 \ln p_{t-1} + \beta_3 \ln z_t + \beta_4 \ln y_{t-1} + \varepsilon_t$$
$$\varepsilon_t = \rho \varepsilon_{t-1} + u_t,$$  \hspace{1cm} (2)$$

where $0 \leq \rho \leq 1$, and where $E(u_t) = 0 \ \forall t$, $E(u_t^2) = \sigma_u^2 \ \forall t$, and $E(u_t u_s) = 0 \ \forall t \neq s$. Your colleague believes she can simply reformulate the model in (2) as a nonlinear estimation
problem and thereby obtain consistent and asymptotically normal parameter estimates. Is there any problem with her proposed plan of action? That is, can you think of any reason why her proposed course of action will not yield consistent parameter estimates? Assuming that you believe her approach will not result in consistent estimates, can you recommend an estimation strategy that might allow her to circumvent any problem(s) that you foresee?

c. Returning to the original equation in (1), that is, ignoring any possible issues with autocorrelation, could you suggest any alternatives to simply using \( \ln p_{i-1} \) for \( E_i \left( \ln p_i | \Omega_{i-1} \right) \)? If so, would you still want to use OLS, and if not, what new estimation strategy might your suggestion entail?
Question 2

Two issues related to China’s economic performance are receiving considerable media and research scrutiny, and could impact U.S. agricultural exporters interested in Chinese markets. The first issue is that the Chinese are alleged to maintain an undervalued exchange rate to stimulate and protect exporters, resulting in a considerable trade surplus, especially with the U.S. A second, more recent suggestion is that economic growth in China is now “too fast,” reaching 11% last year. There are calls for the Finance Ministry to slow growth via monetary and fiscal policy. The Chinese Finance Ministry has the task of managing the macro economy and exchange rate in a way that responds to the concerns underlying these issues. In 2005, China revalued its currency, the Yuan, by 2.1% and announced that it would continue to manage the Yuan against a basket of currencies. The following graph provides some information on recent Chinese economic performance and exchange rate movements which may help to put these issues into perspective.

![Graph showing real GDP growth rate and exchange rate from 1991 to 2006.](image)

a. Why would the Chinese Finance Ministry consider strategies to slow economic growth (at least in the short run)? What kind of general specification of an intertemporal objective function of the Ministry would capture this concern as well as the other issues raised above?

b. Building on the intertemporal objective function you specified in (a), develop a dynamic, open economy macroeconomic optimization model that would help the Ministry in setting macroeconomic and exchange rate policy. Assume for simplicity that China utilizes a fixed exchange rate regime. Explicitly define the state variables and control variables of this model. Relate control variables to policy decisions of the Finance Ministry. Also justify your choices for dynamic adjustment and/or behavioral relationships that you have included in such a model. Explain briefly the equations you have included in this model and why you have included them.

c. Have you chosen an infinite-horizon or fixed-horizon for the optimization model? Justify your choice. If you have chosen a fixed-horizon, discuss transversality conditions you have included in your model, if any.
d. Find the first-order optimality conditions for your model. Provide an economic interpretation of each first-order condition.

e. What do you expect the relationship between exchange rate policy and growth to be in this model? What recommendations would you offer to the Chinese concerning slow growth policies and exchange rate revaluation?

f. How has the assumption of a fixed exchange rate affected your choice of policy instruments (control variables)? Why? What would your policy instruments become if you assumed a flexible exchange rate regime? How might your recommendations differ?
Question 3

Consider an oligopolistic food products industry with \( n \) symmetric Cournot firms (quantity competitors in the food product market) and perfectly competitive input markets. Furthermore, consider that the industry is characterized by a common fixed proportions technology that converts a ton of farm input \( z \) into one ton of output \( q \) and uses other inputs, \( x \), in a fixed proportion to the farm input (i.e., \( q = z \) and \( x = az \) where \( a > 0 \)) so that firm-level profit can be solely determined by the optimal choice of output level.

a. Using a graph and words, show the market level equilibrium for this industry. Be careful to describe the economic logic behind the equilibrium. If it helps to write out the optimization problem and first order conditions for the representative firm, then feel free to do so.

b. Redraw your graph from part (a) and identify the perfectly competitive equilibrium in which all firms are price-takers, assuming no difference in the cost structure of the industry between the two market structures. Please compare the two graphs and identify the welfare implications for consumers, producers, and the economy as a whole associated with the existence of the oligopoly outcome in part (a).

c. Recall, that a key parameter in empirical models of oligopoly is the conjectural elasticity, \( \theta \), defined as \( \theta = \frac{\partial Q}{\partial q} \frac{q}{Q} \) where \( Q \) is industry output and \( q \) is representative firm output. Discuss the economic importance of this elasticity as it relates to the market structure and state a testable hypothesis for perfect competition in terms of the conjectural elasticity.

d. Provide a detailed development of an econometric model for testing the hypothesis developed in part (c). Be explicit in your specification of equations and justify the equations in terms of the economic model/market equilibrium from part (a).

e. Describe the appropriate procedure for estimating the econometric model in part (d) and testing the hypothesis. Provide an appropriate test statistic for the hypothesis.