WRITTEN PRELIMINARY Ph.D EXAMINATION

Department of Applied Economics
Jan./Feb. - 2008
Trade, Development and Growth

For students electing
Macro (8701) & Micro (8703) option

Instructions

• Identify yourself by your code letter, not your name, on each question
• Start each question’s answer at the top of a new page
• You are requested to answer a total of FOUR questions
• Answer ONE question from Set One
• Answer THREE questions from Set Two
• You have four hours to complete this examination
SET ONE:
Required Question; Answer ONE Question (I or II but not both)

I. Health and nutrition in developing countries.

1. Many aid agencies have advocated that governments provide basic pre-
ventative health care services (sometimes called primary health care)
at little or no cost to all citizens in developing countries. Give two
reasons why this policy may not be very effective at improving health
status in developing countries. Give one counterargument for each of
your two reasons.

2. Suppose you are operating a refugee camp in an area that has been
hit by a severe drought. One of your responsibilities is to provide
food to malnourished children age 10 or younger. Your food supply is
limited so you want to give it to the most severely affected children.
If you have almost no medical equipment to do sophisticated medical
assessments, what kind of measurements can you obtain that will help
you decide which children are most in need? Assume that parents
have very low levels of education, so they cannot provide much useful
information about the health of their children. Also, explain whether
“sophisticated” medical equipment could improve on what you propose.
Be very explicit in your answer.

3. Consider a simple static model of food consumption for a household
with two children. The utility function for the household depends only
on calorie consumption of the parents \(C_p\), calorie consumption of child
1 \(C_{c1}\) and calorie consumption of child 2 \(C_{c2}\):

\[
U_H = C_{p}^{\alpha}C_{c1}^{\beta}C_{c2}^{\gamma}
\]

where \(\alpha, \beta, \gamma\) are all > 0. Assume that child 1 is very young
and consumes only infant formula, denoted by \(F\), which has a price
(per calorie) of \(p_F\). In contrast, child 2 and the parent consume only
rice, denoted by \(R\), which has a price (per calorie) of \(p_R\). Assume that
household income \(Y\) is exogenously given to the household. Derive the
household’s demand for infant formula \(F\) and rice \(R\) as a function of
4. Suppose that the government cares only about children’s caloric intake because it has an effect on children’s school performance, as measured by test scores \( T \). Assume that child 1 is too young to attend school now (but will attend school when he or she is old enough), while child 2 is old enough to attend school now, and indeed he or she is attending school. According to research by Nobel prize winning economists and medical researchers, the following relationship holds between test scores and children’s calorie consumption: 

\[ T = 10 \times C_{\text{infant}} + 5 \times C_{\text{student}}, \]

where \( C_{\text{infant}} \) is calories consumed while an infant (which are obtained from infant formula) and \( C_{\text{student}} \) is calories consumed while a student in school (obtained from rice). The government has enough money to either subsidize infant formula and reduce its price (per calorie) from \( p_F \) to \( p_F/4 \), or subsidize rice and reduce its price (per calorie) from \( p_R \) to \( p_R/2 \). For simplicity (and without loss of generality), assume that \( \alpha + \beta + \gamma = 1 \). Using your answer from part 3 above, which type of subsidy is most effective in raising children’s test scores? [Hint: this may depend on the values of some exogenous variables and/or parameters.] For extra credit, explain why setting \( \alpha + \beta + \gamma = 1 \) is just a normalization and not a restriction on the utility function.

II. External debt and economic growth

The World Bank’s World Development Report for 2008 is titled Agriculture for Development. It points out that in poor countries, primary agriculture generates on average 29 percent of GDP, employs over 50 percent of the labor force, and accounts for the majority (70%) of a country’s poor. Many of these countries are also incurring relatively high levels of external debt. To take an extreme case, Argentina’s present value of external debt to GDP was 245% in 2005 with debt service to exports of about 21% and short term debt of about 38% of the value of exports of goods and services. This question relates to the economics of agriculture in this process.
Consider an extreme case of a country whose external debt was accumulated because of fiscal deficits caused by spending that did not increase the country’s stock of public goods that might otherwise make private resources more productive. Make assumptions about the relative factor intensity of labor, capital and land in the production of goods in this country and, like most low income countries, assume it is a net exporter of agricultural goods.

1. Depict and explain the short run equilibrium of such a country for which the debt suggests it is living beyond its means. (You may use graphics for this answer)

2. Restricting yourself to the logic of the model, focus on agriculture, and be more analytical.

   (a) If the economy is small, competitive and open with agriculture and industry as traded goods, what is the direct effect of the equilibrium in (1.) on agriculture?
   (b) Discuss/show the indirect effects the equilibrium discussed in (1.) is likely to have on the returns to agriculture’s sector specific resources
   (c) What is the likely effect on the sector’s employment of labor and capital?
   (d) Comment on the kind of consumption effects (2.a) it is likely to have on farm households that, for whatever reason, remain in the sector.

3. Now, suppose a readjustment is required where the country must pay-off its external debt by, for purposes here, imposing lump-sum taxes on households (or effectively, paying in foreign exchange the difference between exports and imports). This part of the question relates to agriculture’s contribution to this adjustment process.

   (a) Explain/show how this readjustment is likely to affect agriculture’s supply response
   (b) What is likely to be the affect on rural household consumption and saving decisions of the lump-sum tax (we presume the tax on each household is equal in per capita terms).
(c) Can you "make a case" for why rural household might be exempt from the tax (and hence the tax on remaining households increased) in order to speed up the process of adjustment to long-run equilibrium.

4. To conclude, with time on the horizontal axis and gdp per worker on the vertical axis, graph what you feel would be the real gdp/worker transition path of this economy starting with the accumulation of debt, the debt crises of readjustment, and then back to sustainable long-run equilibrium. Explain your reasoning.
SET TWO:

Answer THREE of the following four questions (III to VI)

III. Risk, insurance, and social networks.

Consider a community in which two social networks exist, which we can denote as A and B. The people in each of these networks have developed a system to share risks. Membership in these networks is based on ethnic group. There are two ethnic groups in the community, A and B. All the people of ethnic group A are members of social network A, and all the people of ethnic group B are members of social network B. There is only one person in the community who belongs to both networks, since his father is from ethnic group A and his mother is from ethnic group B.

Consider the risk sharing that occurs for members of network A. Through bargaining at time period zero, or perhaps through some dictator social planner, there exists for all members of that group the following social welfare function:

\[ SWF_A = \sum_{i=1}^{N_A} \lambda_i U_i \] with \( \sum_{i=1}^{N_A} \lambda_i = 1 \), and \( U_i = \sum_{t=1}^{T} \beta^t \sum_{s=1}^{S} \pi_s u_i(c_{ist}) \)

where \( N_A \) is the number of people in network A, \( \lambda_i \) is the “social welfare weight” of person \( i \), \( s \) indicates a “state of nature” and \( \pi_s \) is the probability of that state of nature occurring. Assume throughout that \( u_i(c_{ist}) > 0 \) and \( u_i''(c_{ist}) < 0 \) for all \( i \) and all values of \( c_{ist} \).

1. Assume that each person in the network A earns an income of \( y_{ist} \) at time \( t \) if state \( s \) occurs. Assume also that the network cannot save or borrow money over time, so total income of the network members must equal total consumption of network members for each time period. For simplicity, assume that the person who is a member of both network A and network B gives half of his income to each network in each time period. Network A is effective in maximizing social welfare for that network, subject to the constraint that total consumption must equal total income in every time period. For any two persons in network A, \( i \) and \( j \), what is the relationship between their marginal utility of consumption and their social welfare weights? Derive your result, using
the notation that \( y_{i st} \) is the income of person \( i \) at time \( t \) if state \( s \) occurs.  

[Notational hint: use \( N_A \) to denote the number of people in network \( A \).]

2. Suppose that \( u_i(c_{ist}) \) has the following functional form for all \( i, s \) and \( t \):

\[
  u_i(c_{ist}) = (1 - \rho)^{-1} \theta_i c_{ist}^{1-\rho} \quad \theta_i > 0
\]

Note that this assumes constant relative risk aversion. The \( \theta_i \) term simply shows that individuals differ in their “efficiency” of converting \( c_{ist} \) into utility. Use your result in 1.) to derive \( \ln [c_{ist}] \) as a function of \( \ln [c_{jst}], \rho, \theta_i, \theta_j, \lambda_i \) and \( \lambda_j \). Explains in words what this means about the relationship between the consumption of person \( i \) and person \( j \) in the same risk sharing network (network \( A \)).

3. Use your answer to part 2.) to express the relationship between the consumption for person \( i \) in network \( A \) (at time \( t \) if state \( s \) occurs) to the average (log) consumption levels of all people in that network (at time \( t \) if state \( s \) occurs). Explain in words what this means. [Hint: sum over \( j \) for both sides of your answer to 2.)]

4. Use your result in 3.) and apply it to the person who is a member of both networks, \( A \) and \( B \). For notational convenience, let this be \( k \)th person in both networks. Show the relationship between the average (log) consumption in network \( A \) (averaging over all people in that network) and average (log) consumption in network \( B \) (averaging over all people in that network). How is the change in average (log) consumption in network \( A \) from time \( t \) to time \( t + 1 \) related to the change in the average (log) consumption in network \( B \) from time \( t \) to time \( t + 1 \)? Explain the intuition behind your results.
IV. Trade distortion and growth

The IBRD studies directed by Krueger, Schiff and Valdes in the 1980s, and a recently completed update of these studies by Anderson find that protection of the import competing sector remains an implicit tax on agriculture in many of the world’s low and lower middle income countries. This question asks you to explain how trade interventions that protect the industrial import competing sector of an economy are likely to affect the country’s transition to long-run growth (i.e. a steady state for which the interventions remain in place). Make assumptions about the relative factor intensity of labor, capital and land in the production of goods in this country and, assume it is a net importer of industrial goods. Finally, assume that the industrial trade protection is not so extreme as to affect the economy’s underlying fundamental economic forces (e.g., it does not cause some other sector of the economy to close). For purposes here, let technological change \( x \) and the growth in the labor force \( n \) equal zero \((x = n = 0)\).

1. With the trade protection in place, explain the "economics" giving rise to the transition path of the following endogenous variables (recall that the zero profit conditions will look something like: \( C^m(w, r) = (1 + \tau) \), \( C^a(w, r) = p_s \) where \( \tau \) is the tariff rate (say 0.2) so that the domestic price for manufactures is higher than the world price).

   (a) \( \dot{w}/w, \dot{r}/r \) (factor payments to labor, capital, respectively)
   (b) \( \dot{p}_s/p_s, \dot{\pi}/\pi \) (the price of home goods, and land rental payments)
   (c) \( \dot{y}_j/y_j, j = m(\text{manufacturing}), a(\text{agriculture}), s(\text{home good}) \).
   (d) \( \dot{gdp}/gdp \) where \( gdp \) is normalized by the cost of living, typically taken to be price index \( \mu(p_s) \) taken from the expenditure function, \( E = \mu(p_s)q \)
   (e) What is the rate of growth of these values (given assumptions here) in the steady-state

2. Now, suppose the country is in long-run equilibrium (i.e., the steady state) AND trade protection is removed, i.e., \( \tau = 0 \). Explain the economics of the country’s re-adjustment back to long-run equilibrium.

   (a) First, compare and explain briefly the levels of selected variables when the steady state is reached under (2) compared to the case
of (1). (Comment, typically we would choose some point in transition, but for purpose here we use the steady state equilibrium to make the question more clear). The variables are

i. 
\( (w_{ss})^{\text{protection}} : (w_{ss})^{\text{no protection}} \), 
\( (r_{ss})^{\text{protection}} : (r_{ss})^{\text{no protection}} \), 
\( (p_{ss})^{\text{protection}} : (p_{ss})^{\text{no protection}} \)

ii. 
\( (y_{m,ss})^{\text{protection}} : (y_{m,ss})^{\text{no protection}} \), 
\( (y_{s,ss})^{\text{protection}} : (y_{s,ss})^{\text{no protection}} \)

(b) Using a graph with time on the horizontal axis and GDP per worker normalized by the cost of living \( \mu (p) \) (hence, the \( gdp \) in question 1. above), chart the \( gdp^{\text{protection}} \) to some point \( t \) large, and then from this \( t \) (i.e., when reform occurs) to a larger \( t \). For selected endogenous variables of your choice, explain the main "economic" differences in the second compared to the first part of the graph.
V. R&D and R&D spillovers

In a two-country world where a large exporting country (called Home) innovates, carefully sketch out the details of an economic framework for evaluating the magnitude and incidence of the economic consequences of international (i.e., cross-country) R&D spillovers.

Use this basic framework answer the following:

1. Does the welfare of producers in the Foreign (i.e., non-innovating) country increase or decrease as a consequence of R&D spillovers emanating from the Home country compared with a situation of no spillovers? Illustrate and discuss.

2. Research spillovers to the rest of the world increase the national welfare of the Home country compared with a situation of no spillovers. True, false, explain.

3. Carefully describe the data requirements to estimate the welfare consequences of international R&D spillovers in a multi-market equilibrium displacement model.
VI. Growth theory

Consider the environment of the three sector, small open economy. For consistency in notation, agents produce and consume three goods, indexed $j = m, s, a,$ at each instant in time at price $p_j$. The services of labor, $L(t)$, and capital, $K(t)$, are employed in the production of all three goods while land, $H$, a sector specific factor, is also employed in the production of the agricultural good, $j = a$. The manufactured good, indexed $j = m$, is both a consumption and a capital good that is also internationally traded. The rural good is also traded internationally. The home good, indexed $j = s$, is a pure consumption good and only traded within the domestic economy. Labor services are not traded internationally and domestic residents own the entire stock of domestic assets. Households earn income from providing labor services $L$ in exchange for wages $w$, earn interest income at rate $r$ on capital assets $A$, and receive rents from agriculture’s sector specific resource, land $H$.

Key primitives:

$(m = \text{manuf.}, a = \text{agriculture}, s = \text{service})$

\[
Y_m = F^m(AL_m, K_m); \quad \text{Non-farm economy}
\]
\[
Y_a = F^a(AL_a, K_a, A_a(t)H); \quad \text{Farm economy}
\]
\[
Y_s = F^s(AL_s, K_s); \quad \text{Service economy}
\]

with the restriction that $A_a(t) = A(t)L(t) = e^{(\kappa+n)t}$.

Felicity is

\[
q = q_m^\lambda_1 q_a^\lambda_2 q_s^{1-\lambda_1-\lambda_2}
\]

so that the household seek to maximize

\[
\int_{t=0}^{t=\infty} \frac{q^{1-\theta} - 1}{1 - \theta} e^{(n-\rho)t}
\]

The inter-temporal elasticity of substitution is unity and the rate of time preference is $\rho$.

Questions

1. Derive the Euler Equation for the household’s optimization problem.
2. Characterize, the intra-temporal equilibrium of this economy.
3. Show how you would obtain the steady-state solutions for \( \dot{w}, r, p_s \) and \( k \).

4. Derive the differential equations for this model.