WRITTEN PRELIMINARY Ph.D EXAMINATION

Department of Applied Economics
June/July - 2006
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. The Harris-Tordaro model

This problem presents a simple Harris-Todaro model of migration and analyzes the impact of a policy on income inequality. Note that the notation is somewhat different from the notation used in Apec 8703. The set-up of the model is:

\begin{align*}
L &= \text{the number of workers (all of which are identical)} \\
w_u &= \text{the wage in the urban sector, which is fixed outside of the model} \\
w_r &= \text{the wage in the rural sector, which is set so that labor supply equals labor demand in the rural sector} \\
L_u &= \text{labor employed in the urban sector} \\
L_r &= \text{labor employed in the rural sector} \\
U &= L - L_u - L_r = \text{unemployed labor in the urban sector} \\
D_u &= D_u(w_u) \text{is the demand for labor in the urban sector, and } D_u(w_u) < 0
\end{align*}

Assume that:
(a) Labor migrates until the expected wage in urban areas is equal to the wage in rural areas. Express the rural wage (in equilibrium) as a function of $D_u(w_u), w_u$ and $U$.

Assume that:
(b) The demand for labor in rural areas is flat, which means that $w_r$ is not affected by the supply of rural labor and this can be considered to be exogenous. Further, assume that $w_r < w_u$.

1. Using your answer to a), express the rate of unemployment as a function of $w_u$ and $w_r$, both of which can be considered to be exogenous.

2. Now, recall what a Lorenz curve is in the analysis of inequality. Draw a Lorenz curve for this economy, assuming that $U > 0$. Show where all three types of workers (rural, urban employed and urban unemployed) fit on the Lorenz curve. [Hint: the “curve” will be connected line segments, not a curve.]

3. Suppose that the urban wage increases. Is the new distribution of income more equal, less equal, or is the result indeterminant? Demonstrate your answer by drawing a new Lorenz curve.
4. Suppose that the urban sector expands the number of jobs but does not change the wage. Is the new distribution of income more equal, less equal, or is the result indeterminant? Demonstrate your answer by drawing a new Lorenz curve.

II. Analysis of trade reform and economic growth

Many countries that are net importers of food protect their agricultural sector by tariffs. The reasons for protection often include

1. Food security,

2. The rational that world prices would be higher if advanced countries did not protect their agriculture, thus causing surplus world production which places downward pressures on world agricultural prices and hence an implicit tax on a food importing country’s farmers, and

3. Most of a country’s poor reside in the rural sector, and they tend to be net producers of agricultural goods. Protection of agriculture is a way to transfer income to the poor.

Consider an economy with the following basic features at some point in time, say \( t = 0 \).

<table>
<thead>
<tr>
<th>Table 1: Main features of the economy</th>
<th>Manuf.</th>
<th>Ag.</th>
<th>Serv.</th>
</tr>
</thead>
<tbody>
<tr>
<td>K share</td>
<td>0.49</td>
<td>0.317</td>
<td>0.41</td>
</tr>
<tr>
<td>L share</td>
<td>0.51</td>
<td>0.587</td>
<td>0.59</td>
</tr>
<tr>
<td>Land share</td>
<td></td>
<td>0.095</td>
<td></td>
</tr>
<tr>
<td>Output share</td>
<td>0.30</td>
<td>0.13</td>
<td>0.57</td>
</tr>
<tr>
<td>Cons. share</td>
<td>0.11</td>
<td>0.20</td>
<td>0.69</td>
</tr>
<tr>
<td>Trade</td>
<td>Export</td>
<td>Import</td>
<td>Hm.gd.</td>
</tr>
<tr>
<td>Tariff rate</td>
<td></td>
<td>0.25</td>
<td>0</td>
</tr>
<tr>
<td>( K(0) &lt; K_{ss} )</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pop. gwth rate = 0.024</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Harrod x = 0.014</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Suppose that you have analyzed the effect on the economy from removing the 25 percent level of protection on agriculture by using an inter-temporal
three sector growth model. Some of the results appear in the accompanying charts and table.

<table>
<thead>
<tr>
<th>Table 2: Selected &quot;steady&quot; state values in year t = 100</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>$K_{ss}(t = 100)$ (bils.)</td>
</tr>
<tr>
<td>$P_{ss}$</td>
</tr>
<tr>
<td>$w_{ss}(t = 100)/worker/yr$</td>
</tr>
<tr>
<td>$GDP_{ss}/worker (t = 100)(bils.)$</td>
</tr>
<tr>
<td>Land rent (profits) (bils.)</td>
</tr>
<tr>
<td>Equivalent variation</td>
</tr>
</tbody>
</table>

Steady state is in "·" because some of the variables grow at rate $x$ per worker forever.

Equivalent variation is the amount the agent would be willing to pay in period $t = 0$ to obtain the discounted present value of utility associated with the NO tariff economy.

![Level of ag imports with and without protection](image-url)
Share of economy’s work force in agriculture with and without protection

Output of manufacturing and service
1. Explain the effects of trade reform on the economy. More specifically, why did the removal of the tariff cause: (Be "reasonably" analytical in your answer to this question)

   (a) Labor to depart agriculture?
   (b) The price of home goods to decrease in transition
   (c) The output of manufacturing and service to increase? And,
   (d) What has been the major "source" of households willingness to pay about 19 percent of their wage income in period $t = 0$ to remove the protection on agriculture?

2. Notice that the simulation of trade reform causes an instantaneous adjustment in $t = 0$ between the tariff and non-tariff regime.

   (a) How would you describe, qualityf, or explain this result to a policy maker? (short answer please)
   (b) How would you "counter" a policy maker’s argument above about: (1) food security OR (2) world prices, OR (3) the rural poor (short answer on one of these)
   (c) Does trade reform affect the country’s long-run rate of growth? (yes or no)
3. Acemoglu, among many others) suggests that the quality of institutions is the only positive and significant determinant of income levels. Rodrik and Sachs among others argue that integration can induce trickle down institutional reform. Notice that the results of the simulation of trade reform above increases the share of GDP in foreign trade.

(a) How might you use the above model to obtain insights into the link between foreign trade reform (i.e., integration) and "trickle down" institutional reform? (Short answer please)
SET TWO:

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

III. Labor supply

This problem asks you to derive some results from a modification of Jacoby’s (1993) model of agricultural households’ labor supply. There are three household members (husband, wife and child). The household utility function is:

\[ U = U(C, L_1, L_2, L_3, S_3) \]

where \( C \) is consumption of the only good, which is an agricultural good (note that there is no \( Q \) home-produced good), \( L_i \) is the leisure of person \( i \), and \( S_3 \) is time that the child spends in school for this year (e.g. weeks in school). (The original model also had a “taste shifter” variable, \( Z \), but you can ignore that for this problem.)

The agricultural production function takes the form:

\[ Y = F(L_1, L_2, L_3, H_1, H_2, H_3, A) \]

where \( L_i \) is the labor supply of person \( i \), \( H_i \) is hired labor of three types (adult male, adult female and child), and \( A \) is a vectors of fixed inputs such as land. The household budget constraint is:

\[ C = Y - W_1^H H_1 - W_2^H H_2 - W_3^H H_3 + W_1 M_1 + W_2 M_2 + W_3 M_3 - p_s S_3 \]

where \( W_i^H \) is the wage of hired labor of type \( i \), \( W_i \) is the wage household members of type \( i \) can earn in the labor market, \( M_i \) is the household’s marketed labor of type \( i \), and \( p_s \) is the price of one time unit of school. The market price of \( C \) is set to 1.

Finally, there are three labor supply constraints for the household’s male, female, and child labor:
\[ T_1 = L_1 + M_1 + L_1 \]
\[ T_2 = L_2 + M_2 + L_2 \]
\[ T_3 = L_3 + M_3 + L_3 + S_3 \]

where \( T_i \) is the household’s endowment of labor time of type \( i \).

1. What are the household’s choice variables in this model? Do not include endogenous variables that are functions of other endogenous variables. Just show the variables that the household chooses to maximize its utility.

2. Show the first order conditions for this household’s utility maximization problem.

3. In this model, which adds schooling for children, are household consumption decisions (including consumption of schooling for the child) separable from household production decisions? Demonstrate your answer using your first order conditions in b). Assume that household labor and hired labor of each type (male, female and child) are perfect substitutes, and that \( W_i^H = W_i \) for \( i = 1, 2 \) and \( 3 \).

4. Suppose that the price of schooling, \( p_3 \), increases. Show what happens to \( S_3 \), again referring to the first order conditions. Assume that \( U''_{S3} \leq 0 \) and that \( \partial^2U/\partial C\partial S_3 = 0 \).

IV. R&D and R&D spillovers

In a world where a large country in trade (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. Are benefits to producers in the innovating (i.e., Home) country increased or decreased as a consequence of R&D spillovers to other countries? Illustrate and discuss.

2. Does overall welfare in the innovating (i.e., Home) country increase or decrease as a consequence of spillovers? Illustrate and discuss.

3. Describe and explain the implications for rest-of-world producers if only the Home country innovates, absent international spillovers. How does your answer change if Home country research also transfers to countries elsewhere in the world?

V. Analysis of food aid in static general equilibrium

Consider a static three-sector framework

**The household**

Given the *micro*-economic primitives

\[ u = \mu(q_m, q_a, q_s) \] utility

where

\[ q_m = \text{industrial good consumption} \]
\[ q_a = q^* + q_a^c = \text{total food = food aid } q^* + q_a^c \text{ commercial food purchases} \]
\[ q_s = \text{service good consumption} \]

The individual budget constraint

\[ Y = p_m q_m + p_a q_a^c + pq^* + p_s q_s \]

where \( Y \) is income, and \( p \) is the "food stamp price" of food aid \( q^* \), can be expressed as

\[ Y + q^* (p_a - p) = p_m q_m + p_a q_a + p_s q_s \]

if a black market does not exist for \( q^* \).

**Firms**

Firms employ the CRS technologies

\[ y_j \leq f^j(\ell_j, k_j) \] production, \( j = m, s \)
$$y_a \leq f^a (\ell_a, k_a, h)$$  agriculture production

$$wL + rK + \pi H = \text{factor payments to the total endowments of}$$

labor $L$, capital $K$ and land $H$ where $\pi = \text{land rental rate}$

**Economy**

Thus, the economy’s total income is

$$wL + rK + \pi H + Q^* (p_a - p)$$

where total food aid $Q^* = \sum q^*$.

**Question**

1. Characterize the equilibrium for this small open and competitive economy that exports the $m$ good and imports the $a$ good, while good $j = s$ is only traded in the domestic economy, and receives $Q^*$ in food aid.

2. The home good price equation:

   (a) Indicate the conditions from which you would derive this equation and identify its arguments (i.e., you need NOT derive it).

   (b) State (i.e., you need not prove) this equation’s key mathematical properties.

   (c) Explain why you might expect $\partial p_s / \partial Q^* > 0$.

3. Now, use a two-dimensional diagram to explain the effects of, say "large" amounts of $Q^*$ on this economy.

**VI. Growth theory**

Consider the environment of the three sector growth model. 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
home good, indexed $j = s$, is a pure consumption good. 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 $T$.

Let the key primitives be the following. The manufacturing and home good sectors ($j = m, s$) employ constant returns to scale technologies that, at the sector level, can be expressed as

$$Y_j(t) = F^j(A(t)L_j(t), K_j(t)), \ j = m, s$$

(1)

where $A(t) = e^{xt}$ is exogenous labor augmenting change.

Agriculture’s sector level technology is

$$Y_a(t) = F^a(A(t)L_a(t), K_a(t), A_a(t) H)$$

where land $T$ is specific to the sector but can be rented at price $\pi$ among firms within the sector. The technology $F^a(\cdot)$ has the same properties as (1). Land’s productivity can also grow exogenously as determined by

$$A_a(t) = e^{nt}$$

Households are represented by the typical infinitely-lived Ramsey consumer that receives utility from the sequence $\{C_m, C_a, C_s\}_{t=0}^{t=\infty}$ expressed as a weighted sum of all future flows of utility

$$\int_{t=0}^{t=\infty} \frac{u(C_m, C_a, C_s)^{1-\theta} - 1}{1 - \theta} e^{(n-\rho)t} dt$$

(2)

The number of household members are assumed to be proportional to the number of workers, to grow at the exogenously given positive rate $n$,

$$L(t) = e^{nt} L(0)$$

and to discount future consumption at the rate $\rho > 0$.

**Answer question (1) or (2) but not both.**

1. Equilibrium:
(a) Characterize both the intra- and inter-temporal equilibrium for this model (you need not derive the necessary dual functions, such as cost and revenue, just state and use them)

(b) Indicate how you solve for the model’s steady state level of capital

(c) Presume that you have derived the model’s two key differential equations. Discuss the time elimination method used to empirically solve them.

2. The no-arbitrage condition:

(a) Show why the budget constraint
\[
\dot{k} = w + rK + \pi H - E
\]
implies a no-arbitrage condition between the capital asset \( K \) and the land asset \( H \)

(b) What are "some" implications of this condition?

(c) Aside from the above model, suppose that there is segmentation between say urban capital markets and rural capital markets so that for urban households, the following Euler condition applies
\[
\frac{\dot{E}_{urban}}{E_{urban}} = r_{urban} - \rho
\]
and for the rural households the Euler condition is
\[
\frac{\dot{E}_{rural}}{E_{rural}} = r_{urban} - \rho
\]
where, as is typical in developing countries, at some transition point, \( t \)
\[
r_{urban}(t) < r_{rural}(t)
\]
i. What implications might this difference in the return to urban vs rural capital assets imply about the market for land, and the price of land?

ii. What implications might this difference imply about a policy of "land reform" in which low income households are given title to land?