WRITTEN PRELIMINARY Ph.D EXAMINATION

Department of Applied Economics
Trade, Development and Growth
January 2012

For students electing
APEC 8701 and APEC 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.
* Write on one side of the paper only.
* You are required 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. Financial Crises

Imbalances in the world economy have received increased attention since the recession that struck many countries beginning in 2007. A typical feature can be seen from the imbalances in Europe (attached figure). The negative bar includes the countries of Irland, Greece, Spain and Portugal.

![Figure 2: European Surplus Countries Offset European Deficit Countries Current Account Imbalance (billions of dollars)](image)

By a simple accounting identity

\[
S - I = (G - T) + (X - M)
\]

a current account deficit (exports \(X\) less than imports \(M\)) implies a capital inflow that can cause savings \(S\) to be less than investment \(I\) and/or for government expenditures \(G\) to exceed tax revenues \(T\). While a country may incur a current account deficit in the long-run (because returns to foreign assets owned by domestic residents exceed the returns to foreign owners of domestic assets), the growth in the deficits of many countries (Greece in particular) to undergo painful restructuring.

**Question**

Consider an economy (say Greece) having the following factor shares in sectoral gdp, and sector shares in total gdp (e.g., 0.2158 is agriculture's sector share in total gdp).
Start with the supposition that:

- The country has accumulated a large stock of government debt (i.e., $G > T$ for some extended period)
- As a member of the European Union, it cannot devalue its currency (if it cannot devalue the Euro, adjustments must come in terms of home good prices, wages and other variables rather than the nominal value of the currency).
- Assume debt repayment implies the need for tax revenues to exceed government expenditures, $T > G$, for some extended period into the future.
- For simplicity, presume the rate of return to capital $r^k$ is determined by the productivity of capital in Greece only (so the capital market clearing equation is de-linked from that of the rest of the EU).

1) Provide a graphical depiction and accompanying explanation of the adjustments brought about by a "financial collapse" and the need to accommodate payments on principle and interest for the case of $T > G$. In this depiction, you should also discuss briefly the likely dynamic effects on saving, investment and transition growth.

2) Now, for the purpose of this question, narrow you focus to agriculture. Be more analytical, and explain the adjustment in agricultural factor (labor, capital) allocations associated with readjustment $(T > G)$. To answer this question, you need to take into account the links between the evolution of the price of home goods, wages, and returns to capital $r^k$. Here, you will need to draw up the structure features of the economy as shown in the above table.

<table>
<thead>
<tr>
<th>Agric.</th>
<th>Mnf.</th>
<th>Serv.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Share: Labor</td>
<td>0.5871</td>
<td>0.5191</td>
</tr>
<tr>
<td>Capital</td>
<td>0.3175</td>
<td>0.4809</td>
</tr>
<tr>
<td>Land</td>
<td>0.0953</td>
<td></td>
</tr>
<tr>
<td>Sec. share in econ.</td>
<td>0.2158</td>
<td>0.2116</td>
</tr>
</tbody>
</table>
II. Human capital, physical strength and work choices.

Suppose that workers can be employed in different types of jobs (including self-employment work), each of which is indexed by i. Each worker possesses human capital, denoted by H, and physical strength, denoted by B (“brawn”). Each job pays the following wage:

\[ W(i) = \pi(i)H^{\alpha(i)}B^{(1-\alpha(i))}, \]

where \( \pi(i) > 0 \) and \( 0 < \alpha(i) < 1 \) for all i.

Again, i is an index for the different jobs, and \( \pi(i) \), which is > 0, is the price of the good produced by activity i.

a) Assume that there are many types of jobs, so that i can be thought of as a continuous index, and hence a continuous variable. Without loss of generality, order the \( \alpha(i) \) terms by i, so that a smaller i implies a smaller \( \alpha(i) \). That is, if \( i < i' \) then \( \alpha(i) < \alpha(i') \). So think of \( \alpha \) as a continuous function of a variable i, such that \( \partial \alpha(i)/\partial i > 0 \). The worker chooses i, and thereby chooses \( \alpha(i) \), to maximize his or her wages. Show the first order condition for a worker to maximize wages by choosing the type of job (choosing i). Note that \( \pi(i) \) can also be thought of as a continuous function of i. Express your answer so that \( \log(H/B) \) equals an expression involving one or more functions of i (some of which could be derivatives of functions of i). [Hint: Maximizing the log of the wage is equivalent to maximizing the wage.]

b) Consider your answer for a). Suppose that men have more strength (B) than human capital (H), while women have more human capital than strength. That is, \( H/B > 1 \) for women and \( < 1 \) for men. What happens to the price of the good when a woman moves to a more skilled (higher \( \alpha(i) \)) job? What happens to the price of the good when a man moves to a more skilled (higher \( \alpha(i) \)) job?

c) Consider the choice of child schooling and adult consumption made by the parent of a girl. Let the parent’s utility function be \( U(C, W) \), where C is the consumption of the parent and W is the wage that the girl will earn when she is an adult. Assume \( W = \pi H^{\alpha}B^{(1-\alpha)} \). [Note: for the rest of the problem ignore the choice of i and focus on schooling and consumption choices.] Assume that B is a constant but H can be determined by \( H = H(S) \), where S is years of schooling. Finally, assume the family faces a budget constraint of \( Y = pC + (1-S)\omega + S\rho \), where Y is fixed parental income, p is the price of the consumption good, \( \omega \) is the child wage rate and \( \rho \) is the price of schooling. (Note that S has been normalized to be from 0 to 1.) Derive and interpret the first order conditions for the choice of C and S.

d) This final question is harder. Suppose that for men strength (B) is also a choice, so that \( B = B(C) \). That is, unlike women men can build up their strength by consuming more calories. In addition, calories have a direct effect on the child wage rate for boys: \( \omega = \omega(C) \), where \( \partial \omega/\partial C > 0 \). Work out the first order conditions for the parent’s utility maximization problem for a boy, where their choices again are S and C. Compare your answer to c); in particular will parents invest more in schooling for boys, or more schooling of girls?
SET TWO:

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

III. Measuring the Welfare Effects of R&D

In a two-country world where a large exporting country (called Home) innovates, use a clearly labeled figure of a multi-market model and associated explanation to evaluate the following questions:

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

3. 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.
IV. Land Contracts

Consider a simple model of efficient land contracts. Assume that there are 3 possible outcomes, and call them high, medium and low. Total output = H in the high case and = L in the low case. In the medium case let output = M, where H > M > L. Assume that the probabilities of the three cases be:

\[
\text{Prob}[M] = \mu \quad \text{(for some exogenous } \mu \text{ such that } 0 < \mu < 1)
\]

\[
\text{Prob}[H] = e(1-\mu) \quad (e \text{ is the tenant’s effort})
\]

\[
\text{Prob}[L] = (1-e)(1-\mu)
\]

Assume that rental contracts take the simple form of different payments to the tenant from the landlord depending on whether L, M or H occurs:

\[
l = \text{payment to tenant when L occurs} \quad \text{(and the landlord gets the rest)}
\]

\[
m = \text{payment to tenant when M occurs} \quad \text{(and the landlord gets the rest)}
\]

\[
h = \text{payment to tenant when H occurs} \quad \text{(and the landlord gets the rest)}
\]

The “payoff” (expected utility) of the tenant is the expected payment minus the disutility of effort, \(d(e)\), and the “payoff” of the landlord is his/her expected payment. Assume that \(d'(e) > 0\) (greater effort implies greater disutility).

a) Derive the equation that (implicitly) solves for the socially optimal level of tenant effort, where social welfare is the sum of the “payoffs” of the tenant and the landlord. You can assume that the social welfare function is strictly concave in \(e\).

b) How does this level of effort compare to the level of effort for the case where there is no “medium” category? Assume that \(d''(e) > 0\) and \(\text{Prob}[L] = (1-e)\rho\text{and Prob}[H] = e\). Give the intuition behind this result.

c) Show the modified versions of the two constraints to the landlord’s optimization problem given in class (modified to allow for three outcomes instead of two). To avoid confusing notation, denote the income that the tenant could earn elsewhere by \(y_i\) instead of \(m\). In this model with 3 outcomes, is it in the landlord’s interest to set the values of \(l, m \text{ and } h\) so that the tenant chooses the socially optimal level of effort? Explain your answer. [Hint: To answer the question about what is in the landlord’s best interest you don’t need to do anything mathematical, just think of the logic of the question.]

d) Show at least one set of solutions for \(h, l \text{ and } m\) that characterize the solution to the landlord’s optimization problem. Is this the only possible solution, or are other solutions possible?
V. Growth Accounting

Consider a competitive economy producing two goods \( Y_1(t), Y_2(t) \) by employing the following neoclassical technology (meaning CRS) and factors of production

\[
Y_1 = \min \left\{ F^1(K_1, AL_1), \frac{Y_{11}}{\sigma_{11}}, \frac{Y_{21}}{\sigma_{21}} \right\}
\]

\[
Y_2 = \min \left\{ F^2(K_2, AL_2), \frac{Y_{12}}{\sigma_{12}}, \frac{Y_{22}}{\sigma_{22}} \right\}
\]

where \( K_j, L_j \) are stocks of capital and labor employed in the \( j \)-th sector, and \( \sigma_{ij} \) are input-output coefficients. \( \bar{A} \) is the assumed augmentation effect of Harrod neutral technological change. Gross output is \( Y_j \) and \( Y_{ij} \) is the amount of output from sector \( i \) that is employed as an intermediate factor of production in sector \( j \). The amount of a final good produced is thus \( Y_1^{\text{final}} = Y_1 - Y_{11} - Y_{12} \). If we assume the economy is competitive and technologies are neoclassical, a competitive market equilibrium should lead to the following GDP function (which we assume is smooth-continuous and at least once differentiable in its arguments)

\[
GDP = G((p_1 - \sigma_{11}p_1 - \sigma_{21}p_2), (p_2 - \sigma_{12}p_1 - \sigma_{22}p_2), K, AL) = \max_{K,K_1,K_2,L,L_1,L_2} \left\{ (p_1 - \sigma_{11}p_1 - \sigma_{21}p_2)F^1(K_1, AL_1) + (p_2 - \sigma_{12}p_1 - \sigma_{22}p_2)F^2(K_2, AL_2) \right\}, \text{s.t.} \]

\[
K \geq K_1 + K_2, L \geq L_1 + L_2
\]

where \( K \) and \( L \) are the country's stock of labor and capital at each point in time \( t \) (\( t \) is omitted for notational purposes) and we assume the capital and labor constraints are binding at each \( t \).

- Given the assumption that the GDP function exists, conduct a "growth accounting exercise", i.e., perform the operations that would, in principle,
  - Allow you to calculate the sources of growth in real GDP
  - Use this result to isolate/solve for total factor productivity \( \bar{A}/A \)
- What are "typical" numerical measures of \( K \), and \( L \)?
- If: the economy is in long-run balanced growth-path equilibrium, the rate of growth of \( L \) is constant at rate \( n \), and the rate of Harrod neutral technological change is also constant at rate \( x \), what is the contribution of the growth in \( K \), technological change \( \bar{A}/A \), and labor force \( L \) to the long-run growth in GDP?
- Show that \( \partial G(\cdot)/\partial p_j \) yields the supply function for the final good, e.g., \( Y_{i}^{\text{final}} = Y_i - Y_{i1} - Y_{i2} \)
VI. Trade distortion and transition growth

This question asks you to explain how an intervention to restrict a low income country's exports of its agricultural good is likely to affect its transition path to long-run equilibrium.

Consider a three sector, small, competitive and open "Ramsey - endogenous savings" economy that produces three final goods (industry, agriculture and services), employing labor and capital to produce the industrial and service sector good, and labor, capital \((k)\) and land \((h)\) to produce the agriculture good. Households hold homothetic preferences and exchange the services of these resources for wages, rents to capital and land, which they allocate to consumption of the three goods and to savings. The economy is in transition growth with capital stock in period \(t = 0\), less than its long-run equilibrium level. For purposes here, let the rate of technological change and the rate of population growth equal zero, let the industrial sector be the most capital intensive sector. Let the service sector be the most labor intensive of the three sectors.

To capture the effect of the policy to restrict agricultural exports, let the export tax equivalent of a quota on agricultural exports be \(\tau > 0\), so that the price faced by agriculture is \(p_a = p_a^w(1 - \tau)\) where \(p_a^w\) is the world price of the agricultural good.

To limit the scope of this question:

- Characterize the intra-temporal equilibrium conditions for this economy (you need not state the primitives, just their dual counter parts like cost and profit functions in “general” form)
- From this characterization, derive/state -in general form- the reduced form equations for wages \(w\), the capital rental rate \(r^k\), and the three supply functions \(y_m\) (industry), \(y_s\) (services) and \(y_a\) (agriculture).
- Using the fact that, for an interior solution, the price of home goods can also be expressed as a function of the prices of the two traded goods, \(p_m, p_a\) and factor endowments, that is, \(p_s = P^r \phi_m, p_a, k, h\), and given (1.), (2.) explain why for \(\tau > 0\) compared to \(\tau = 0\),
  - the transition of wages is lower \(\dot{w}(t)/w(t)|_{\tau>0} \leq \dot{w}(t)/w(t)|_{\tau=0}\)
  - the transition of capital payments is higher \(\dot{r}^k(t)/r^k(t)|_{\tau>0} \geq \dot{r}^k(t)/r^k(t)|_{\tau=0}\)
  - the transition of the price of home goods is lower \(\dot{p}_s(t)/p_s(t)|_{\tau>0} \leq \dot{p}_s(t)/p_s(t)|_{\tau=0}\)
  - the rate of capital deepening is higher, \(\dot{k}(t)/k(t)|_{\tau>0} \geq \dot{k}(t)/k(t)|_{\tau=0}\)
- Explain the likely effects of \(\tau > 0\) relative to \(\tau = 0\), on the
  - Rental rate of agricultural land
  - Agricultural supply, and
  - the demand for agricultural labor and capital