WRITTEN PRELIMINARY Ph.D EXAMINATION

Department of Applied Economics
June - 2009
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. Credit Markets and Group Lending

[Note: The notation is not exactly the same as the notation used in class!] Consider a bank making a group loan to a “group” of two borrowers, each of whom has a project that he or she wants to implement using the loan. For borrower $i$ ($i = 1$ or $2$), the probability of success is $p_i$ (which takes values between 0 and 1), and the return if the project is successful is $R_i$. For borrowing the amount of capital needed to implement the project, the bank requires a repayment of $r$ from person $i$ if his or her project is successful. If the project is unsuccessful the borrower gets no income, and no repayment is made to the bank. In addition, if his or her project is successful but the other person’s project is unsuccessful the first person must pay the bank an additional payment of $c$. Assume that $r > 0$ and $c > 0$.

Questions:

1. Suppose that borrower 1’s (expected) utility is simply equal to his or her expected income (there is no disutility from work effort). Write the expression for the expected utility of borrower 1 as a function of $p_1, p_2, R_1$ and $c$.

2. Consider a second potential partner of borrower 1, called borrower 2', whose project has a probability of success of $p_2'$. Assume that $p_2 > p_2'$. Of course, borrower 1 prefers to have borrower 2 as a group partner instead of borrower 2', since that would reduce borrower 1’s probability of having to pay the “penalty” of $c$.

   (a) How much would borrower 1 be willing to pay to have borrower 2 as a partner instead of borrower 2'?

   (b) Does this willingness to pay for borrower 2 increase or decrease with the value of $p_1$? What is the intuition for this increase or decrease?

3. Now suppose that there are $P$ types of borrowers, each of which has a different $p$. Thus there are types 1, 2, ..., $P$, with corresponding probabilities of success $p_1, p_2, ..., p_P$, where $p_i$ always lies between 0 and 1.
Assume that for each type there is an even number of borrowers, so that if each type decides to form 2-person partnerships only with people of their own type, then there will be no “extra” person of that type who cannot find a partner of the same type. Consider a situation where all people have formed partnerships with another person of the same type. Is it possible that a person of type $p_i$ may be able to pay a person of type $p_j$, where $p_i < p_j$, enough money to make it worthwhile for the $p_j$ person to be his or her partner? [Hint: use your answer to 2. and consider the fact that other people may also want the $p_j$ person to be their partner. Note also that the answer is primarily one of logic, not a mathematical answer.]

4. Now consider a situation in which many people initially start out in partnerships with people of a different type. Is this “equilibrium” stable, or will people tend to change their partners so that they are matched with people of the same type? Explain your answer. [Hint: start by considering people of the type with the highest $p_i$, which you can denote as the $p_1$ group. Again, the answer is primarily one of logic, not mathematics.]

5. Finally, consider the relationship between expected utility and $p$. Assume that $R$ is a decreasing function of $p$ (so that $\dot{R}(p) < 0$ for all $p$) and that $p \times R(p)$ is a constant: $pR(p) = \hat{R}$. Lastly, assume that $r > c$. Using your answers above, prove whether a borrower’s expected utility from taking a joint liability loan is an increasing or decreasing (or ambiguous) function of $p$. Give the intuition for your result.

II. Economic Growth and Market Linkages

Many emerging market and middle income countries employ technologies that are identical to technologies employed in rich countries. Nevertheless, most of these countries appear to be converging toward long-run levels of real income per capita less than rich countries (Parente and Prescott). Some argue (e.g., Agenoglu, Johnson, Robinson, Rodrick) the reason lies in institutional differences, others (Sachs) the cause is geography and yet others, the problem is bad policy (e.g., the trade school).

Your **task** is to contrast two countries that have identical technology, with one key difference. The difference is the resources required to employ
intermediate inputs in the production process. That is, "linkages" among markets relate to physical infrastructure and social-governance infrastructure that affect the amount of resources required to employ resources in the production process.

Consider the following model to partially address the general question: why do countries with "identical technologies" experience differences in transition growth and in the level of long-run real income per capita?

Primitives

The representative HH of the current generation is presumed to maximize the present value of discounted inter-temporal utility \( U \)

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

subject to a budget constraint:

\[
\dot{k} = w + k (r^k - n - \delta) - c
\]

and a constraint to prevent a Ponzi scheme

\[
\lim_{t \to \infty} \left\{ k(t) e^{-\int_0^t (r(v) - n) dv} \right\} \geq 0.
\]

Technology is

\[
Y = B \left( K^\alpha (e^{xt} L)^{1-\alpha} \right)^{1-\sigma} (X)^\sigma
\]

where: \( X \) is an intermediate factor of production that is equal to

\[
X = \mu Y
\]

\( K \) is capital stock, \( L \) is the stock of labor that goes at rate \( n \), and \( x \) is the rate of labor augmenting technological change. Gross domestic product (GDP) is

\[
Y - \mu Y = wL + r^k K
\]

Our key parameter is \( \mu \). In rich countries, \( \mu_{\text{rich}} < \mu_{\text{poor}} \). Initial conditions also vary; capital stock per worker in rich is greater than for the poor country. i.e., \( [K (0)/L (0)]_{\text{rich}} > [K (0)/L (0)]_{\text{poor}} \).

Questions
1. Characterize the intra-temporal and the inter-temporal equilibrium for
the typical economy, i.e. for a given $\mu$. (you need not derive the Euler
condition, just state it)

2. Derive the long-run (steady-state) equilibrium condition for either $K$
or $Y$ and discuss how $\mu_{rich} < \mu_{poor}$ affects this result.

3. Discuss (using a graphic):

   (a) Where on the transition path to long-run equilibrium are we likely
to "see" the rich and poor country at time $t$?

   (b) How the transition path of $\tilde{gdp}$ (GDP/effective worker) to long-run
equilibrium is likely to appear for $\mu_{rich}$ compared to $\mu_{poor}$. 
SET TWO:
Answer THREE of the following four questions (III to VI)

III. Application of Growth Theory

Your main task is to explain the empirical results from fitting a three sector growth model to Turkish data. You are given "limited" information as to the structure of the economy because, knowing the basic three-sector model, you can predict much of its underlying structure from observing the empirical results. The model depicts a small open economy with one home good, a food - agricultural good that employs labor, capital and a fixed factor, land. The other two sectors employ labor and capital.

To answer this question, you must refer to tables 1, 2 and 3 attached.

Questions

1. Table 1 shows the evolution of the economy from 2001 to 2031 in constant Turkish Lira. Use Table 1 to explain:

(a) Why is capital per worker increasing?
(b) Why is wage per worker increasing?
(c) Why is land rental income per worker declining from 2001 to 2011, and then increasing thereafter?

2. Refer to Table 2. To help explain the results in Table 2, you may need to refer to Table 3.

(a) Why is the share of industry in GDP rising, the share of agriculture in GDP falling, and the share of service in GDP rising?

3. Refer to Table 3.

(a) Why is the contribution of the capital stock to economic growth of the industrial sector positive, and why is its contribution to growth of the service sector negative?

(b) For the case of agriculture, why is the effect of gross output affected negatively by the wage effect, and positively by the interest rate effect?
(c) Why does the price effect affect the growth of the industrial sector more negatively than it affects the growth of the agricultural sector?

4. In the long run, what does the model predict regarding the growth rates of industrial, agricultural and service sector output?
IV. Models of Education Investments in Developing Countries.

Much of the question is concerned with the following 2-period model of investments in education:

\[ U = C_1 + \delta C_2 + \sigma A \]  
(1)

\[ A = \alpha f(Q)g(S) \]  
(2)

\[ C_1 = Y_1 - pS + (1 - S)kY_c \]  
(3)

\[ C_2 = Y_2 + lY_c \]  
(4)

\[ Y_c = \pi A \]  
(5)

where \( C_i \) is consumption and \( Y_i \) is income in period \( i \), \( A \) is academic skills, \( Q \) is school quality, \( S \) is time (years) in school, and \( Y_c \) is income earned by children.

Questions

1. Substitute equations (2) – (5) into equation (1) to obtain an expression where utility is a function if \( Y_1, Y_2, S, Q \), and the various parameters.

2. Assume the school quality \( (Q) \) is exogenous. Derive the first order condition for utility maximization and explain what role \( Y_1 \) and \( Y_2 \) play in determining the optimal value of \( S \).

3. Note that \( Y_1 \), and \( Y_2 \) do not appear in the F.O.C., so they have no effect on the optimal level of \( S \).
4. Is your answer to 2. regarding the role played by \( Y_1 \), and \( Y_2 \) is intuitive, given the nature of the utility function in equation (1)? If possible try to explain your result with “deeper” intuition.

5. Suppose you think that the above model is plausible, and you want to estimate equation (2). You have data on \( A \), measured by test scores given to school children, and data on years of schooling and on about 10 different indicators of school quality, demoted by \( Q_1, Q_2, \ldots, Q_{10} \). You do not have any data on inmate ability (\( \alpha \)). You regress \( A \) on \( S \) and on the 10 \( Q \) variables.

(a) Give one reason why you may overestimate the impacts of the \( Q \) variables on \( A \).

(b) Give one reason why you may underestimate them.

6. Suggest two methods that could get around the problems you raised in question 5., and point out at least one shortcoming for each of your suggestions.

V. Poverty and Economic Growth

Suppose we characterize poverty by a condition where, in time period \( t = 0 \), food consumption per worker \( c(0) \) is just slightly greater than that needed to sustain life, i.e., \( c(0) \gtrsim c^o \) where \( c^o \) is the minimum level of consumption need to sustain life. Utility of the representative household is given by

\[
U = \int_0^\infty \frac{(c(t) - c^o)^{1-\theta} - 1}{1 - \theta} e^{(n-\rho)t} dt
\]

and the flow budget constraint is (we omit the \( t \) notation)

\[
\dot{k} = w + k \left(r^k - n - \delta \right) - c
\]

where \( k \) is the capital stock per worker, \( w \) is the wage rate, \( \delta \) is depreciation, \( r^k - \delta \) is the rate firms pay households for the use of capital, \( n \) is the rate of growth in the work force and \( c \) is the level of consumption per worker AND expenditure per worker for the simple case here. Thus, expenditure must equal or exceed \( c^o \), i.e., \( c \geq c^o \).

Questions
1. Derive the Euler condition for this economy, and discuss how

(a) Subsistence consumption needs, $c^o$, affects the growth rate of capital per worker, i.e., $k$.

(b) What effect does the elasticity of inter-temporal substitution, $1/\theta$, have on the accumulation of $k$ (i.e., growth in capital stock).

(c) Describe\ discuss the effect of $c^o$ on the transition to long-run equilibrium when initial conditions are $c(0) \lesssim c^o$, compared to the case where $c(0) \gg c^o$ (i.e., $c(0)$ is much greater than $c^o$)

(d) Show whether (or under what circumstances) $c^o$ affects the long-run equilibrium (e.g., $r^k$ in the steady state) of this economy.

(e) How would a once and for all lump-sum income transfer in period $t(0)$ affect the growth path of this economy relative to the baseline growth path without the lump-sum transfer?

2. Presuming neoclassical technology, let the GDP function per worker be denoted as

$$gdp = G(\cdot, k)$$

where $k$ is of our major interest.

(a) If a long-run equilibrium exists, what is the rate of growth in GDP, and in $K$?

3. An extension of the simple model: Consider the case where malnutrition causes a Malthusian like effect. In other words, the growth rate of population (which we assume is proportional to the growth in the labor force) is positively affected by the extent to which consumption exceeds subsistence levels. That is,

$$n = n(c - c^o),$$

where $n(c - c^o) \downarrow 0$ as $c - c^o \downarrow 0$ and $n(c - c^o) \downarrow \text{constant } n$ as $c$ becomes "large." Thus, $n(c - c^o)$ is continuous and positive single valued function, concave in $c - c^o$ so that the growth rate of population $L(t)$

$$L(t) = L(0) e^{n(c-c^o)t}$$
remains equal to or greater than zero. Finally, when agents optimize, they do not take into account the effect of $c$ on $L(t)$. This also means that the budget constraint appears as

\[ \dot{k} = w + k \left( r^k - n (c - c^o) - \delta \right) - c \]

Using your intuition

(a) Do you "reason" that "children not living" (hence a small $n (c - c^o)$ for small $t$) speeds up or slows down the rate of convergence to same long-run equilibrium as in part 1 above? Explain.

VI. Productivity and the Welfare Effects of R&D

1. Measuring Productivity:

(a) Using a Laspeyres indexing procedure to aggregate inputs will cause measured multi-factor productivity to decrease in response to changes in relative factor prices, even in the absence of technical change. True or false? Illustrate graphically and explain in a one output, two input world.

(b) Setting aside the problem of aggregation bias, identify and carefully discuss at least two additional reasons for measured multi-factor productivity growth to deviate from zero.

2. Measuring the Welfare Effects of R&D:

(a) When supply and demand elasticities are of equal but opposite signs, producers and consumers share equally in the benefits from R&D. True or false, explain.

(b) With a parallel research induced shift in supply, producers are always better off. True or false, explain.
\[ U = (c - c^o) \]

\[
J = \int_0^t \frac{(c - c^o)^{1-\theta}}{1 - \theta} e^{(n^* - \rho)t} + \xi (w + k (r^k - \delta - n^*) - c)
\]

\[ (c - c^o)^{-\theta} e^{(n - \rho)t} - \xi \]

\[ \frac{\dot{\xi}}{\xi} = (r^k - \delta - n^*) \]

\[ \frac{\dot{c}}{c - c^o} = \frac{1}{\theta} (r^k - \delta - \rho) \]

\[
\hat{k} = f - f_{kk} k + f_{kk} (r^k - \delta - n^*) - c
\]

\[
\dot{\hat{k}} = f + f_{kk} (r^k - \delta - n^* - 1) - c
\]

\[
\ddot{k} = f + f_{kk} (r^k - \delta - n (c - c^o) - 1) - c
\]

\[
\dot{c} = \frac{(c - c^o)}{\theta} (r^k - \delta - \rho)
\]

See c:\m\grad\osvaldo\yr09\1sec.nb