WRITTEN PRELIMINARY Ph.D EXAMINATION

Department of Applied Economics
June - 2014
Trade, Development and Growth

For students electing
Macro (8701/Prof. Roe) & Micro (8703/Prof. Glewwe and Bellemare) 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
I. Rural Credit Markets With Moral Hazard and Adverse Selection.

A farmer with a given amount of land cultivates a crop using an input $x$. The output depends on the innate talent of the farmer. There are 2 possible states: $S$ (success) or $F$ (failure). Output, which depends on the amount of inputs ($x$) used and on success or failure, is as follows:

\[
\begin{align*}
    f_S(x) & \text{ if state } = S(\text{success}) \\
    f_F(x) & \text{ if state } = F(\text{failure})
\end{align*}
\]

Both $f_S(x)$ and $f_F(x)$ are strictly concave, $f_F(0) = 0$, $f_S(0) = 0$, and $f_S(x) > f_F(x)$ for all $x$.

The farmer needs to borrow money to purchase the input $x$, which has a price $= 1$. The lender offers two sizes of loans, $x_L$ (low) and $x_H$ (high), where $x_L < x_H$. The “gross” interest rate, which includes the principal, is $R(= 1 + r)$, and is the same for both loans. Assume throughout that the farmer is risk neutral.

Questions

a) The units of the output are set so that its price is also $= 1$. The value of the output when a small loan is taken, and the state is “failure”, is exactly enough to pay back the loan: $f_F(x_L) = x_L R$. Suppose that the farmer borrows a large loan, so that he or she borrows $x_L$. If the state is “failure”, will the harvest be sufficient to pay back the loan? No math is needed to answer this question.

b) For a given farmer, the probability of success is $p$, and thus the probability of failure is $1 - p$. Assume that, if the farmer cannot pay back the loan, the lender gets all of the output. If the farmer can repay, the loan is paid in full. What is the farmer’s expected profit if he or she takes the smaller loan ($x_L$)? What is the farmer’s expected profit if he or she takes the larger loan ($x_H$)?
c) Suppose that the following relationship holds if the state is “success” (S):

\[ f_S(x_H) - x_H R > f_S(x_L) - x_L R \]

State in words what this relationship means. Given this relationship, and your answer to b), will the farmer (who wants to maximize expected profits) prefer a large loan \((x_H)\) or a small loan \((x_L)\)?

d) Next, consider moral hazard. The farmer has the option of selling all of the input purchased using the loan for a higher price, \(q\), than he or she pays for it when using money borrowed from the lender (that is, the lender makes the input available for a price of 1, but the farmer can sell it for \(q\), which is \(> 1\)). For simplicity, if this happens the farmer sells all of the input. Most importantly, the lender cannot seize any of the income that the farmer gets from selling the input; it can seize only the crop grown by the farmer. If the farmer sells all of the input, what is his or her expected profit if he or she takes the smaller loan \((x_L)\)? What is the expected profit if he or she takes the larger loan \((x_H)\)? Which does the farmer prefer to borrow, the smaller loan or the larger loan?

e) Given this state of affairs, and assuming that different farmers have different values of \(p\) (the probability of “success”), what are the values of \(p\) that correspond to the farmers that the lender would be willing to lend to, and what are the values of \(p\) that correspond to farmers that the lender would not be willing to lend to? For the farmers that the lender is willing to lend to, what is the expected profit of those farmers, and what is the expected profit of the lender? Your answer should depend upon \(p\).
II. Growth Theory

Consider the three sector growth model in which there are two traded goods sectors, industry and agriculture, and a non-internationally traded good, services. Index these goods as \( j = m(\text{industry}), a(\text{agriculture}), s(\text{service}) \). Households own the economy’s factor endowments, labor, \( L(t) \), capital \( K(t) \), and land \( H \). Households rent out the services of these resources in exchange for factor payments \( w(t), r^k(t) \) and \( \Pi(t) \), respectively, which they in turn allocate to savings and expenditures on industrial \( Q_m(t) \), food \( Q_a(t) \) and service goods \( Q_s(t) \).

The representative household seeks to maximize

\[
\int_0^\infty \frac{q^{1-\theta} - 1}{1-\theta} e^{(\rho-\theta)t} dt
\]

subject to the flow budget constraint

\[
\dot{\hat{k}} = w + k(r - n) + \pi H - \epsilon
\]

where expenditures

\[
\epsilon = \mathcal{E}(p_a, p_m, p_s) q \equiv \min_{q_a, q_m, q_s} \{ p_a q_a + p_m q_m + p_s q_s : q \leq u(q_a, q_m, q_s) \}
\]

and \( p_m = 1 \).

The behavioral rule (the Euler equation) for households, in effective labor units, is

\[
\frac{\dot{\epsilon}}{\epsilon} = \frac{1}{\theta} \left( r^k - \rho - \delta - \theta x + \lambda_s \frac{p_s}{p_s} (\theta - 1) \right)
\]

where expenditures per effective worker are

\[
\hat{e} = \mathcal{E}(p_m, p_a, p_s) \hat{q}
\]

The behavioral rules for firms in the manufacturing and the service sector are

\[
C^j(\hat{w}, r^k) \hat{y}_j \equiv \min_{l_j, k_j} \left\{ \hat{w} l_j + u^k \hat{k}_j : \hat{y}_j \leq f^j(l_j, \hat{k}_j) \right\}, \ j = m, s
\]

and agriculture (in units per effective worker) they are

\[
\pi^a(p_a, \hat{w}, r^k) H \equiv \max_{l_a, \hat{k}_a} \left\{ p_a f^a(l_a, \hat{k}_a, H) - \hat{w} l_a - r^k \hat{k} \right\}
\]
Questions
State any necessary additional assumptions and conditions that may be necessary, then

1. Characterize *intra-temporal* equilibrium

2. Show/discuss how you derive the reduced form functions for $\{\hat{w}, r^k, \hat{y}_m, \hat{y}_s\}$.

3. Show "how" you solve for the model’s steady-state values $\{\hat{k}^{ss}, \hat{y}_s^{ss}\}$.

4. Derive/go through the steps showing how you obtain the model’s two differential equations
III. Child Labor And Schooling, With A Little Econometrics.

A household with one child is considering whether to send the child to school or send him or her to work. Let the variable \( d \) take only 2 values: \( d = 1 \) if the child works, and \( d = 0 \) if the child goes to school. The child is either working or in school, and (unlike models discussed in class) cannot do both at the same time. The utility function of the household \((U)\) is:

\[
U = C + u_s(1 - d)
\]

where \( C \) is household consumption and \( u_s \) is the utility the household obtains from the child being in school, which is a function of the vector \( x \) and a random error term \( \varepsilon \):

\[
u_s = x'\beta + \varepsilon
\]

Finally, the household faces the following budget constraint (note that schooling is free):

\[
C = y + wd
\]

where the price of \( C \) is equal to 1, \( y \) is adult income, which is exogenous, and \( w \) is the wage income of the child if he or she works.

Questions

a) What is the utility of the household if the child goes to school? Denote this by \( U_0 \). What is the utility of the household if the child works? Denote this by \( U_1 \). Your expressions for \( U_0 \) and \( U_1 \) should be functions of \( y, w, x \) and \( \varepsilon \) (though not necessarily all of these), and should not include \( d \) or \( u_s \).

b) The household sends the child to school if the utility from doing that is greater than or equal to the utility of sending the child to work. Express this decision rule in terms of a relationship among the variables \( y, w, x \) and \( \varepsilon \).

c) Assume that \( \varepsilon \) follows a standardized normal distribution, so that \( \varepsilon \sim N(0, 1) \), and that \( \varepsilon \) is uncorrelated with all the other variables. Use your
answer for b) to express the probability that the child goes to school as a function of some or all of the variables $y, x$ and $w$, but not as a function of $\varepsilon$. Use the standard notation that a density of a variable with a standardized normal distribution is denoted by $\phi()$ and the cumulative distribution function for such a variable is denoted by $\Phi()$. [Hint 1: Probit! Hint 2: You may not need both $\phi()$ and $\Phi()$.

\[ d) \text{ Let there be three } x \text{ variables, child age, child sex, and parental education. You have data on all three of these variables, and on } y \text{ and } d, \text{ for all children and their households. Suppose that } w \text{ varies by child, and that you observe } w \text{ for all children who are working. Are these data sufficient to estimate the probability that a child goes to school as you expressed in c)? If so, very briefly explain how you would estimate it. If not, what data are still needed? Please be brief.} \]

\[ e) \text{ Finally, assume that child wages are determined by the function } w = z'\gamma + \eta, \text{ where } \eta \text{ is also uncorrelated with all variables, and uncorrelated with } \varepsilon, \text{ and is also normally distributed. Modify your answer to c) to express the probability that the child goes to school as a function of some or all of the following variables } y, x \text{ and } z, \text{ but not as a function of } w, \varepsilon \text{ or } \eta. \]

\[ f) \text{ Let there be three } z \text{ variables, child age, child sex, and child height. You have data on all three of these variables, and on the three } x \text{ variables, and on } y \text{ and } d, \text{ for all children and all households. Are these data sufficient to estimate the probability that a child goes to school as you expressed in e), or do you also need data on } w? \text{ Also, are these data sufficient to estimate the relative impact of child sex and parental education on the utility that parents obtain from sending their child to school? Please be brief.} \]
IV. Share Tenancy

There is a long tradition of research on share tenancy in economics going back to Smith’s (1776, 1976) *Wealth of Nations.*

Questions

a) Discuss how sharecropping can be the result of a failure of the insurance market.

b) Discuss the empirical issues one must be mindful of when studying principal-agent relationships empirically. Note that your answer must go beyond a simple mention of the causes of statistical endogeneity (i.e., measurement error, unobserved heterogeneity, reverse causality/simultaneity) to focus on the context-specific causes of endogeneity in this context.

c) How would you go about testing between the Marshallian view that sharecropping is inefficient and the Cheungian view that sharecropping is first-best efficient? In other words, how would you go about determining empirically whether there is an efficiency loss associated with share tenancy relative to fixed rent due to moral hazard?
V. Characterizing Economic Growth

Countries experiencing long-run trend growth in real income per capita almost always experience the type of structural transformation shown in Figure 1.a and 1.b.

Figure 1.a Figure 1.b

*Source:* Herrendorf, B., R. Roberson and A. Valentini (2013). *Growth and Structural Transformation*, NBER Working Paper 18996. **Figure 1.a** On the "y" axes: Share of labor in agriculture (top panel), manufacturing (middle panel) and service (bottom panel) to Log GDP per capita; **Figure 1.b** On the "y" axes: Share of agriculture GDP (top panel), manufacturing GDP (middle panel) and service GDP (bottom panel) to Log GDP per capita.

Questions

Use your knowledge of the three-sector "platform" growth model to explain the underlying economics of this transition process. More specifically

1. First,

   (a) Specify you assumptions for each sector on labor and capital factor shares (you can use hypothetical numbers to be explicit).
(b) Indicate which sectors are internationally tradeable, and state other assumptions necessary for guiding your reasoning on transition growth.

2. Explain the basic economic forces (e.g., capital deepening, changes in the marginal value product of labor, growth in income) causing the share of labor in agriculture to fall, and the share of labor in manufacturing and services to rise.

3. Consider a transition path where growth in GDP is expressed as a function of growth in sectoral GDP as follows.

\[
\frac{\dot{GDP}(t)}{GDP(t)} = S_a(t) \frac{\dot{GDP}_{ag}(t)}{GDP_{ag}(t)} + S_m(t) \frac{\dot{GDP}_{mnf}(t)}{GDP_{mnf}(t)} + S_s(t) \frac{\dot{GDP}_{ser}(t)}{GDP_{ser}(t)}
\]

Also, suppose a long-run steady state equilibrium is one where

\[
\left( \frac{\dot{GDP}}{GDP} \right)^{ss} = S^{ss}_a(x + n) + S^{ss}_m(x + n) + S^{ss}_s(x + n) = x + n
\]

and \(x, n\) denote Harrod technical change and \(n\) growth in the labor force. **Question:** Explain agriculture’s contribution to economic growth as a country transitions from low to higher income as depicted in the above diagrams.
VI. Policy Application: 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 Ireland, Greece, Spain and Portugal. The positive includes Germany, Netherlands and France.


Question

Consider the case of Greece; start with the supposition that:

- The country has accumulated a large stock of government debt for some extended period
- As a member of the European Union, it cannot devalue its currency (the Euro) (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 Taxes > Gov spending 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.
- Make the necessary assumption and answer the following two questions
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 Taxes > Gov spending. 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 your focus to agriculture. Be more analytical, and explain/show the adjustment in agricultural factor (labor, capital) allocations associated with readjustment (Taxes > Gov spending). 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 $r^k$. 

12