Written Exam for the B.Sc. or M.Sc. in Economics summer 2013

Advanced Development Economics: Micro Aspects

Final Exam

August 2013

(3-hour closed book exam)

MODEL ANSWER

Please note that the language used in your exam paper must correspond to the language of the title for which you registered during exam registration. I.e. if you registered for the English title of the course, you must write your exam paper in English. Likewise, if you registered for the Danish title of the course or if you registered for the English title which was followed by "eksamen på dansk" in brackets, you must write your exam paper in Danish.

This exam question consists of 2 pages in total including this page.

Question 1: Social Learning

a) Define the concept of social learning and describe the "Target Input" model.

b) Comment on how neighbor technology adoptions affect own adoption, and describe the two most important testable implications of this model.

c) Discuss how unobserved farmer characteristics affect estimation of different types of learning (individual versus social learning)?

Question 2: Rural Land Market

a) Describe how a limited liability constraint, *i.e.*, a scheme in which the tenant is only liable up to his own wealth level, may affect a sharecropping contract.

b) Operation Barga in India was a drive to increase tenant registration in West Bengal in India. A registered tenant could not be evicted as long as they paid their dues and the maximally legal binding due was set at 25 percent of the output. Explain and discuss the expected effects of operation Barga on agricultural productivity.

c) Describe the approach used in Banerjee, Gertler and Ghatak (2002) to test the effect of operation Barga.

Question 3: Credit

a) Consider a rural credit market where borrowers and lenders are risk neutral. Explain and illustrate graphically how a competitive equilibrium model with complete information and markets compares with a (i) competitive equilibrium with moral hazard (ii) Equilibrium with a fully informed monopolist, and (iii) Equilibrium where there is competition between an informed local moneylender and uninformed outside lenders.

b) Outline examples of how the consequences of moral hazard may be neutralized.

c) Microcredit institutions use different mechanisms to insure high borrower repayment rates and to reduce moral hazard problems. Describe these mechanisms and discuss advantages and disadvantages of each of the mechanisms.

Model Answer

Question 1: Social Learning

The questions can/should be answered using Chapter 12 in Bardhan and Udry (1999) and/or Foster and Rosenzweig (1995).

a) Define the concept of social learning and describe the "Target Input" model.

Social learning

Techniques of production are characterized as being *tacit* and *circumstantial sensitive* (CS): Seemingly identical techniques of production are used quite differently across producers and non-tradable inputs (land) vary in characteristics in ways that affect the performance of different technologies. When technology is tacit or circumstantial sensitive local investment in learning and innovation must take place. Generally speaking there are two ways of learning:

a. Learning-by-doing (uncertainty)

b. Learning from others (uncertainty + information spillovers)

The concept of social learning is given by:

"Social learning" = Learning-by-doing + Learning from others.

The target input model

A producer is maximizing profit. In the model inputs are costless, so output equals profits. The profit of a producer declines with the distance between the actual input used and the *a priori unknown*, optimal target level of input use. After input has been applied and output realized, the producer can deduce the target level of inputs in the given situation. But the "situation" changes (e.g., weather conditions). Hence, each round of production is an experiment which yields information about the distribution of the random target input. The model, which leads to a Kalman filter updating model, is described in detail in section II in Chapter 12 of Bardhan and Udry (1999, pp. 154-157).

b) Comment on how neighbor technology adoptions affect own adoption, and describe the two most important testable implications of this model.

Assume there is a "traditional" technology with riskless return $q(a)$ and a new technology with an unknown (random) target input for which profits are increasing in the number of experiments performed by both the farmer and the farmer's neighbors. Let $\mu = 1$ if the farmer uses the new technology and $\mu = 0$ otherwise. The profit value function for period t is given by:

$$V(I_{t-1}, N_{t-1}) = \max\left\{(1-\mu_t)q_a + \mu_t \, \mathrm{E}_t \, q_t(I_{t-1}, N_{t-1}) + \delta V_{t+1}(I_t, N_t)\right\}$$

Where *I* is the cumulated number of own experiments with the new technology and *N* is the cumulated number of neighbor experiments. E is the expectation operator and δ is the time preference rate.

The neighbors' use of the new technology has a direct effect on the expected value of the flow of profits. The more experiments done by the neighbors (high *N*), the higher the expected profit. Many neighbor adoptions may delay own adoption as the value of the information received from own experiments with the new technology is lower the more other farmers experiment. This can be seen by looking at the gain from the initial switch to the new technology:

$$q_0 - E_0 q(0, N_0) \leq \delta\left[V_1(1, N_0) - V_1(0, N_0)\right].$$

The LHS is the expected gain when not switching compared to switching to the new technology. The RHS is the expected increase in profits from the first own experiment. The RHS is decreasing in the number of experiments done by neighbors (N_0). If more farmers use new technology, less additional information is gained by own experiments.

The two most important testable implications of the simple model are:

1. It is possible to test directly if farmers learn from others.
2. It is possible to test whether neighbor and own experience are perfect substitutes and whether there is efficient learning.

c) *Discuss how unobserved farmer characteristics affect estimation of different types of learning (individual versus social learning)?*

In the model neighbor and own experience are perfect substitutes. However, with different farmer characteristics the fact that the technology worked well for a neighbor does not necessarily imply that it will work well for you: Individuals learn from *similar neighbors only*, a result that generally slows down the rate of technology diffusion because it effectively decreases *N* by limiting the number of comparable farmers. By conditioning on observable differences between his own and his neighbors' observed characteristics when learning from them the farmer can improve his performance. But this does not take account of unobserved characteristics.

Thus, with unobserved farmer characteristics the prospects for social learning decline. Consistent but inefficient estimates of the expected yield would be obtained with individual learning (learning by doing). Efficient estimates with social learning. With social learning more information is being utilized, but there is a bias because the farmer cannot control for the unobserved characteristics of neighbors. Therefore, there is a trade-off between bias and efficiency when choosing between individual or social learning. A testable prediction is that farmers choose individual learning if the population is heterogeneous and yield is sufficiently sensitive to unobserved characteristics, otherwise social learning preferred.

Question 2: Rural Land Market

a) *Describe how a limited liability constraint, i.e., a scheme in which the tenant is only liable up to his own wealth level, may affect a sharecropping contract.*

This sharecropping model is from Chapter 6, Section III in Bardhan and Udry (1999, pp. 67-74). The model shows that binding limited liability constraints under risk neutrality gives rise to an optimization problem that is similar to the more standard sharecropping contract with risk aversion (and risk sharing). The requirement in both models is that the effort of the tenant is unobservable.

A model

There are many tenants. Any tenant is liable up to his own wealth ($w > 0$) and the tenant has an outside option ($m > 0$). The tenant chooses effort ($e \in [0,1]$), he has disutility of effort characterized by $d(e)$, $d'(e) > 0$, $d''(e) > 0$, $d(0) = 0$. Output (y) takes a high value (H) with probability e and a low value (L) with probability $1-e$. A sharecropping contract stipulates a payment schedule as a function of the random output variable. The tenant has to pay rent to the landlord ($y-t(y)$) where $t(y)$ is specified as a simple function of the two possible output levels:

$$t(y) = \begin{cases} h & if\ y = H \\ l & if\ y = L \end{cases}, \quad h > l$$

When effort is unobservable, the landlord maximizes his expected rent subject to a participation constraint (PC) (the farmer must be willing to take the contract) and an incentive compatibility constraint (ICC) (the effort must be the highest possible, given the contract):

$$\max_{t(\cdot)} E(y(e)-t(y(e))$$

$st.$

$$E(t(y(e))-d(e)) \geq m \quad (PC)$$

$$e \in \arg\max_{e} E(t(y(e))-d(e) \quad (ICC)$$

Inserting the expectation and the payment rule gives

$$\max_{t(\cdot)} e(H-h)+(1-e)(L-l)$$

$st.$

$$eh+(1-e)l-d(e) \geq m \quad (PC)$$

$$e \in \arg\max_{e} eh+(1-e)l-d(e) \quad (ICC)$$

The limited liability constraint implies that the transfer must be less than the farmers wealth for all realizations of the output ($t(y)+w \geq 0$). Specifically, in the low output case the maximization problem is subject to a third condition (Limited Liability Condition):

$$l+w \geq 0 \quad (LLC)$$

This says that in the bad outcome the farmer can at most pay his total wealth.

Results

The limited liability constraint means that for poor farmers (low *w*) the landlord may not be able to set the transfer payment in the bad outcome so as to produce a sufficiently high powered contract. The result is that the gain for the farmer in the good outcome (*H-h*) will be lowered because the landlord will require a higher payment in the good outcome as he cannot get as much as he wants in the bad outcome. This will induce a lower effort level from the farmer and there will be allocative inefficiency for poor tenants (tenants with binding LLC) compared to better-off tenants (for whom the LLC is not binding). Looking across tenants with varying levels of wealth one may find a "tenancy ladder" illustrated in Bardhan and Udry (1999, Figure 6.6):

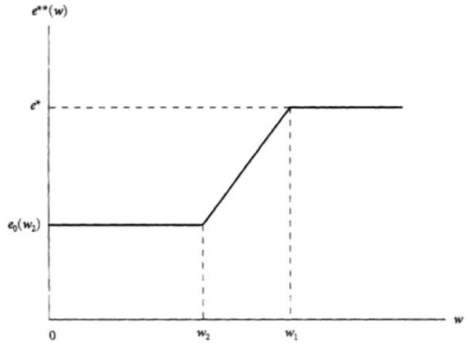

Figure 6.6

b) *Operation Barga in India was a drive to increase tenant registration in West Bengal in India. A registered tenant could not be evicted as long as they paid their dues and the maximally legal binding due was set at 25 percent of the output. Explain and discuss the expected effects of operation Barga on agricultural productivity.*

Barga reduced eviction threats. There are two effects such reduced threats: Changes in bargaining power and changes in security.

The Bargaining power effect: Removal of eviction as a threat reduces the landlord's bargaining power, and forces him to offer the tenant a higher crop share, which translates into stronger incentives.

The Security effects: (i)The landlord may use the threat of eviction when output is low to induce the tenant to work harder. With Barga he cannot use the eviction threat as a discipline device which may reduce effort and efficiency. (ii) The greater security of tenure encourages the tenant to invest more since it gives him the confidence that he will stay on the land long enough to enjoy the fruits of his investment.

Overall the effect of Barga on productivity is ambiguous.

c) *Describe the approach used in Banerjee, Gertler and Ghatak (2002) to test the effect of operation Barga.*

BGG compare rice productivity (yield per hectare) in West Bengal (the Barga state) and Bangladesh (did not have the Barga) before and after the introduction of Barga (1978). Thus, this is a basic difference-in-difference approach. Using an estimate of the fraction of rice area under sharecropping in West Bengal (about 25%), BGG find an increase of 51% on the productivity of registered tenants.

Question 3: Credit

a) *Consider a rural credit market where borrowers and lenders are risk neutral. Explain and illustrate graphically how a competitive equilibrium model with complete information and markets compares with a (i) competitive equilibrium with moral hazard (ii) Equilibrium with a fully informed monopolist, and (iii) Equilibrium where there is competition between an informed local moneylender and uninformed outside lenders.*

The perfect answer follows the description in Bardhan and Udry (1999), page 80-85 including Figure 7.1.

A Model setup

The objective is to write a contract specifying the interest on the loan and, if possible, the effort of the farmer (i,a). The farmer is producing an agricultural output with a random return. The return of the production is $R = 0$ if harvest fails and $R > 1$ if it is successful. The farmer needs working capital, which can be borrowed at the rate $i \leq R$. The probability of successful harvest depends on effort (a):

$$\Pr(R > 1 \mid a) = \pi(a),\ \pi'(a) > 0,\ \pi''(a) < 0,\ a \in [0,1],$$

But there is disutility of effort

$$D(a),\ D'(a) > 0,\ D''(a) > 0.$$

Assumptions: (i) The farmers all have the same amount of land (fixed cost, not included); (ii) there is no market for land (no ”wealth”); (iii) Both lenders and borrowers are risk neutral; (iv) the lenders have access to a risk-free capital market with return ρ, $1 < \rho < R$; (v) the farmer has an outside option yielding utility W.

Given the setup the expected returns (utilities) are

Borrower

$$U(i,a) = \pi(a)(R - i - D(a)) - (1 - \pi(a))D(a) = \pi(a)(R - i) - D(a)$$

Lender

$$\Pi(i,a) = \pi(a)i + (1 - \pi(a))0 = \pi(a)i$$

Base: Competitive equilibrium model with complete information and markets: The lender can observe the effort. The contract maximizes the utility of the farmer by specifying an interest rate and an effort level.

$$(1)\quad \max_{i,a} U(i,a) = \pi(a)(R - i) - D(a),$$

s.t.

$$(2)\quad \Pi(i,a) = \pi(a)i \geq \rho$$

$$(3)\quad U(i,a) = \pi(a)(R - i) - D(a) \geq W$$

Solution:

$$\pi'(a_1)R = D'(a_1) \Rightarrow R = \frac{D'(a_1)}{\pi'(a_1)},$$

$$\pi(a_1)i_1 = \rho \Rightarrow i_1 = \frac{\rho}{\pi(a_1)},$$

$$U(i_1, a_1) = \pi(a_1)R - D(a_1) - \rho \geq W$$

The optimum effort is determined by equating the marginal rate of substitution between the disutility of effort and the probability of successful harvest to the return. Perfect competition results in zero profit to the lenders and this condition determines the interest rate as the risk adjusted interest rate, for any level of effort. The level of utility for the farmer may be larger than the outside option. The outcome is given as point 1 (i_1, a_1) in figure 7.1 below.

Case (1): Competitive equilibrium with moral hazard: When effort is unobserved, the contract cannot specify an effort level. Instead a new condition (ICC) is added to the maximization problem.

$$(4) \quad \pi'(a)(R-i) - D'(a) = 0$$

This results in a new solution

$$\pi(a_2)i_2 = \rho \Rightarrow i_2 = \frac{\rho}{\pi(a_2)} \qquad \Rightarrow i_2 > i_1,$$

$$\pi'(a_2)(R-i_2) = D'(a_2) \Rightarrow R - i_2 = \frac{D'(a_2)}{\pi'(a_2)} \quad \Rightarrow a_2 < a_1,$$

$$U(i_2, a_2) = \pi(a_2)R - D(a_2) - \rho < U(i_1, a_1)$$

Perfect competition again results in zero profit to the lenders and this condition determines the interest rate as the risk adjusted interest rate, for any level of effort. The zero profit condition and the incentive compatibility constraint jointly determine the interest rate and the optimum level of effort. Compared to the base case this interest rate is higher, the effort level is lower and utility for the farmer is lower. The outcome is given as point 2 (i_2, a_2) in figure 7.1 below.

Case (2): Equilibrium with a fully informed monopolist: When the lender has monopoly power the maximization problem changes to maximizing the profit of the monopolist, who sets both the interest rate and the level of effort of the famers, subject to the participation constraint.

$$
\begin{aligned}
&(1)\quad \max_{i,a} \Pi(i,a) = \pi(a)i, \\
&s.t. \\
&(2)\quad \Pi(i,a) = \pi(a)i \geq \rho \\
&(3)\quad U(i,a) = \pi(a)(R-i) - D(a) \geq W
\end{aligned}
$$

The resulting solution is:

$$
\begin{aligned}
&\pi'(a_3)R = D'(a_3) \Rightarrow R = \frac{D'(a_3)}{\pi'(a_3)} \Rightarrow a_3 = a_1, \\
&U(i_3, a_3) = W \\
&\pi(a_3)(R-i_3) - D(a_3) = W \Rightarrow i_3 = \frac{\pi(a_3)R - D(a_3) - W}{\pi(a_3)} > i_1
\end{aligned}
$$

The monopolist sets the effort level to equate the return to the farmer to the marginal rate of substitution between disutility of effort and the probability of success, as in the base case. The monopolist subsequently sets the interest rate such that the utility of the farmer is at the level of the outside option, which is lower than the two other outcomes. The interest rate is higher than the risk adjusted market rate (there is monopoly profit). The outcome is given as point 3 (i_3, a_3) in figure 7.1 below.

Case (3): Equilibrium where there is competition between an informed local moneylender and uninformed outside lenders: The maximization problem is as in Case (2), but the outside lenders offer the farmers a new outside option because they can borrow from them: The utility level of the outside option is as in Case (2) with competition and moral hazard (W_2).

$$
\begin{aligned}
&(1)\quad \max_{i,a} \Pi(i,a) = \pi(a)i, \\
&s.t. \\
&(2)\quad \Pi(i,a) = \pi(a)i \geq \rho \\
&(3)\quad U(i,a) = \pi(a)(R-i) - D(a) \geq W_2 = U(i_2, a_2)
\end{aligned}
$$

The solution now becomes

$$
\begin{aligned}
&\pi'(a_4)R = D'(a_4) \Rightarrow R = \frac{D'(a_4)}{\pi'(a_4)} \Rightarrow a_4 = a_1, \\
&U(i_4, a_4) = W_2 \\
&\pi(a_4)(R-i_4) - D(a_4) = W_2 \Rightarrow i_4 = \frac{\pi(a_4)R - D(a_4) - W_2}{\pi(a_4)} < i_3
\end{aligned}
$$

The monopolist still sets the effort level to equate the return to the farmer to the marginal rate of substitution between disutility of effort and the probability of success, as in the base case. But

he has to set a lower interest rate than case 2 because of the outside option which increases the utility level of the farmers from W to W_2. The outcome is given as point 4 (i_4, a_4) in figure 7.1.

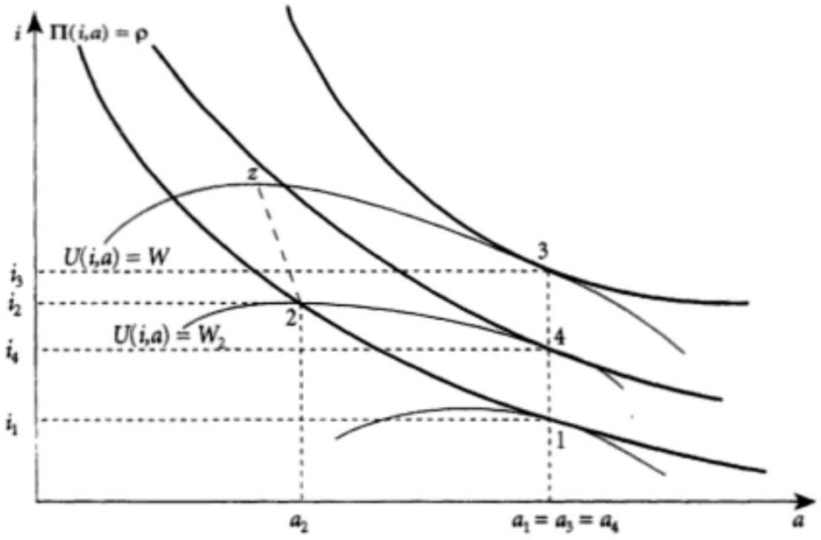

Figure 7.1

b) Outline examples of how the consequences of moral hazard may be neutralized.

The consequences of moral hazard in the credit market can be neutralized by the use of collateral, when both borrowers and lenders are risk-neutral. Suppose that each borrower owns some assets with value greater than the return. If the project fails, the borrower transfers the collateral pledged for the loan to the lender. The borrower absorbs the entire risk of the transaction, and the return to the lender no longer depends on the choice of effort by the borrower. The loan is now risk-free for the lender, so the interest rate is at the level of the riskless rate. Borrowers are induced to put the optimal effort into the project. Lenders make zero profits, and borrowers achieve the same utility as they achieve in the complete information equilibrium. The result depends crucially on the assumed risk neutrality of both parties. If the borrower is risk-averse the use of collateral cannot not entirely remove the moral hazard problem, because the borrower would not be willing to take the entire risk of the transaction without some compensation from the lender.

Another way of neutralizing moral hazard is by joint liability. The idea is that by lending to a group, each member of which is liable for the repayments owned by each other member, lenders from outside a local community can take advantage of some of the information and enforcement mechanisms available within that community.

c) *Microcredit institutions use different mechanisms to insure high borrower repayment rates and to reduce moral hazard problems. Describe these mechanisms and discuss advantages and disadvantages of each of the mechanisms.*

1. Group lending: This mechanism utilizes that borrowers have local information about one another: Peer monitoring in groups mitigates moral hazard problems. Moreover, peer selection in groups leads to assortative matching: Safe types form groups with safe types because this is more profitable. The limited liability payment has to be made less often when you team up with a safe type. Assortative matching is an advantage as well as a disadvantage as the poorest may be excluded from the groups.
2. Dynamic incentives: Lending is made progressive: loan size increase contingent upon repayment. In this way dynamic incentives also reduces moral hazard. However, increased competition erodes the beneficial effect thus, it works better in areas with low mobility.
3. Regular payments: Payments start almost immediately and continue on a regular—often weekly—basis. The advantage is that the mechanism provides interim information on borrower type whereby undisciplined borrowers can be detected early. The disadvantages are that households must have another income source and that agricultural cultivation with strong seasonality is not suited for these regular repayments.