

Lecture XXIV: Asymmetric Information and Agricultural Debt

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Readings for next time

Ex Ante Asymmetric Information

The Model

Fixed Investment Financial Structure Equilibrium

Readings for Monday

- ▶ Erickson, K., A.K. Mishra, and C.B. Moss. 2003. Cash Rents, Imputed Returns, and the Valuation of Farmland Revisited. *Government Policy and Farmland Markets*. Iowa State University Press, pp. 223-235.
- ▶ Featherstone, A.M. and C.B. Moss. 2003. The Certainty Equivalence of Farmland Values: 1910 to 2000. *Government Policy and Farmland Markets*. Iowa State University Press, pp. 159-178.
- ▶ Moss, C.B. 1997. Returns, Interest Rates, and Inflation: How They Explain Changes in Farmland Values. *American Journal of Agricultural Economics* 79, 1311-1318.
- ▶ Moss, C.B. and A. Katchova. 2005. Farmland Valuation and Asset Performance. *Agricultural Finance Review* 65, 119-130.

Ex Ante Asymmetric Information

- ▶ Innes, R.D. 1993. Financial Contracting under Risk Neutrality, Limited Liability and Ex Ante Asymmetric Information. *Economica* 60(237), 27-40.
- ▶ This paper has several similarities with Innes's 1990 article.
- ▶ Overview/Purpose
 - ▶ "... relevant studies of *ex ante* informational asymmetries have made the following restrictive assumptions: (1) the size of the borrowers' investment projects is fixed and homogeneous; (2) the only possible contracts between borrowers and lenders are pure debt and pure equity; and (3) the investment projects yield *ex post* profits which are random, but take either one of two possible values or a particular additive risk form."
 - ▶ "The purpose of this paper is to generalize the latter research by characterizing optimal financial arrangements in the presence of *ex ante* information asymmetries, allowing for arbitrary *ex post* profit distributions, arbitrary contract forms and variable levels of investment."

The Model

- ▶ We start by assuming that entrepreneurs have investment endowments of unknown quality q . These qualities are distributed over the interval $[0, Q]$ and the probability of the quality can be represented by the distribution function $g(q)$.
- ▶ The entrepreneur knows his own quality, but others do not.
- ▶ The entrepreneur's investment in his opportunity (endowment) yields a profit (stochastic end-of-period net worth) of $\pi = \pi(q, A, \theta)$ where A is the initial level of investment and θ is a random variable.
- ▶ The entrepreneur can let the project opportunity lapse and receive a payoff of $\bar{u}$.

- ▶ If the entrepreneur undertakes the project, he must find an investor to put up I – the entrepreneur commits $A - I$ of his own wealth.
- ▶ Given $A - I$ we can rewrite $\pi(q, A, \theta) \Rightarrow \pi = \pi^*(q, I, \theta)$.

Stochastic Structure

- ▶ Stochastic Structure – Remember from Lecture 23 the concept that high levels of effort produce a higher probability of a payoff

$$\frac{\partial}{\partial \pi} \left(\frac{g_e(\pi | e)}{g(\pi | e)} \right) > 0. \quad (1)$$

In this formulation we make a similar assumption regarding the quality of the investment opportunity

$$\frac{\partial}{\partial \pi} = \frac{f_q(\pi; q, I)}{f(\pi; q, I)} > 0. \quad (2)$$

- ▶ This is the **monotone likelihood ratio property (MLRP)**.
- ▶ The assumption also implies that $q > q_0$ implies first-order stochastic dominance (**FOSD**).

Financial Contracts

- ▶ As in Lecture 23 we assume that the outside investor is risk neutral and requires a expected rate of return of ρ . However, the investor is ignorant of the entrepreneur's quality.
- ▶ In addition, the investor cannot directly observe θ *ex post* – after the fact the investor cannot directly observe the quality of the entrepreneur, it is confused with the random outcome.
- ▶ Following the previous study, the question is to design a financial contract by specifying an investor payoff function $R(\pi)$ and level of investment I .
- ▶ Again we assume that $0 \leq R(\pi) \leq \pi$ and that $R(\pi)$ is a monotone non-decreasing function.

Definition of Equilibrium

- ▶ Assuming Nash-type competitors each investor offers entrepreneurs a set of contracts that maximize his (the investor's) expected profits given the offers of all the other investors.
- ▶ Entrepreneurs then either accept one of the offers or chooses to forgo the investment opportunity ($\bar{u}$).
- ▶ The investor knows that entrepreneurs of different risk levels (quality types) choose the contract offer in their (the entrepreneur's) best interest.

- ▶ **Definition:** A set of contract offers is an *equilibrium* if (1) all contracts in the set earn investors an expected return of at least ρ , and (2) there is no other set of contracts that, when offered in addition to the equilibrium set, earn investors an expected return greater than ρ .
- ▶ "With a fixed (and homogeneous) investment level, an equilibrium will be shown to exist here."
- ▶ "However, when investment is allowed to vary and thereby to serve as a screening device, an equilibrium will often fail to exist...."

Fixed Investment Financial Structure Equilibrium

- ▶ "In this section, the external investments required for the entrepreneurs' projects will be held fixed at a common level, I .
- ▶ Like in Innes 1990, the only contract offered will be the debt contract $R(\pi) = \min(\pi, z)$ where z represents the promised loan repayment.

- ▶ Following the scenario from Lecture 23 – we posit two alternative contracts:
- ▶ $R_N(\pi)$ which satisfies the monotonicity constraint – basically an ownership share.
- ▶ $R_q(\pi) = \min(\pi, z_q)$ which is a debt contract that agents of quality q will take.
- ▶ We assume that the expected payoff for each contract to the investor will be the same

$$\mathbb{E}(R_q(\pi) | q, I) = \mathbb{E}(R_N(\pi) | q, I). \quad (3)$$

- ▶ By monotonicity $R_N(\pi + \epsilon) \geq R_N(\pi) \forall (\pi, \epsilon) \in R_+^2$.

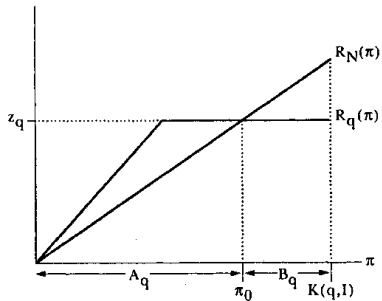


FIGURE 1

- Consider the two profit levels

$$\begin{aligned} A_q &\equiv \{ \pi : R_q(\pi) > R_N(\pi), \pi \geq 0 \} \\ B_q &\equiv \{ \pi : R_q(\pi) < R_N(\pi), \pi \leq K(q, I) \} \end{aligned} \quad (4)$$

- **LEMMA 1:** (a) For every $\pi_A \in A_q$ and $\pi_B \in B_q$, $\pi_A < \pi_B$.
(b) $A_q = \emptyset$ (the null set) if and only if $B_q = \emptyset$. (c) If $A_q = B_q = \emptyset$, then $A_{q'} = B_{q'} = \emptyset \forall q' < q$.

- ▶ **LEMMA 2:** With the debt contract, $R_q(\pi)$, investors earn an expected payoff on qualities $q' < q$ which is no lower than with the non-debt contract, $R_N(\pi)$. Equivalently, entrepreneurs of quality lower than q earn an expected payoff with $R_q(\pi)$ which is no greater than the expected payoff that they earn with $R_N(\pi)$.
- ▶ Note the similarities with the outcome from Lecture 23.

- ▶ "Lemma 2 indicates that, if an investor offered the debt contract $R_q(\pi)$ instead of $R_N(\pi)$, she would earn the same expected profit on quality q takers and generally higher (and never lower) expected profit on lower-quality takers."
 - ▶ "... low-quality entrepreneurs have more probability weight in low-profit states."
 - ▶ "... consider increasing contracted payments in low-profit states and decreasing them in high-profit states so as to preserve the expected investor payoff on a high-quality entrepreneur. This transfer hurts the lower-quality entrepreneur more than the high-quality entrepreneur; because of his different probability weightings, the firm gains less from the decreased payments in high-profit states and loses more from the increased payments in low-profit states. "

- ▶ I love the proof of equilibrium by the renegade investor:
- ▶ "... consider the problem of a prospective renegade investor when all other investors are offering debt financing on common terms; suppose further that these debt terms yield an expected investor return of ρ when the financing is obtained by all entrepreneur quality types who can profitably undertake it."
- ▶ "Then, if the renegade investor were to offer any non-debt contract, what entrepreneur quality types would she attract away from the debt contract, assume that her offer is accepted by some entrepreneurs?"

- ▶ "Given Lemma 2, the non-debt offer would attract all entrepreneurs who have quality less than some critical level and who are funded under the debt contract; in addition, the non-debt offer would attract still lower-quality types who are not funded under the debt contract."
- ▶ "The average quality of the non-debt borrowers would thus be lower than the average quality of the original debt-contract applicant pool."
- ▶ "... the renegade investor would earn less from each of her non-debt borrowers than would be earned from each of these borrowers under the debt contract."

- ▶ We start by defining $z_D(q)$ as the maximal debt contract loan payment that an entrepreneur of quality q is willing to accept

$$z_D(q) : E\{\pi - R_0(\pi; z_D(q)) | I, q\} = \bar{u} \ni R_0(\pi; z) = \min(\pi, z) \quad (5)$$

remember that $\bar{u}$ is the level of utility generated by forgoing the investment opportunity.

- ▶ $z_D(q)$ may be called the loan demand function and is easily shown to be **upward-sloping in q** ; owing to their superior distributions, higher-quality types can make higher loan payments and still earn their reservation expected price level.

- ▶ Next, $z_S(q)$ is the loan payment that investors are willing to offer for quality types above q

$$z_S(q) : \frac{\int_q^Q \{ E(R_0(\pi; z_S(q)) | I, s) g(s) \} ds}{(1 - G(q))} = (1 + \rho) I \quad (6)$$

- ▶ $z_S(q)$ may be called the loan payment supply function, which is **downward-sloping in q** ; the higher is the average quality of the borrower pool, the lower is the investor's required loan payment.

- ▶ **ASSUMPTION 1:** $\exists q \in (0, Q) : z_D(q) > z_S(q)$.
- ▶ "The possible debt contract outcome can now be defined quite simply as $R^*(\pi) = \min(\pi, z_S(q^*))$, where q^* is the following critical level "

$$q^* \equiv \begin{cases} 0 & \text{if } z_D(q) > z_S(q) \quad \forall q > 0 \\ q : z_D(q) = z_S(q) & \text{otherwise} \end{cases} \quad (7)$$

- **Proposition 1:** With fixed investment size common to applicant entrepreneurs, there will exist a unique equilibrium characterized by a single debt contract.
 $R^*(\pi) = \min(\pi, z_S(q^*))$, where $z_S(q)$ is defined in Equation 6 and q^* is as defined in Equation 7. This contract will be taken by all entrepreneurs with quality of q^* or above. Entrepreneurs with quality less than q^* will not invest in their project.

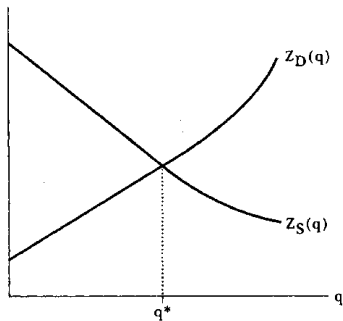


FIGURE 2