Lecture Notes - Insurance

1 Introduction

- need for insurance arises from
  - uncertain income (e.g. agricultural output)
  - risk aversion - people dislike variations in consumption - would give up some output (or money) to get smoother consumption over **different states of the world** (i.e. different realizations of output - e.g. bad crop vs. good crop) and over time.
- types of uncertainty - **idiosyncratic** (affects only given individual, e.g. get sick) or **aggregate** (affects a whole group of individuals, e.g. weather). Different types of insurance can deal with these different types of risk.

Forms of insurance

- **self-insurance** - using one's own wealth to smooth uncertain shocks in income. This works by accumulating/running down stocks of cash/output (often also livestock - e.g. bullocks in India (50% of wealth of small farmers, very organized market present), jewelry, even land).
- **credit** - already discussed
- **mutual insurance** - suppose e.g. agents pool output and share equally. Then idiosyncratic shocks (those that affect each separate person) can be completely insured away and only aggregate shocks (those that affect the total amount of output) are reflected in agents' consumption.
  - Mutual insurance relies on the fact that people with good shocks make transfers to people with bad shocks every period - history doesn't matter. Clearly to sustain this it is needed that all shocks are due to chance only, not laziness for example.
  - **Correlation** between the individual shocks matters - if all people get bad shocks and good shocks at the same time - no use of pooling as insurance. On the other hand, perfect negative correlation (e.g. half agents get good shocks and half bad shocks every period) is the perfect basis for mutual insurance. That is why mutual insurance may be hard to arrange for weather shocks.
  - mutual insurance - often **informal - enforced by reciprocity norms** (need incentives for people to participate for norms to survive)

2 The Perfect Insurance Model

2.1 Theory

- Suppose a village is populated by large number of farmers (all identical for simplicity)
- each farmer has income Y at each date given by

$$Y_i = A + \varepsilon_i + \theta$$

- A is non-random component (will treat it as average income); ε_i - idiosyncratic component (independent across farmers); θ - aggregate shock - affects all farmers in the village (e.g. weather). Assume $E(\varepsilon_i) = E(\theta) = 0$ - shocks have zero expected value.
- For a large number of farmers all idiosyncratic variation embodied in ε can be insured away by pooling all ε's into a common fund - some pay, some receive, on average all such transfers cancel out and each farmer gets:

$$\bar{Y}_i = A + \theta$$

- notice that the above value, $\bar{Y}$ carries no individual risk. If farmers are risk averse they would then prefer consumption $\bar{Y}$ to Y.
- What about the aggregate shock, θ? Can it be insured away in this manner? No, it affects all farmers - need someone outside the village to smooth that, or need to do self-insurance to smooth that out over time.
- Perfect insurance theory: suggests that **individual consumption will co-move one to one with aggregate income but not with individual income** (this is the same as saying only aggregate shocks will matter).

2.2 Testing the Theory

- natural test: controlling for movements in aggregate (village) consumption, fluctuations in individual income (e.g. getting sick, unemployment, etc.) should have no effect on individual consumption
- do a regression: regress household consumption on average village consumption and household income plus other household and village controls
- if theory is right should get coefficients close to 0 on individual income and all other household specific variables and coefficients close to 1 on village controls.
- Townsend (1994) used Indian data - finds a lot of idiosyncratic risk in income; finds also that a **lot of smoothing is taking place** but hard to say whether due to mutual insurance or self-insurance, credit, etc. Townsend (1995) - Thai data - convincingly reject perfect insurance.

- Another issue (Morduch, 1995) - less well-off farmers found to be able to smooth consumption to less extent - suggests they may be trying to smooth out income (e.g. go to safe crops, may be inefficient though if insurance were possible).

3 Limits to Insurance

- the perfect insurance model fails in general to fit the data, what is the reason? There are limits to the abilities of households to insure one other.

3.1 Imperfect Information

- Because of the above information problems – groups with better access to information about their members are in better position to provide mutual insurance (e.g. extended families); However - in such groups diversification possibilities may be limited - e.g. there may be huge positive correlation between their idiosyncratic shocks to income - leads to tendency for families to send/marry members in different geographical locations.

- Two potential information problems:

  - a person can ask for insurance transfer lying about his **output realization** - less likely to occur in traditional societies with close-knit ties between individuals; flow of information is crucial
  - **moral hazard** - a person who knows he's insured may change his behavior - e.g. not put a lot of effort growing the crop; size of harvest (output) may be visible to all to see but why it is small may not be visible. Under full insurance - incentive to undersupply effort is very high. Clearly if all farmers shirk that way insurance will be very limited/impossible. Thus to mitigate moral hazard - only **limited insurance** can be offered - once again there is a trade-off between insurance and incentive provision as in the tenancy model with unobserved effort. Under this limited insurance individual consumption will vary with the individual income realization (e.g. high consumption when income is high). See below for details.

Theory – optimal insurance in a principal-agent model

1. Full information (first-best)

Risk neutral principal, risk-averse agent with utility $u(c)$ – strictly concave. Stochastic output/income takes n values, y_i, $i = 1, ..N$ with probabilities $\pi_i > 0$.

The problem is:

$$\max_{\tau_i} \sum_{i=1}^{n} \pi_i u(y_i + \tau_i)$$
$$\text{s.t.} \quad \sum \pi_i \tau_i = 0$$

where τ_i is a contingent transfer (can be positive or negative) from the principal to the agent and the constraint conveys the idea that the insurer breaks even in expectation.

Calling agent's consumption in each state $c_i \equiv y_i + \tau_i$, the FOCs of the above problem imply:

$$\pi_i u'(c_i) = \lambda \pi_i$$

thus, since $u'(c)$ is monotonically decreasing we have $u'(c_i) = \lambda$ (constant) for each i, i.e. full insurance is provided, $c_i = c$ for all i.

2. Optimal insurance under moral hazard

Note: the full insurance result above will not obtain if the probabilities π_i depended on some hidden effort by the agent. Then a moral hazard problem would occur and an extra constraint (incentive-compatibility) needs to be introduced. Verify that if effort is observable instead, nothing in the above analysis changes.

Think of simple model with $n = 2$, $y_1 > y_2$ and probabilities $\pi_1 = \pi(e)$ and $\pi_2 = 1 - \pi(e)$ where $\pi(e)$ is increasing and concave in e. Effort cost is $c(e)$.

Given transfers τ_1,τ_2 the agent chooses effort so that:

$$\max_e \; \pi(e)u(y_1 + \tau_1) + (1 - \pi(e))u(y_2 + \tau_2) - c(e)$$

with a first-order condition:

$$\pi'(e)[u(c_1) - u(c_2)] = c'(e)$$

The above condition captures the optimal response of the agent to a contract (τ_1, τ_2). It will enter the principal's problem as the incentive-compatibility constraint that ensures that the offered transfers and effort are mutually consistent with the agent's incentives. *[Note: using the first-order condition of the agent's problem as the ICC in the principal's problem is not valid in general, see Rogerson (1986) or google for "the first-order approach" but it is valid in this two-output levels setting].*

The problem becomes:

$$\begin{aligned}
&\max_{\tau_1,\tau_2,e} \; \pi(e)u(y_1 + \tau_1) + (1 - \pi(e))u(y_2 + \tau_2) - c(e) \\
&\text{s.t. } \pi(e)\tau_1 + (1 - \pi(e))\tau_2 = 0 \quad \text{(zero profits for insurer)} \\
&\text{s.t. } \pi'(e)[u(c_1) - u(c_2)] = c'(e) \quad \text{(incentive-compatibility)}
\end{aligned}$$

Call the multipliers on the constraints λ and μ. Then, the FOCs with respect to τ_1 and τ_2 are:

$$\begin{aligned}
\pi(e)u'(c_1) - \lambda\pi(e) + \mu\pi'(e)u'(c_1) &= 0 \\
(1 - \pi(e))u'(c_2) - \lambda(1 - \pi(e)) - \mu\pi'(e)u'(c_2) &= 0
\end{aligned}$$

or, $u'(c_1) = \frac{\lambda}{1+\frac{\mu\pi'(e)}{\pi(e)}}$ while $u'(c_2) = \frac{\lambda}{1-\frac{\mu\pi'(e)}{1-\pi(e)}}$. Clearly, $u'(c_1) \neq u'(c_2)$ and therefore $c_1 \neq c_2$ – full insurance does not obtain anymore due to the moral hazard problem. *[NOTE: you can show that $\mu, \lambda > 0$ with some extra work and then we see that $c_1 > c_2$ – higher consumption in the high income state].*

3.2 Imperfect Enforcement

- Mutual insurance schemes are rarely formal contracts - they are usually informal arrangements set in context of reciprocity and enforced by social sanctions
- suppose 2 outputs possible - H and L, with probabilities p and $1-p$ and suppose no aggregate risk. Under perfect insurance each farmer gets $M = pH + (1-p)L$.
- Suppose now a farmer got H - if he could pocket that, he'll gain $G = u(H) - u(M)$.
- However there is a loss of not conforming - call it L - consists of the loss of being non-insured in the future plus a social sanction, S
- For the insurance scheme to be viable need $L > G$. More likely to hold if people care a lot about the future or if social sanctions are high.
- If perfect insurance is not feasible (the gain from deviating is higher than the loss) - only imperfect insurance can be achieved - only imperfect insurance can be sustainable not giving perfect smoothing (and hence calling for smaller transfers if high output is obtained)
- **correlated shocks** - if the entire economy is in a bad aggregate state the farmers who did relatively well will have a greater incentive to deviate from a mutual insurance scheme - harder to satisfy the enforcement constraint in bad times.

3.3 Interactions with Other Forms of Insurance

- **self-insurance and mutual insurance**: if you deviate from mutual insurance - can self-insure to some extent - accentuate tendency for mutual insurance to fall apart - may lead to socially inefficient outcome
- **credit vs. insurance** – remember we said the difference is that insurance disregards history - transfers do not carry an obligation to repay. This is the "first-best" scheme when there are no enforcement/info problems. In a second best it can be shown that **history must matter** to provide better incentives. For example an optimal second best scheme would reward a person who has produced high output today by a higher share of the pie tomorrow. But this linking of insurance transfers with the past resembles credit - not only reciprocity but some obligation implied. The latter is confirmed to some extent by empirical work (Udry 1993, 94 on Nigerian credit markets).