Insurance I: How the Poor Deal with Risk

14.740x: Foundations of Development Policy

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Dealing with risk

Households in developing countries have income that is variable and risky. What are the big sources of risk?

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How do they cope with such risk?

Ways to cope:

We will start by seeing how much households can achieve by borrowing and saving.

Savings of a rainy (or dry...) day: Introducing uncertainty

Consider a farmer who faces an income : y_1 is known but y_2 is uncertain. We will assume it can be high (y_H) with probability p and low (y_L) with probability $1 - p$.
Maximization problem:

$$\text{Max} u(c1) + \beta E[u(c2)]$$

such that:

$$c_1 = y_1 - S$$

$$c_2 = y_2 + RS$$

Risky business

Note that we have the *expectation* of future consumption in the maximization problem. I do not know how much consumption I will be able to afford. On the other hand, we know that the budget constraint will be satisfied with certainty.
Specifically,

- -with probability p, c_2 will be:
- -with probability $1 - p$, c_2 will be:

Euler Equation

Now replace c_1 and c_2 with their values from the budget constraints in the maximization problem.

$$\text{Max} u(c_1) + \beta[pu(y_H + RS) + (1-p)u(y_L + RS)]$$

FOC:

$$\beta R = \frac{u'(c_1)}{pu'(y_H + RS) + (1-p)u'(y_L + RS)}$$

which can be rewritten:

$$\beta R = \frac{u'(c_1)}{E[u'(c_2)]}$$

An example

Note that in general it does *not* imply that $c_1 = E(c_2)$ even if $\beta R = 1$.
However, consider the special case of a quadratic utility function:

$$u(c) = ac - 0.5bc^2$$

$$u'(c) =$$

The FOC becomes:

$$\beta R = \frac{a - bc_1}{E[a - bc_2]}$$

if $\beta R = 1$ we get

$$c_1 = E(c_2)$$

If $\delta = r$, and utility is quadratic, consumption is a martingale.

Solution

We can now determine the level of c_1.
First combine the two budget constraints. We obtain:

$$c_2 + Rc_1 = y_2 + Ry_1$$

which we can rewrite:

$$c_1 + \frac{c2}{1+r} = y_1 + \frac{y2}{1+r}$$

Take expectation at time 1:

$$c_1 + \frac{E[c2]}{1+r} = y_1 + \frac{E[y2]}{1+r}$$

$$c_1 + \frac{c_1}{1+r} = y_1 + \frac{E[y2]}{1+r}$$

$$c_1 = y_1 \frac{1+r}{2+r} + \frac{E[y_2]}{2+r}$$

Response to income shocks

We are now in a position to consider how a household will react to an increase in income depending on its source.

1. Compare two households who face the same income process. Household 1 received the high value in period 1, household 2 received the low value in period 1. To simplify, assume that $y_H = y_L + 1$.

$$c_1^1 - c_1^2 =$$

2. Now compare two households who face a different income process. For household 1, y_H and y_L are always one unit higher than for household 2 but they both get y_H in period 1

$$c_1^1 - c_1^2 =$$

Result 2

This is the second important result: the propensity to consume out of permanent income change should be higher than the propensity to consume out of a temporary change in income. The propensity to consume out of a permanent change in income should be 1. If the horizon is infinite, the propensity to consume out of a transitory change in income should be 0. It follows immediately that: the propensity to save out of permanent income should be close to 0, and the propensity to save out of transitory income should be close to 1 (with a long horizon).

Testing this model: Savings and Rainfall in Thailand

The paper by Chris Paxson in the reading packet tests this proposition, using data from rice farmers in Thailand. She seeks to run the regression

$$S_{irt} = \alpha_0 + \alpha_1 Y_{irt}^P + \alpha_2 Y_{irt}^T + Controls + \epsilon_{eirt},$$

where i is the individual, r is the region, t is the time period, S_{irt} is the savings rate, Y_{irt}^P is the permanent income, and Y_{irt}^T is the transitory income.
What does she expect to find?

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Paxson

What is the main problem she faces in implementing this equation?
How can she construct measures of Y_{irt}^{P} and Y_{irt}^{T}?
Idea: the income of a rice farmer is essentially determined by the amount of rainfall (more rainfall is better). But the exact amount of rainfall in a given season is unpredictable, and in particular is not serially correlated: a good rainfall this season does not predict how much rainfall you will get next season, once you control for the region's average rainfall.
Therefore, deviation from the norm should be a good predictor of:

Paxson

So she can run a regression of income on rainfall (X_{irt}^T) and characteristics that will help predict the permanent income (X_{irt}^P).

$$Y_{irt} = \beta_t + \beta_{0r} + X_{irt}^P \beta_1 + X_{irt}^T \beta_2 + \epsilon_{eirt}$$

She then uses the fact that:
-rainfall predicts only the transitory portion of the income
-the other variables predict permanent portion of the income
to construct:
$\hat{Y}_{irt}^P =$
$\hat{Y}_{irt}^T =$
$\hat{e_{irt}} =$
She then runs the regression:

$$S_{irt} = \alpha_0 + \alpha_1 \hat{Y}_{irt}^P + \alpha_2 \hat{Y}_{irt}^T + Controls + \epsilon_{eirt}$$

What are the results?

Effect of permanent and temporary shocks

Variable	Two-step SAVE1	SAVE2	SAVE3
$\hat{Y}^{P}$ (α_1)	0.2773 (5.40)	0.4400 (8.94)	0.1824 (2.73)
$\hat{Y}^{T}$ (α_2)	0.7362 (4.28)	0.8039 (4.87)	0.7340 (3.21)
$\hat{\varepsilon}$	0.6015 (24.89)	0.6925 (29.71)	0.3801 (11.91)

Introducing borrowing constraints

What if household cannot borrow? Can they achieve their utility level?

They can accumulate assets in good time (through savings), and run them down in bad times. For example, if you call x_t the "cash on hand" available to a household at date t (the sum of accumulated assets+current income), it can be shown that a simple rule of thumb is very close to the best a household can do: consume everything if cash on hand is below some threshold, otherwise save a fraction of what's above the surplus.

Smoothing by saving up

For example, for a i.i.d. income of mean 100.

$$c_t = x_t \text{ if } x_t < 100$$

$$c_t = x_t - (x_t - 100) * 0.7 \text{ if } x_t \geq 100$$

How much smoothing can they achieve in this way? Look at figures 6.8 and 6.9 in handout (simulations by Deaton). What are the main remarks?

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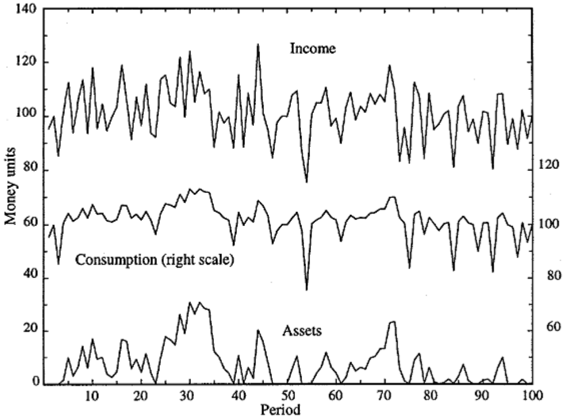
There are times when assets run out and consumption can drop dramatically. Can households do better, and achieve consumption smoothing through mutual insurance?

Buffer Savings Simulation, 70% Savings

Figure 6.8. Simulation of income, consumption, and assets

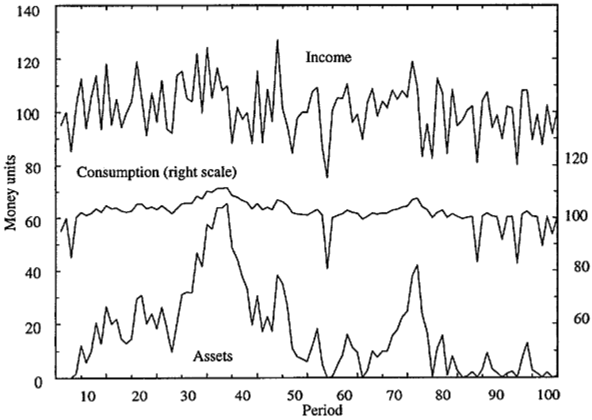


Source: Author's calculations as described in the text.

Source: Deaton (1997): "The Analysis of Household Surveys"

Buffer Savings Simulation, 80% Savings

Figure 6.9. The effects of a conservative saving policy



Source: Author's calculations as described in the text.

Source: Deaton (1997): "The Analysis of Household Surveys"

Savings constraints

Households do not always have great savings instruments (they are not served by banks, banks do not want small accounts). The returns to their savings may be low (lower than the discount rate). They may save in inefficient instruments, which they should be able to keep, rather than to liquidate. For example, in bullocks!

Income smoothing

Without being able to borrow, household may be exposed to large drop in consumption when their income is low. Next time, we will see whether they can get into formal or informal insurance mechanisms. But if that is also limited, they can try to deal with risk in other ways.

Work more when wage is low

What is the problem with this strategy though (Seema Jayachandran, 2006)? What would expect to see about the volatility of wages in places that are :

- poor isolated (no roads)
- have no banks or roads
- So paradoxically, the poor will have more volatile wage, precisely *because* they cannot be insured.

Avoid Risk Ex-ante

- you can chose activities that are less risky: you will for example not use a new crop or fertilizer, even if you know it will increase your profit on average, to avoid a low realization (evidence in the next lecture)
  - Other examples?