14.74 Foundations of Development Policy
Spring 2009

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Lecture 14: Savings: How Villagers Deal with Risk

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April 22, 2009

Households in developing countries have income that is variable and risky. How do they cope with such risk?

Ways to cope:
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We will start by seeing how much households can achieve by saving. Saving is a way for an individual to transfer resources into the future.

1 Savings: A simple model with certainty

Imagine you can live for 2 periods. In the first period you earn y_1, in the second period you earn y_2. You can save or borrow in period 1.

Maximization problem:

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

such that:

$$c_1 = y_1 - S$$

$$c_2 = y_2 + RS$$

where R is the gross interest rate.

What is the solution of this problem?

If $\beta R = 1$, what does this imply? β is the value of consumption tomorrow, relative to today. Economists often use a related concept, the discount rate, defined by:

$$\beta = \frac{1}{1 + \delta}$$

If the $\delta = r$, $\beta R = 1$, therefore $c_1 = c_2$.

This is the *permanent income hypothesis*: if the discount rate is equal to the interest rate and the income stream is certain, the consumption should be equal over the life cycle.

We can now use the budget constraint to recover S, and $c_1 = c_2 = c$.

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

Let's use the same model, but think of it as describing a shorter horizon (i.e. one year). We now introduce uncertainty: 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:

$$c_1 = y_1 - S$$

$$c_2 = y_2 + RS$$

Note that we now 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:

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:

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

The first order condition resembles the one in section 1, except that we now have an expectation. 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.

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:

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

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

$$c_1(\frac{2+r}{1+r}) = y_1 + \frac{E[y2]}{1+r}$$

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

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

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).

3 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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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:

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:

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

See the handout: what are the results?

4 Introducing borrowing constraints

You will see very soon that households may not be able to borrow. How much can they smooth income?

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.

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?

5 Savings and Self Control

These results assume that the individual has a utility function with a constant discount rate β. In fact, there is evidence that individuals may be “present biased", i.e. they discount tomorrow with respect to today more than they discount day after tomorrow with respect to tomorrow.

Such preferences lead to " preference reversal" when people are asked to chose between a certain amount today and a higher amount in the future.

- Would you prefer P200 today or P300 guaranteed in a month?
-Would you prefer P200 in 6 months or P300 guaranteed in 7 months?

In the table in the handout, the light grey indicate preference reversal in the "expected' order.
Note that people also reverse their preferences in the opposite order■
Could be time-inconsistencies, or mistakes, or worry that the future is uncertain.

Such preferences are some times represented as "hyperbolic discounting": with 3 periods, the individual maximizes:

$$\text{Max} u(c1) + \beta[u(c2) + \delta u(c3)]$$

Write down the traditional exponential utility function to compare:

Such individuals will not save enough. Why?

However, if they know that they suffer from hyperbolic discounting, they can decide to force themselves to save, starting tomorrow: such persons should enjoy products that force them to save regularly, and such products will lead them to save more.

Work with 1,700 clients of a microfinance institution in the Philippines, which offers savings account. Introduce a new savings product with a commitment feature.

Questions:
-Will anybody take it up?
-Will individuals identified as hyperbolic be more likely to take it up? Will it result in increased savings (for those offered/for those who take up)

-Can we make sure it is the effect of the commitment and not something else?

Experimental design:
1,700 existing clients are randomly assigned to one of three groups:
-Treatment group (offer of commitment savings product is made during home visits)
-Marketing group (value of commitment is extolled during home visits but no product is offered).
-Control group: nothing is offered.

Before anything is offered, individuals are surveyed, including questions to evaluate whether individuals are likely to be hyperbolic Savings in this bank and other banks are measured after 6 and 12 months

Commitment Treatment:
Individuals can choose to set either a time goals (I will leave the money in the account until X date) or a amount goal (I will not take the money out until I have reached

a particular sum). The decision is theirs, but once they have decided they cannot withdraw the money until the target is achieved. They are given a certificate which says for what they are savings They are also offered a lockbox to put accumulate their savings before they go deposit it to the bank (low barrier comitment).

Marketing treatment:
Individuals receive a home visit, and they are encourage to set themselves a goal (either time or an objective). They are given a similar certificate However, they are not offered an account with commitment features. (they are not allowed to open one even if they hear about it).

Results:

- Did any body take this up

202 accounts were opened
-50% of the account stayed at the minimum deposit after 12 months
-Half of clients did more than one contribution.

-Fewer people (62) chose the amount goal than the time goal (147)
- Those who did the amount goal saved much more
- Nobody tried to withdraw before maturity
- Accounts who reach time or amount maturity all rolled over.

•Did the people who are hyperbolic take it up? Yes for females, not for males.

• Savings: Balances after 6 months are significantly higher in commitment savings group Large effect in proportion (savings in control groups are rather small). Effect is due to commitment: there is no significant increase in balance for the marketing group (though the estimate is large too...)