BREAD open course on Development Economics

Module 2: Credit, Insurance and Risk

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Class 5: Saving: Benchmark and External Barriers

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Risk and Saving

- There are many motives for saving
  - Life-cycle
  - Intergenerational
  - Seasonality
  - Addressing fixed costs/lumpy purchases
  - Addressing risk

A Simple Model

- Individual faces exogenous variable income process and interest rates $\{y_t, r_t\}$
- Utility at time t is

$$u_t = E_t \Sigma_{\tau=t}^{T} v_\tau(c_\tau)$$

  - Conventional would be

$$v_{t+a}(c_{t+a}) = (1+\delta)^{-a} v(c_{t+a})$$

- Resource constraint

$$A_{t+1} = (1+r_t)(A_t + y_t - c_t)$$

- with $A_{T+1} = 0$
- $A_t + y_t$ is “cash on hand”

- What have we assumed?
  - Unlimited, perfectly enforced, zero transaction cost borrowing/saving
  - Time separable preferences
  - Expected utility maximization

- A value function is the expected utility of someone who makes the optimal consumption choice now, given a certain cash on hand and knowing that she will continue to make optimal consumption choices in the future

$$V_t(A_t + y_t)$$

$$= \max_s \{u(A_t + y_t - s) + E_t V_{t+1}[(1 + r_{t+1})s + y_{t+1}]\}$$

$$V_t(A_t + y_t)$$
$$= \max_s \{v_t(A_t + y_t - s) + E_t V_{t+1}[(1 + r_{t+1})s + y_{t+1}]\}$$

So

$$v_t'(c_t) = E_t(1 + r_{t+1})V_{t+1}'[A_{t+1} + y_{t+1}]$$

and at the optimal s, $V_t'(A_t + y_t) = v_t'(c_t)$ by the envelope theorem. So

$$v_t'(c_t) = E_t[(1 + r_{t+1})v_{t+1}'(c_{t+1})]$$

The Euler equation you have all seen before

MU of c now = today's expectation of the discounted expected MU of c tomorrow

$$v_t'(c_t) = E_t[(1 + r_{t+1})v_{t+1}'(c_{t+1})]$$

Now special cases

- Exponential discounting of stable utility, plus constant r:

$$v'(c_t) = \frac{1 + r}{1 + \delta} E_t v'(c_{t+1})$$

- Let $r = \delta$ and utility be quadratic $(v(c) = (k - c)^2)$

$$c_t = E_t c_{t+1}$$

$$c_t = E_t[c_{t+1}]$$

So the lifetime bc is

$$E_t \sum_{\tau=t}^{T} (1+r)^{-\tau} c_{t+\tau} = A_t + E_t \sum_{\tau=t}^{T} (1+r)^{-\tau} y_{t+\tau}$$

- Let $T \to \infty$ and solve for c_t

$$c_t = \frac{r}{1+r}\left[A_t + E_t \sum_{\tau=t}^{\infty} (1+r)^{-\tau} y_{t+\tau}\right]$$

- Consume the annuity value of your permanent income – the PIH
- Transitory shocks to y have no (minimal) impact on c; they are fully saved

Precautionary savings

- Marginal utility is positive $v'(c) > 0$ for all c
- Risk aversion: $v''(c) < 0$
- $v(c)$ exhibits *precaution* when $v'''(c) > 0$
- $v'''(c) > 0$ means that at low c, fluctuations in c hurt more than similar fluctuations at high c

Precautionary savings

- If $v'''(c) > 0$, then $v'(c)$ is decreasing and convex
- So an increase in the variability of c increases the RHS of the Euler equation

$$v'(c_t) = \frac{1+r}{1+\delta} E_t v'(c_{t+1})$$

(by Jensen's inequality, an increase in the spread of c_{t+1} at fixed mean c_{t+1} increases the expected value of $v'(c_{t+1})$)

- Thus c_t must decline (savings increase) to compensate for expected future variability
- In our PIH example with quadratic utility, $v'''(c) = 0$ and there is no precautionary motive

Weather, risk and savings

- Paxson (1992) addressed the question: do farmers use savings to smooth consumption in the face of transitory income shocks?
- Main empirical obstacle: data does not usually come with a variable labeled “transitory income”
- Main innovation: Income of farmers is related to rainfall. Use transitory shocks to rain (identified from a time series of rainfall data) to identify a transitory shock to income.
- Incredibly simple and intuitive idea. Used many, many times since

- Related ideas: Wolpin (1982) used cross-sectional variation in weather to identify *permanent* income.
- Bhalla (1980) used long-run average income from panel data to identify permanent income.
- Minor theme: be careful with data. Think of income and consumption measured over different periods in an inflationary environment

- Paxson (1992) wants to estimate

$$S_{irt} = \alpha_0 + \alpha_1 Y_{irt}^P + \alpha_2 Y_{irt}^T + \alpha_3 Y_{irt}^U + \alpha_4 Var_{ir} + W_{irt}\alpha_5 + u_{irt}$$

where

$$Y_{irt}^P = \beta_t^P + \beta_r^P + X_{irt}^P \beta_1 + \epsilon_{irt}^P$$

$$Y_{irt}^T = \beta_t^T + \beta_r^T + X_{irt}^T \beta_2 + \epsilon_{irt}^T$$

with rainfall measures in X^T

$$S_{irt} = \alpha_0 + \alpha_1 Y_{irt}^P + \alpha_2 Y_{irt}^T + \alpha_3 Y_{irt}^U + \alpha_4 Var_{ir} + W_{irt}\alpha_5 + u_{irt}$$

$$Y_{irt} = \beta_t \ + \beta_r \ + X_{irt}^P \beta_1 + X_{irt}^T \beta_2 + \epsilon_{irt}$$

$$S_{irt} = \gamma_t + \gamma_r + X_{irt}^P \gamma_1 + X_{irt}^T \gamma_2 + \nu_{irt}$$

The key implication of the PIH is that $\alpha_2 = 1$

$$\gamma_2 (= \beta_2 \alpha_2) = \beta_2$$

(note: need at least 2 cross sections to distinguish region-specific transitory rain shocks from region effects)

Comment from Rosenzweig and Wolpin (*JEL* 2000)

- For farmers $Y_{irt} \neq \pi_{irt}$ because of non-purchased inputs.
- A general problem. Let's simplify and suppose farmers have access to a labor market, but that labor expenditure is not recorded in the data
- So the farmer's income, given rainfall realization r is

$$\pi^*(r) = \max_L f(r, L) - wL$$

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So

$$\frac{\partial f(r, L)}{\partial L} = w$$

Therefore we have

$$\frac{d\pi}{dr} = \frac{\partial f(r, L)}{\partial r} + \frac{\partial f(r, L)}{\partial L}\frac{dL}{dr} - w\frac{dL}{dr} = \frac{\partial f(r, L)}{\partial r}$$

$$\pi^*(r) = \max_L f(r, L) - wL$$

Unfortunately, if we don't observe L or wL, we don't observe $\pi(r)$. We only observe $y(r) = f(r, L)$. What we estimate is

$$\frac{dy}{dr} = \frac{df(r, L)}{dr} = \frac{\partial f(r, L)}{\partial r} + \frac{\partial f(r, L)}{\partial L}\frac{dL}{dr}$$

This is a problem, because we want to test PIH by showing

$$\frac{dS}{dY^T} = \frac{\frac{dS}{dr}}{\frac{d\pi(r)}{dr}} = \frac{\frac{dS}{dr}}{\frac{\partial f(r, L)}{\partial r}} = 1$$

$$\frac{dS}{dY^T} = \frac{\frac{dS}{dr}}{\frac{d\pi(r)}{dr}} = \frac{\frac{dS}{dr}}{\frac{\partial f(r,L)}{\partial r}} = 1$$

But we do not observe the denominator. Instead, we have

$$\frac{\frac{dS}{dr}}{\frac{\partial f(r,L)}{\partial r} + \frac{\partial f(r,L)}{\partial L}\frac{dL}{dr}}$$

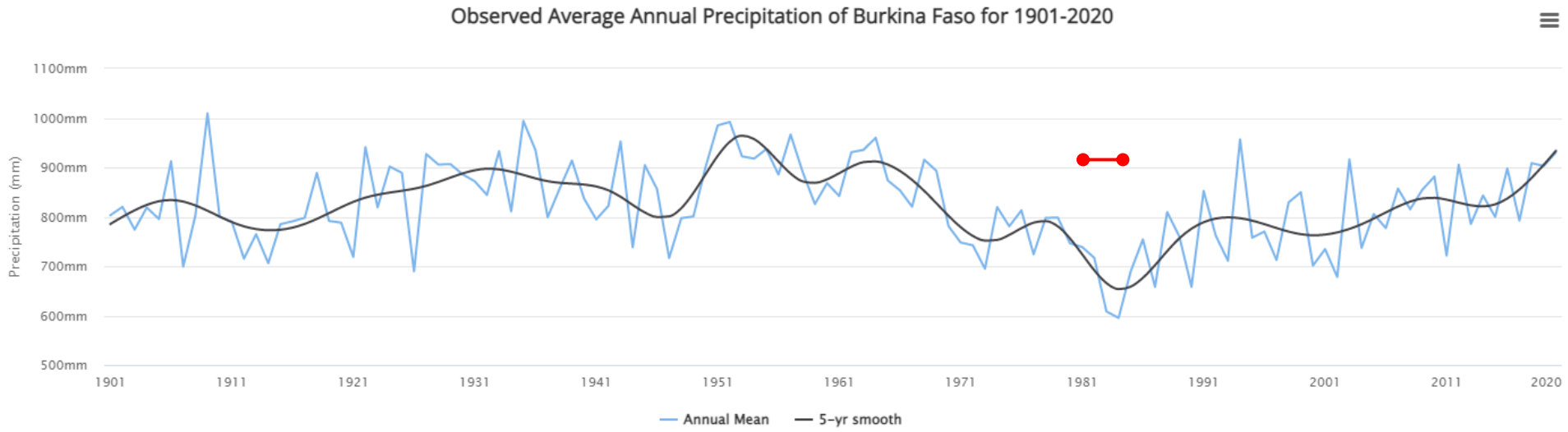
and we don't even know the sign of that last term. Obviously, it depends on

$$\frac{\partial^2 f(r,L)}{\partial L \partial r}$$

which is a feature of the local agricultural technology

Saving in Crisis: Burkina Faso and Drought 1981-1985

Kazianga and Udry (2006)



Saving in Crisis: Burkina Faso and Drought 1981-1985

- Mean food consumption < $0.50/AE/day
- Median < 2000 kilocalories /AE/day ≈ 70% of the recommended level "a moderately active adult"
- Median livestock holdings

	Sahel			Soudanian			Northern-Guinean		
	1982	1983	1984	1982	1983	1984	1982	1983	1984
Cattle	4.0	4.5	2.5	0	0	0	0.5	1.0	2.0
Goats & Sheep	16	14	10	27.5	26	19.5	7	6.5	5

Saving in Crisis: Burkina Faso and Drought 1981-1985

$$\pi_{ivt} = z_{ivt}\alpha_1 + \alpha_V F_{vt} + F_{vt}X_{ivt}\alpha_2 + \gamma_i + \epsilon_{ivt}$$

$$y_{ivt}^{T} = \hat{\alpha}_V F_{vt} + F_{vt}\, X_{ivt}\hat{\alpha}_2$$

Saving in Crisis: Burkina Faso and Drought 1981-1985

$$\pi_{ivt} = z_{ivt}\alpha_1 + \overbrace{\alpha_V F_{vt}}^{\substack{Village- \\ year \\ specific}} + \overbrace{F_{vt}X_{ivt}\alpha_2}^{\substack{interacted\ with \\ household \\ specific\ vars}} + +\gamma_i + \epsilon_{ivt}$$

$$y_{ivt}^{T} = \hat{\alpha}_V F_{vt} + F_{vt}X_{ivt}\hat{\alpha}_2$$

Saving in Crisis: Burkina Faso and Drought 1981-1985

$$\pi_{ivt} = z_{ivt}\alpha_1 + \alpha_V F_{vt} + F_{vt}X_{ivt}\alpha_2 + \gamma_i + \epsilon_{ivt}$$

$$y_{ivt}^{T} = \hat{\alpha}_V F_{vt} + F_{vt}\, X_{ivt}\hat{\alpha}_2$$

$$y_{ivt}^{P} = z_{ivt}\hat{\alpha}_1$$

$$c_{ivt} = \zeta_1 y_{ivt}^{P} + \zeta_2 y_{ivt}^{T} + \zeta_3 y_{ivt}^{U} + \lambda_i + \nu_{ivt}$$

Determinants of Consumption

	(1)	(2)
Permanent income	0.432	
	[0.183]**	
Transitory income	0.551	
	[0.059]***	
Unexplained income	0.481	
	[0.056]***	
Rich		
Permanent income		0.318
		[0.195]
Transitory income		0.499
		[0.096]***
Unexplained income		0.515
		[0.093]***
Poor		
Permanent income		0.863
		[0.275]***
Transitory income		0.593
		[0.079]***
Unexplained income		0.500
		[0.074]***
Constant	43.562	30.499
	[33.511]	[33.964]
Observations	395	395
Number of hh	112	112
R-squared	0.42	0.43
Poor trans. Inc.=rich trans. Inc. F(2, 270)		41.61

Determinants of changes in value of grain storage and livestock holdings

	grain storage	livestock
Permanent income	0.381	-0.032
	[0.196]*	[0.006]***
Transitory income	0.245	-0.004
	[0.075]***	[0.002]**
Unexplained income	0.047	-0.002
	[0.057]	[0.002]

Limits on Self-Insurance, Barriers to Saving

- We assumed frictionless borrowing and saving:
$$A_{t+1} = (1 + r_t)(A_t + y_t - c_t)$$
- Credit may not be available
  - Limited liability
  - Incomplete information
  - Transaction costs
- Savings – at least usually – can be arranged
- What will a household do if it can save but not borrow (Deaton 91)? $(A_t \geq 0)$

- Borrowing constraints induce precautionary savings, even if preferences don't display prudence
  - And strengthen the precautionary motive if $v'''(c) > 0$
- Consider $v(c) = (k - c)^2$ and $r = \delta$, as in the PIH
- But add the borrowing constraint $A_t \geq 0$
- Three periods $(1,2,3)$ and the Euler equation in period 1 becomes
- $$c_1 = \begin{cases} E_0(c_2) & if\ A_2 > 0 \\ y_1 + A_1 & if\ A_2 = 0 \end{cases}$$

- In period 3, consumption is equal to cash on hand

$$c_3 = A_3 + y_3$$

- In period 2

$$c_2 = \begin{cases} E_2(c_3) & if\ A_3 > 0 \\ y_2 + A_2 & if\ A_3 = 0 \end{cases}$$

- Which can be written

$$c_2 = \min\left(A_2 + y_2, E_2(A_3 + y_3)\right)$$

- and in period 1

$$c_1 = \min\left(y_1 + A_1, E_1(c_2)\right)$$

$$c_1 = \min\left(y_1 + A_1, E_1\left(\min\left(A_2 + y_2, E_2(A_3 + y_3)\right)\right)\right)$$

$$c_1 = \min\left(y_1 + A_1, E_1\left(\min\left(A_2 + y_2, E_2(A_3 + y_3)\right)\right)\right)$$

- Suppose $var(y_3)$ increases while keeping $E(y_3)$ fixed.
  - With quadratic prefs and no credit constraints, this has no effect on consumption/savings in period 1
- But with credit constraints, the increased variance of y_3 makes it more likely that the underlined term binds in period 1, thus c_1 must fall
- So even if the preferences are not `prudent', precautionary motives might generate additional saving
  - If preferences are prudent, this effect is strengthened

Saving in a time of crisis

- Burkinabe households experienced extreme aggregate transitory income shocks during severe drought
  - Substantial idiosyncratic income variation
- Small amount of consumption smoothing, largely via accumulation/decumulation of grain stocks
- Most households experiencing consumption decline held livestock through end of period
- Potential binding liquidity constraints + herd management concerns lead households to destabilize consumption to conserve livestock through the drought.

- In BF, farmers save in livestock and grain stocks, and use buffer stocks to partially address credit constraints
- Constraints on saving appear important for many
- Dupas and Robinson (2013) provide evidence of constraints on savings by owners of small-scale businesses

Dupas and Robinson "Savings Constraints and Microenterprise Development"

- Setting: Western Kenya market town
- Sample of market vendors (also of bicycle taxi operators, which I won't discuss)
- Very small scale (e.g, sell one item)
- Mean daily investment $6
- No use of formal savings or credit
- RCT: open savings account

- Accts pay zero nominal interest (plus inflation of 10-14%)
- withdrawal fees of US$.50 to $1.50
- bank is open from 9am-3pm M-F, no ATMs
- logbooks over 3 months of income, expenditure, health, business activities, labor supply, intra- and inter-HH transfers

Results

- Negative nominal returns accounts used heavily
- Treatment group daily investment increased by 40-50%
- Treatment group private expenditures increased by $\approx 40\%$

Why save when the returns are negative?

Why not just put the earnings into the business?

- Lumpiness of business investment
- Variation over time in returns to investment
- Business investment reversible only at a cost

Why do alternatives to formal savings have such negative returns?

- Behavioral biases
  - tomorrow
- Safety/Family/Peer demands

Why do alternatives to formal savings have such negative returns?

- Behavioral biases
  - tomorrow
- Safety/Family/Peer demands
  - Deposits relatively infrequent and larger than 1 day's expenditure
  - Pattern suggests guarding against infrequent but difficult to protect against demands for money
  - Use of accounts strongly correlated with ROSCA use and wealth

- Mobile money used to similar effect in Uganda:

  Emma Riley. 2020. “Resisting Social Pressure in the Household Using Mobile Money”

- RCT among female microfinance borrowers
  - Loan disbursed in cash, or via mobile money
- Business capital 11% higher and business income 15% higher for mobile disbursement group after 8 months
- Effects concentrated among women who experienced greatest pressure to share with family at baseline

- Capital shocks (randomized grants) to a female entrepreneur typically invested in her husband's enterprise
- Bernhardt, Field, Pande, Rigol. 2019. "Household Matters" *American Economic Review: Insights*

- Data from RCTs (capital grants) in India, Sri Lanka, Ghana:
  - Enterprise level data show no impact of grants on women's enterprise profits
  - Household level data in India and Sri Lanka show an increase in household income for women receiving grants (no data in Ghana)
  - India: grants to female entrepreneurs have a large impact on other enterprise profits w/in household
  - Sri Lanka and Ghana: grants to women have higher enterprise returns when there are no other enterprises in the household

Sources of increased savings

Michael Callen, Suresh de Mel, Craig McIntosh, Chris Woodruff. 2019. “What are the Headwaters of Formal Savings?” *REStud* 86

- Dupas and Robinson (2013) and others have shown that improved access to formal savings increases formal savings.
  - So what?
    - Profits and expenditure increase, too
  - Where do the funds originate?

- Were savings constrained by commitment/self-control?
  - Should observe decline in consumption
- Avoid intrahousehold barriers to saving?
  - Should observe change in intra-household transfers
  - Perhaps reduce use of alternative ways to hide savings
- Does the intervention redirect informal savings?
  - Declines in ROSCA participation/contributions

- Production function non-convexities
  - Consumption, transfers out, other investments decline
  - Lumpy investment made
- Intertemporal substitution due to increased return on savings
  - Increase in labor supply (as long as the positive substitution effect outweighs the plausibly negative income effect)

Deposit collectors

- Informal agents common in many countries. Related to ROSCAs (both called *susu* in southern Ghana). Visit savers at home or business place to collect daily/weekly deposits.
- Sri Lanka's National Savings Bank in 2008 began a program with agents using wireless POS terminals.
  - Bank agreed to expand program to remote rural areas to reach lower-income under-banked households
- Treated households receive assistance opening accounts, incl payment of minimum required balance (which was small relative to income). After opening account, mobile POS collection began.
- Effective 5% increase in real interest rate

Deposit collectors

- Sample mostly daily wage workers and self-employed. Good targets for weekly deposit collection
- Sample organized around “*seetu*”s - ROSCAs
- Monthly /quarterly surveys of individual cash flow, including cash balances, making sure that accounts balance.

Experimental Design

- Randomization at zone (cluster of hhs) level into:
  - Treatment (78 zones)
  - Control (78 zones)
- *Seetu* saturation experiment
  - 45 of the close *seetu* communities are control
  - 13 treated at 20%
  - 13 treated at 40%
  - 13 treated at 60%
- After 6 months, treatment further randomized
  - Lockboxes established in subtreatment zones

TABLE 2

Estimated impacts of deposit collections on savings outcomes

	Survey data			
	Total no. of transactions (4)	Bank savings (5)	Informal and cash savings (6)	Total savings (7)
Panel A: Pooled				
Treated	1.57***	689.6***	42.2	883.0**
	(0.15)	(198.6)	(322.0)	(376.7)
Observations	9172	9172	9172	9172
R-squared	0.58	0.25	0.32	0.33
Number of HHs	783	783	783	783

Sources

- Treated household have immediate increase in total income
  - No support for “save-invest-earn” pattern generated by non-convexities
- No change in transfers to other household members
- No decrease in consumption
- Labor hours at market wage increase
- Shift out of self-employment into wage labor
- w/i self-employment, all increases focused on manufacturing

Sources

- Minor evidence of self-control problems
- No larger effects for those initially lacking control over savings, so no support for “other-control” problems
- No evidence of crowd-out of *seetus*
- The main barrier to savings, in this context, was the low return to saving