Development Economics

Poverty Traps

Emily Breza, Harvard University

AEA Continuing Education

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Roadmap

1. Poverty Traps: Refresher
2. Ultra-Poor Interventions
3. Are the Extreme Poor in a Poverty Trap?
4. Does Microcredit Unlock a Poverty Trap?

Poverty Traps

Poverty trap:

- Setting with multiple equilibria, steady state depends on initial conditions
  - Steady state (e.g., K*): once reach steady state assets, stay there forever
  - E.g., begin with K_0, invest in business. If returns high, save some of profits to expand biz. Next period, repeat. Under diminishing returns, eventually want to stop - $(K*)$
  - Today: differences in initial conditions across individuals (e.g., HH wealth)
  - Macro: differences in initial conditions across economies (see work of Zilibotti and Matsuyama, among others)
- Attractive concept from a policy perspective: if we can find one, then all we need is a 1-time shock to send people out of the "bad" steady state

Standard Convex Problem

Recall Euler Equation:

$$u'(c_t) = \delta R E_t[u'(c_{t+1})]$$
$$s.t. W_{t+1} = R(W_t - y_t - c_t)$$
$$y_t = F(k_t) - Rk_t$$

Standard convex problem has unique steady state

- $F(k_t)$ concave, no borrowing constraint, no interest rate wedge
- Invest until $F'(k_t) = R$
- $u'(c_t) = \delta F'(k_t) E_t[u'(c_{t+1})]$

In order to generate multiple steady states:

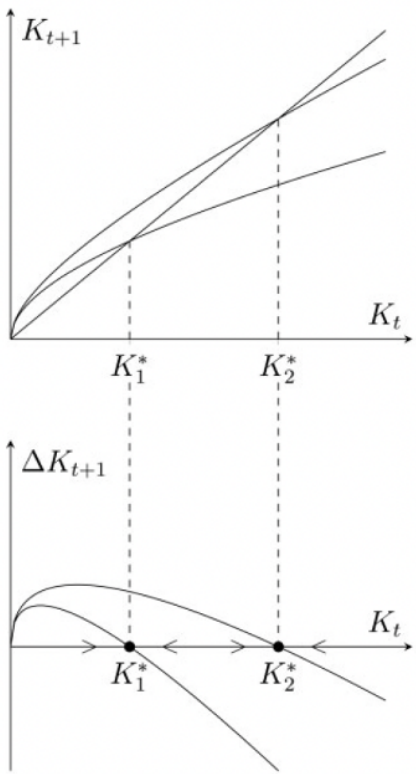
1. Need non-convexity somewhere (typically in F(.))
2. AND need financial constraints
   - With credit: borrow to get to region with high returns

Different F(.) Cases, No Credit

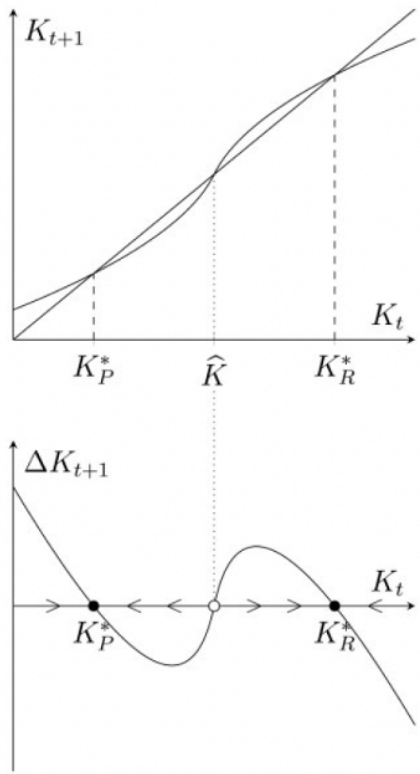
Solow-type model $K_{t+1} = \Phi(K_t)$ (Balboni et al 2022)

$\Phi(K_t) = s_i A_i F(K_t) - (1 - \rho)K_t$

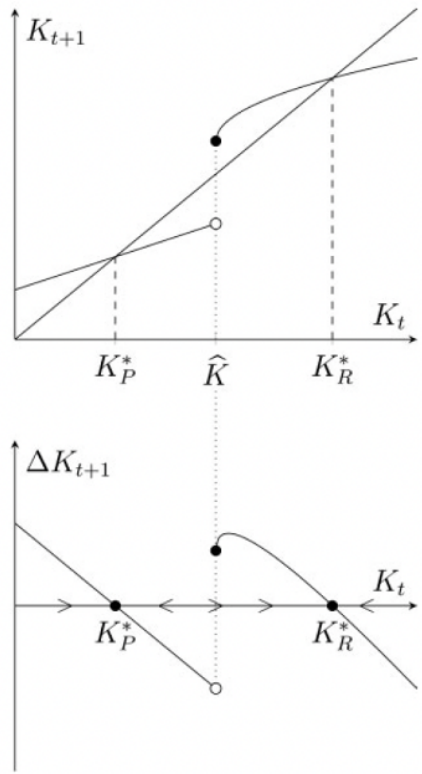
- Exogenous savings rate s_i, productivity A_i, depreciation ρ
- Steady state: $K^* = \Phi(K^*)$ savings exactly offsets depreciation



(A) Globally Concave Production Function



(B) S-shaped Production Function

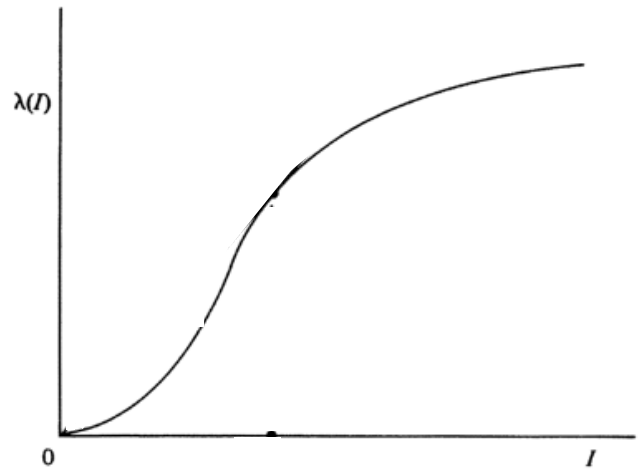


(C) Production Function with Indivisibilities

The Capacity Curve

Evidence for poverty traps?

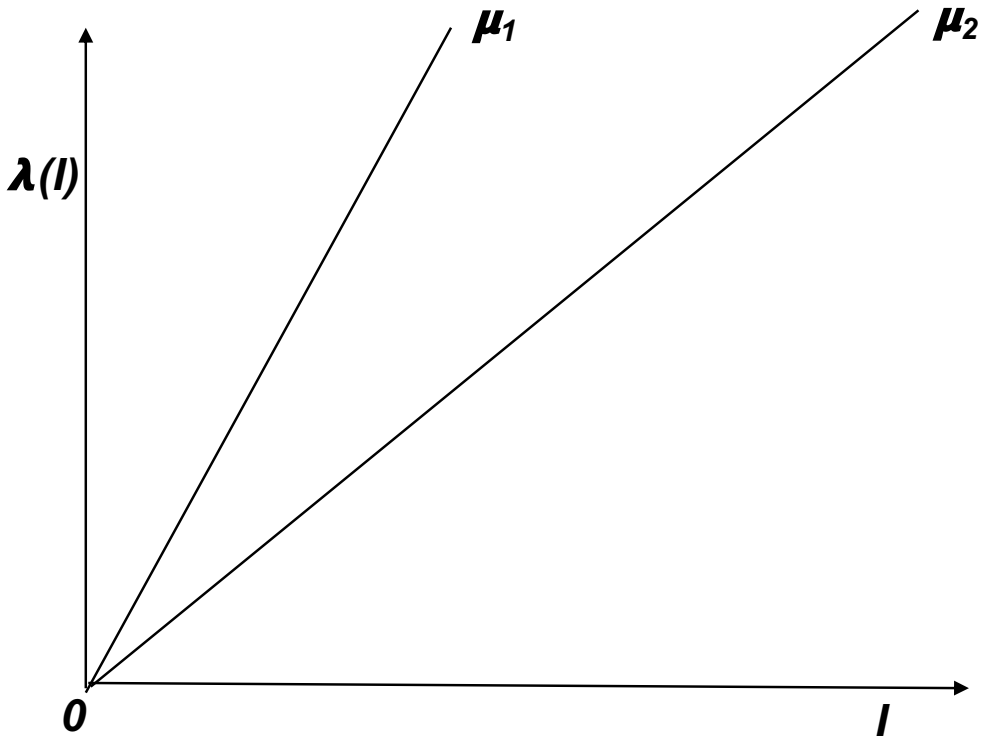
- Canonical model of DasGupta and Ray (1986)
- Uses nutrition-productivity relationship as motivating example
- Non-convexity from the capacity curve:



- Capacity curve shows how work output is a function of income
- I: Income
- $\lambda(I) =$ Power (work) output feasible for income I. (if you buy calories with all of I)
- Credit constraint: can't borrow to improve today's nutrition

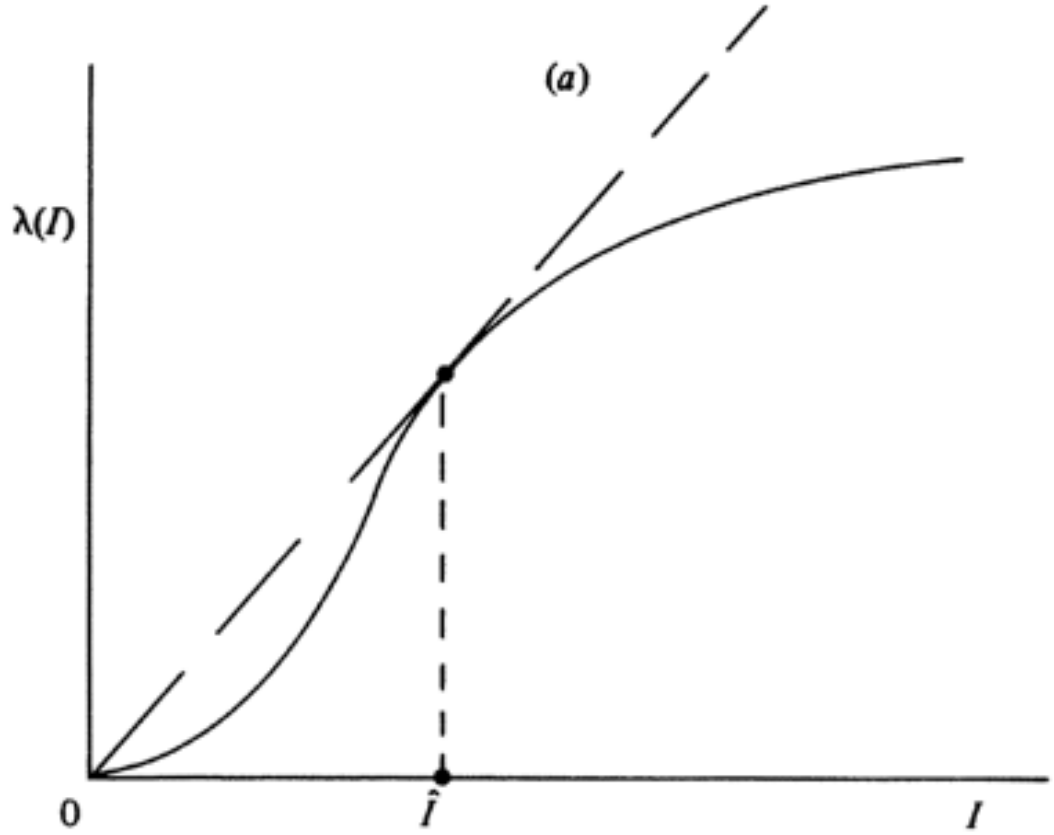
The Capacity Curve

Suppose that workers are paid piece rates for their work output



- Can plot income as function of work on the same axes
- Denote the piece rate μ
- $I = \lambda\mu$
- Which piece rate is higher, μ_1 or μ_2?

The Capacity Curve



- Dashed line represents the minimum piece rate $\hat{\mu}$ such that any work can be done
- $\hat{I}$: food adequacy standard, defined s.t. $\hat{\mu}\lambda(\hat{I}) = \hat{I}$

Dynamic model based on capacity curve

- a worker eats in the morning, works all day, and is paid a piece rate wage v at night.
- the next morning, he wakes up and eats again, works, ...
- ...

Let's define the key relationships:

- $nutritiontoday = g(incomeyesterday)$
- $productivitytoday = \widetilde{f}(nutritiontoday)$
- $incometoday = v \times (productivitytoday)$

$\tilde{f}(.)$ is the 'capacity curve'

Substituting the pieces:

- $incometoday = v \times (productivitytoday) = v \times \widetilde{f}(nutritiontoday) = v \times \widetilde{f}(g(incomeyesterday)) = f(g(incomeyesterday))$
- where $f = v\tilde{f}$

Now we have income today as a function of income yesterday.

Finding the steady states

Workers vary in initial income y_0.

- Poorest workers on bottom of S-curve, low productivity

We can follow the agent's income over time: from y_0 ('yesterday'), y_1 ('today') on the curve, and then to y_2 ('tomorrow')..
The next three pictures demonstrate three possible scenarios using this model:

- Picture 1
- Picture 2
- Picture 3

Which will generate a poverty trap?

Situation 1

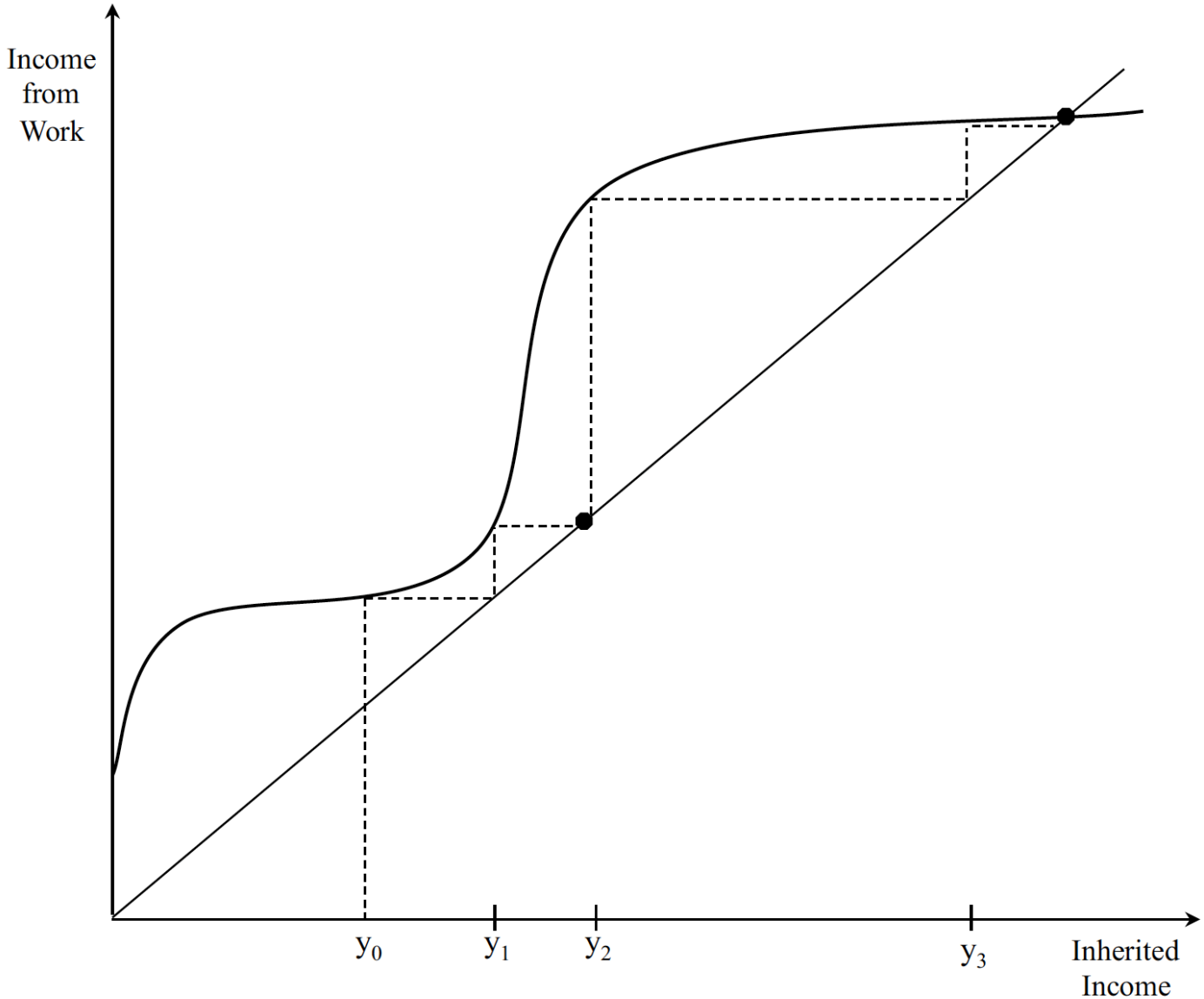
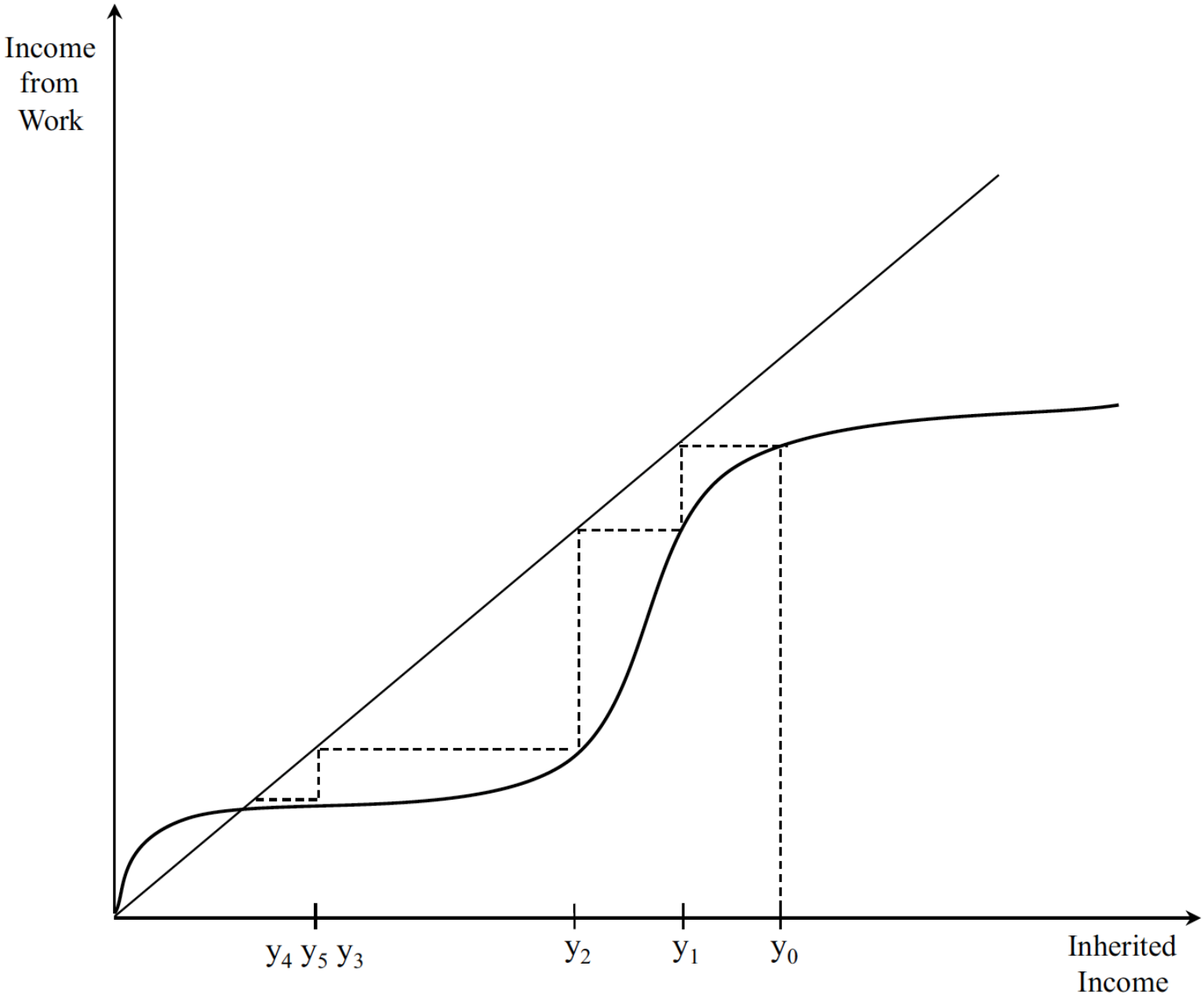
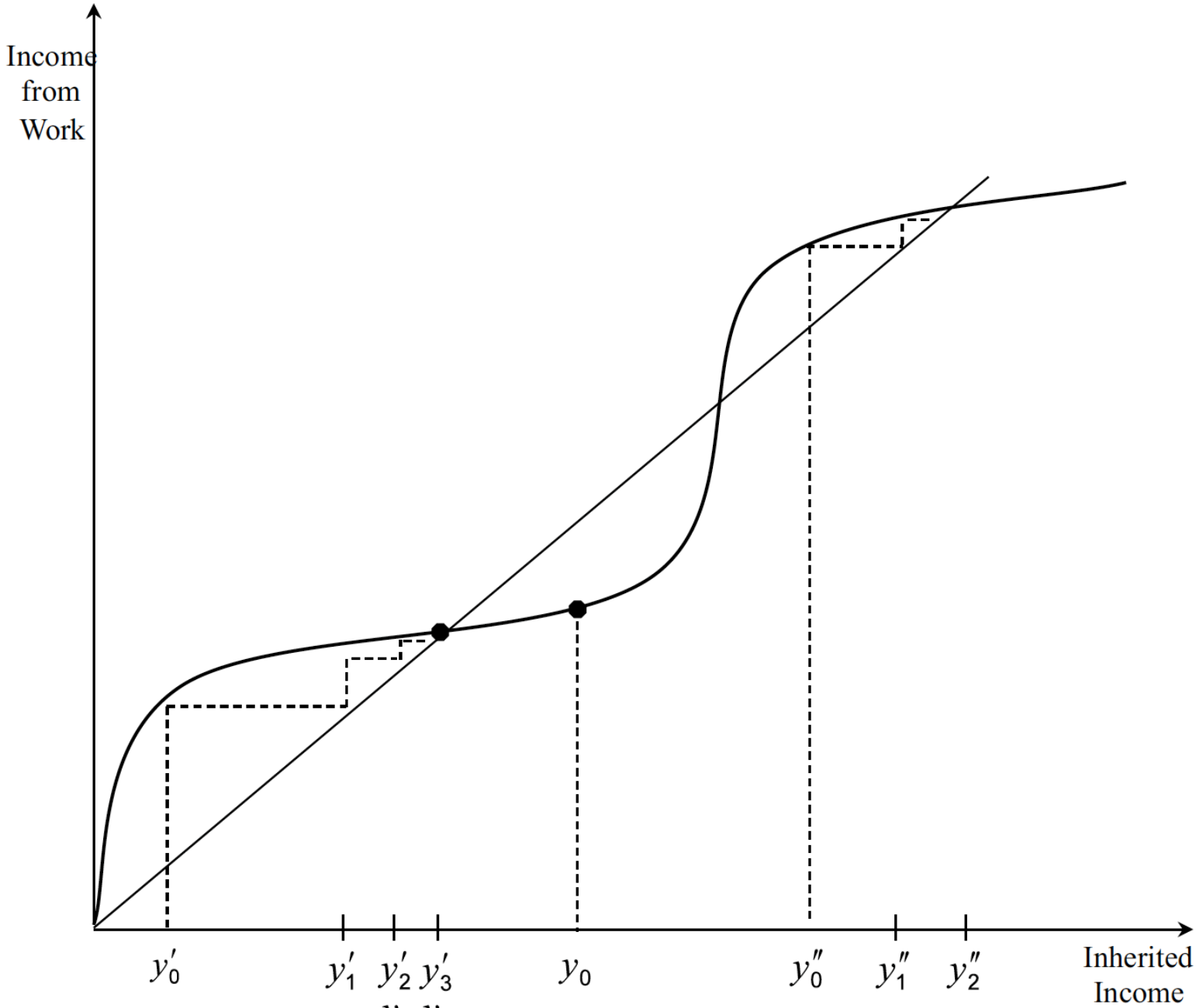


Figure 1

Situation 2



Situation 3



Conditions for a Poverty Trap

In order to have a poverty trap, there must be an unstable steady state

- the curve linking today's income to tomorrow's income must intersect the 45 degree line from below.

Motivates initial set of empirical tests for poverty trap

Conditions for a Poverty Trap

In order to have a poverty trap, there must be an unstable steady state

- the curve linking today's income to tomorrow's income must intersect the 45 degree line from below.

Motivates initial set of empirical tests for poverty trap

- Slope of the curve > 1 in the vicinity of the unstable steady state
- $f(g(y))' = f'g' > 1$

Some algebra:

$$f'g' = gf' * \frac{g'}{g} = \frac{f'}{f}g * \frac{g'}{g}y * \frac{f}{y} \tag{1}$$

Note that $\frac{f'}{f}g$ and $\frac{g'}{g}y$ are simply "elasticities". $\frac{f}{y} = 1$ at SS.
So at unstable steady state, product of following elasticities > 1

- Elasticity of income wrt nutrition > 1
- Elasticity of nutrition wrt income > 1

Evidence 1.0

Elasticity of income wrt nutrition:

- There is an effect of nutrition on productivity, and it could be quite large, elasticity near 1 possible (Schofield 2020)
- Experimental evidence with rickshaw pullers, natural experiment variation with timing of Ramadan and ag harvest

Elasticity of nutrition wrt income:

- Experimental estimates from cash transfers, Almas et al (2019) find elasticity ≈ 0.7
- However, as people become richer, they don't increase calorie consumption proportionally, could afford higher calorie intake (credit constraint not binding?)
- **Not supportive of nutrition-productivity poverty trap**

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Deeper problem with test:

- Need large elasticities in vicinity of *unstable* steady state
- But should expect minimal mass there

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Ultra-poor interventions (BRAC)

Program components try to simultaneously deal with many types of constraints:

1. Asset transfer
2. Training on asset
3. Hand-holding (repeated visits ending before 1 year)
4. Consumption support (repeated small cash transfers ending before 1 year)
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Two papers test the effects of the full, combined intervention in 7(!) different countries.

- Banerjee et al (2015, Science) - collaboration to evalaute 6 different studies.
- Bandiera et al (2017, QJE) Bangladesh: same variation used in Balboni et al (2020) follow-up paper.

What constitutes ultrapoor? (Bangladesh)

HOUSEHOLD CHARACTERISTICS AND ASSET HOLDINGS, BY WEALTH CLASS

	(1) Ultra-poor	(2) Near-poor	(3) Middle class	(4) Upper class
Household characteristics				
Share of population in this wealth class	0.061	0.219	0.585	0.135
Primary female is the sole earner	0.409	0.250	0.142	0.120
Primary female is illiterate	0.929	0.832	0.736	0.489
Consumption and assets				
Household is below the $1.25 a day poverty line	0.530	0.493	0.373	0.121
Consumption expenditure (per adult equivalent)	627.8	645.1	759.5	1,234.2
Household assets [$]	36.5	68.1	279.9	1,663.4
Household savings [$]	7.9	22.1	84.5	481.9
Household receives loans	0.191	0.393	0.498	0.433
Household gives loans	0.012	0.018	0.030	0.067
Business assets (excl. livestock and land) [$]	22.9	54.4	286.1	1,569.8
Livestock				
Household owns cows	0.055	0.154	0.469	0.733
Household owns goats	0.092	0.142	0.300	0.425

Main results: Bangladesh

Authors focus on labor supply results

TABLE III

TREATMENT EFFECTS ON THE LABOR SUPPLY AND EARNINGS OF ULTRA-POOR WOMEN

	Livestock		Agriculture		Maid		All activities	
	(1) Hours	(2) Days	(3) Hours	(4) Days	(5) Hours	(6) Days	(7) Hours	(8) Days
Panel A: Labor supply								
Program impact after 2 years	488***	205.5***	−42.3	−3.54	−57.4	−8.45	341***	72.4***
	(30.7)	(11.1)	(53.0)	(7.02)	(42.9)	(5.88)	(67.9)	(10.0)
Program impact after 4 years	415***	171.6***	−46.2	−4.77	−117**	−16.77***	206***	61.1***
	(38.9)	(10.9)	(42.7)	(5.43)	(45.0)	(5.82)	(73.0)	(12.5)
Control mean at 4-year follow-up	191.00	94.76	278.14	35.40	447.05	63.97	1,217.00	277.40
4-year impact: % change	217%	181%	−17%	−13.5%	−26%	−26%	17%	22%
2-year impact = 4-year impact [p-value]	0.111	0.023	0.930	0.831	0.125	0.125	0.080	0.179
Adjusted R-squared	0.335	0.367	0.184	0.183	0.067	0.061	0.072	0.069
Number of ultra-poor women	6,732	6,732	6,732	6,732	6,732	6,732	6,732	6,732
Number of observations	20,196	20,196	20,196	20,196	20,196	20,196	20,196	20,196
(clusters)	(40)	(40)	(40)	(40)	(40)	(40)	(40)	(40)

Main results: Science paper

	Endline 1			Endline 2		
	(1)	(2)	(3)	(4)	(5)	
Indexed outcomes	**Standardized mean treatment effect**	***q*-value for all 10 hypotheses**	***F*-test of equality of coefficients across sites, with *q*-values**	**Standardized mean treatment effect**	***q*-value for all 10 hypotheses**	**equa a**
Total per capita consumption, standardized	0.122*** (0.023)	0.001	3.207 0.009	0.120*** (0.024)	0.001	
Food security index (five components)	0.107*** (0.022)	0.001	1.670 0.139	0.113*** (0.022)	0.001	
Asset index	0.258*** (0.023)	0.001	14.26 0.001	0.249*** (0.024)	0.001	
Financial inclusion index (four components)	0.367*** (0.030)	0.001	55.33 0.001	0.212*** (0.031)	0.001	
Total time spent working, standardized	0.090*** (0.018)	0.001	7.520 0.001	0.054*** (0.018)	0.004	
Incomes and revenues index	0.383*** (0.036)	0.001	12.05 0.001	0.273*** (0.029)	0.001	

Indices measured in standard deviations

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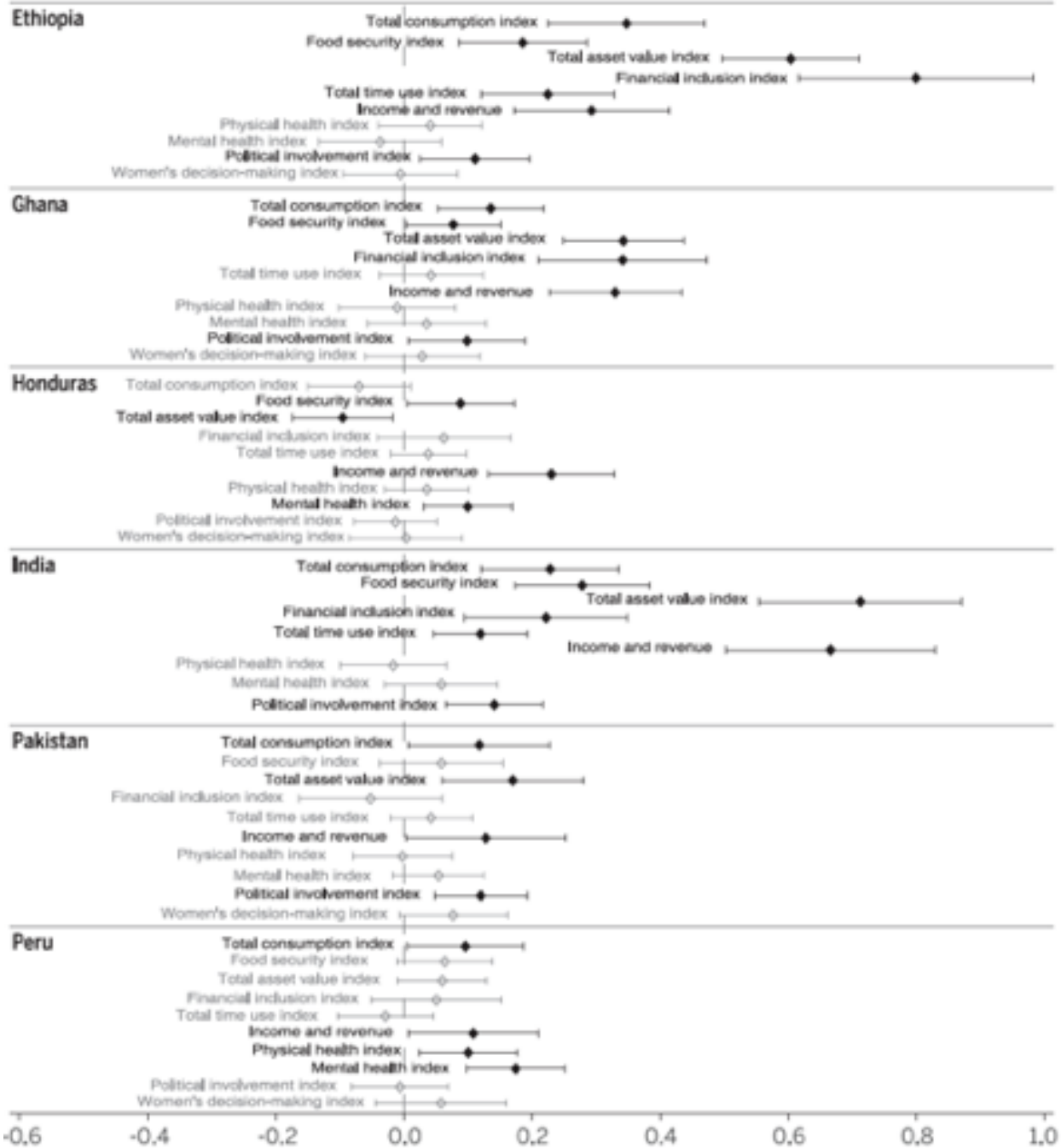
Average Intent-to-Treat Effects by Country, Endline 2 at a Glance



7-year Impacts: Bangladesh

SEVEN-YEAR TREATMENT EFFECTS ON CONSUMPTION, SAVINGS, AND ASSETS OF ULTRA-POOR HOUSEHOLDS

	(1) Household consumption expenditure	(2) Value of household assets	(3) Household cash savings	(4) Value of productive assets
Program impact after 2 years	112.2*	6.860	54.69***	606.4***
	(62.62)	(7.262)	(4.601)	(92.05)
Program impact after 4 years	358.2***	39.65***	53.22***	972.6***
	(63.54)	(9.075)	(4.007)	(158.3)
Program impact after 7 years				
adjustment for program effect on the late treated:				
1. none	281.0**	27.09*	21.43***	662.0***
	(119.6)	(13.93)	(3.935)	(214.4)
2. = median 3Y treatment effect on the early treated	327.2***	30.36**	31.84***	782.8***
	(119.5)	(13.94)	(4.054)	(214.6)
3. = 75th ptile 3Y treatment effect on the early treated	338.9***	33.52**	36.34***	830.9***
	(119.6)	(13.96)	(4.222)	(215.0)
4. = 25th ptile 3Y treatment effect on the early treated	315.5**	28.36**	27.90***	751.1***
	(119.5)	(13.93)	(3.962)	(214.5)

Scale-up had started in control villages. Several sets of assumptions to bound the effects

7-year Impacts: India

	Asset Index	Productive Asset Index	Household Asset Index	Total per capita Consumption, standardized	Food Security Index
	(1)	(2)	(3)	(4)	(5)
				Panel A: Endline 1	
Treatment	0.891***	0.881***	0.125	0.330***	0.184***
	(0.121)	(0.119)	(0.120)	(0.080)	(0.048)
Control Mean	0.18	0.15	0.34	0.00	0.35
Baseline Mean	-0.00	-0.00	0.00	-0.01	-0.00
Observations	813	813	813	813	812
				Panel B: Endline 2	
Treatment	1.004***	0.961***	0.452***	0.249***	0.251***
	(0.135)	(0.133)	(0.163)	(0.067)	(0.059)
Control Mean	0.34	0.26	0.80	-0.00	0.94
Baseline Mean	-0.00	-0.00	0.00	-0.01	-0.00
Observations	875	875	875	875	875
				Panel C: Endline 3	
Treatment	0.933***	0.827***	1.089***	0.359***	0.433***
	(0.145)	(0.134)	(0.291)	(0.066)	(0.062)
Control Mean	0.77	0.39	3.61	-0.00	1.09
Baseline Mean	-0.00	-0.00	0.00	-0.01	-0.00
Observations	870	870	870	870	870

Cost-Benefit Analysis

Bangladesh study:

- Benefit/Cost ratio 3.21
- IRR (20 years of program) 0.22

Note that the program costs are quite expensive too!

- Part of the Give Directly rationale against such interventions

Cost-Benefit Analysis: Science studies

Panel C: Benefit/cost ratios

(11)	Total benefits/total costs ratio: (8)/(2) = (11)	260%	133%	–198%	433%	179%	146%
	Increase in asset value in year 3						
(12)	(Household, productive and financial)/cost of asset transfers: [(5) + (9) + (10)]/(1) = (12)	97%	32%	8%	43%	17%	16%
(13)	Increase in asset value/transfers, 10th percentile	56%	5%	–3%	1%	2%	7%
(14)	Increase in asset value/transfers, 25th percentile	72%	12%	8%	10%	7%	8%
(15)	Increase in asset value/transfers, 50th percentile	85%	20%	15%	23%	15%	7%
(16)	Increase in asset value/transfers, 75th percentile	123%	29%	20%	58%	45%	16%
(17)	Increase in asset value/transfers, 90th percentile	175%	37%	32%	131%	52%	7%
	Sensitivity analysis						
(18)	Internal rate of return (IRR)	13.3%	6.9%	–	23.4%	9.5%	7.5%
(19)	Annual rate of dissipation of the treatment effect such that costs = benefits	10.3%	1.8%	–	31.1%	5.0%	2.6%
(20)	Benefit/cost ratio, at discount rate of 7%	182%	93%	–132%	306%	127%	102%
(21)	Benefit/cost ratio, at discount rate of 10%	124%	63%	–84%	211%	88%	69%

Is this evidence of a poverty trap

Reduced form evidence

- One-time positive shock leads to persistent improvements across the board
- Benefits outweigh the costs in both papers

Not alone sufficient for poverty trap – could just speed up growth if on a growth path. Maybe the poor households would have gotten there eventually - it just would have taken time.

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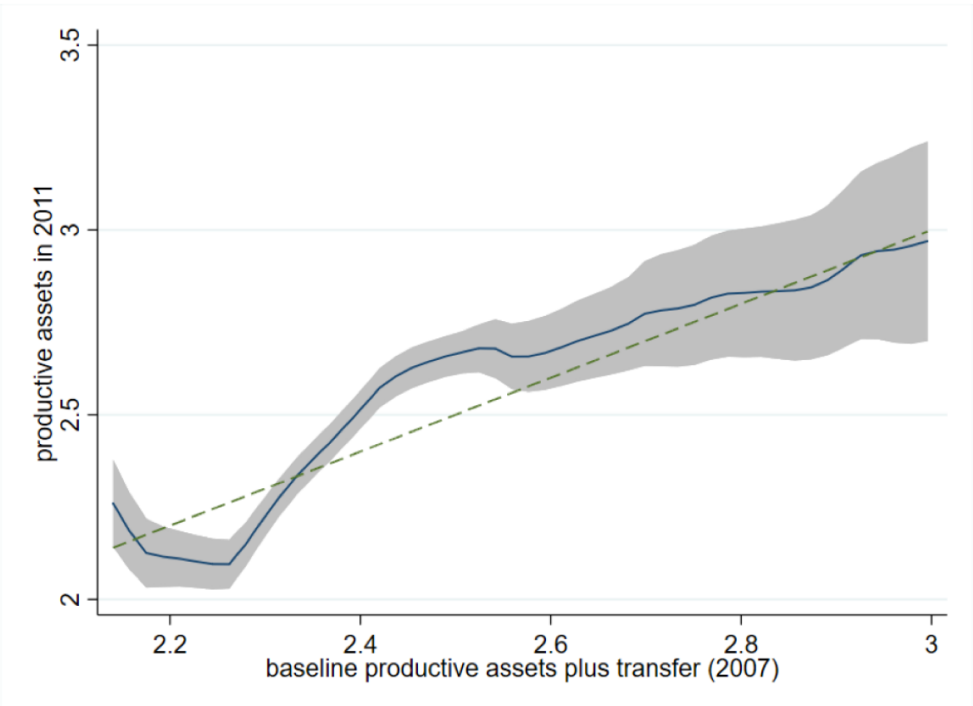
Empirical Test 2.0 (Balboni et al 2020)

The Bangladesh team with others (Balboni et al 2020) have a follow-up paper. More direct test of poverty trap dynamics:

- Suggestive evidence from transition function - S shape!

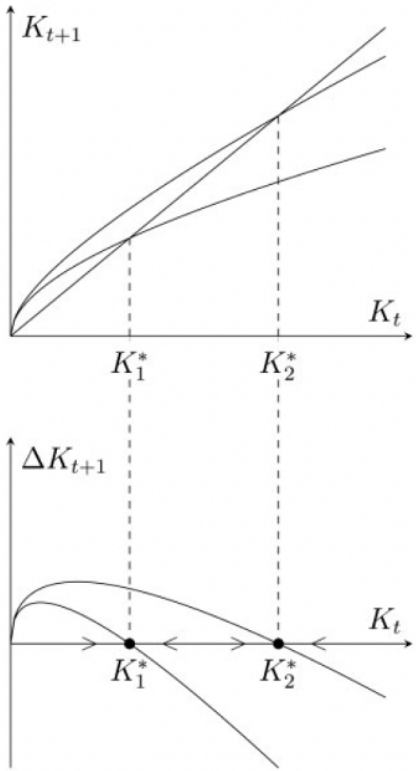
Figure 4: Local Polynomial Estimates of the Transition Equation



- Estimated only in the treatment group
- Unstable steady state $\hat{k} = 9,309$BDT ($504), transfer $488

Different F(.) Cases, No Credit

Potential non-convexity from cost of cow + productive assets (case c)



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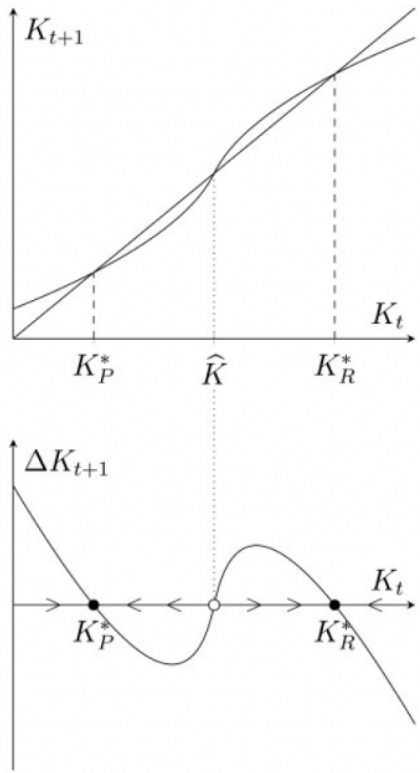

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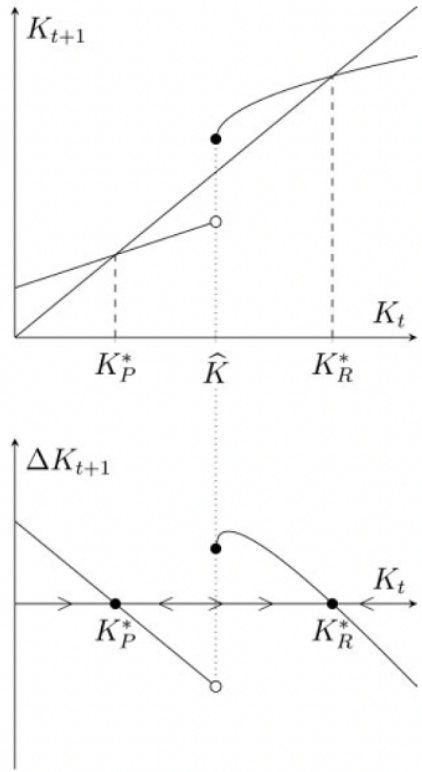

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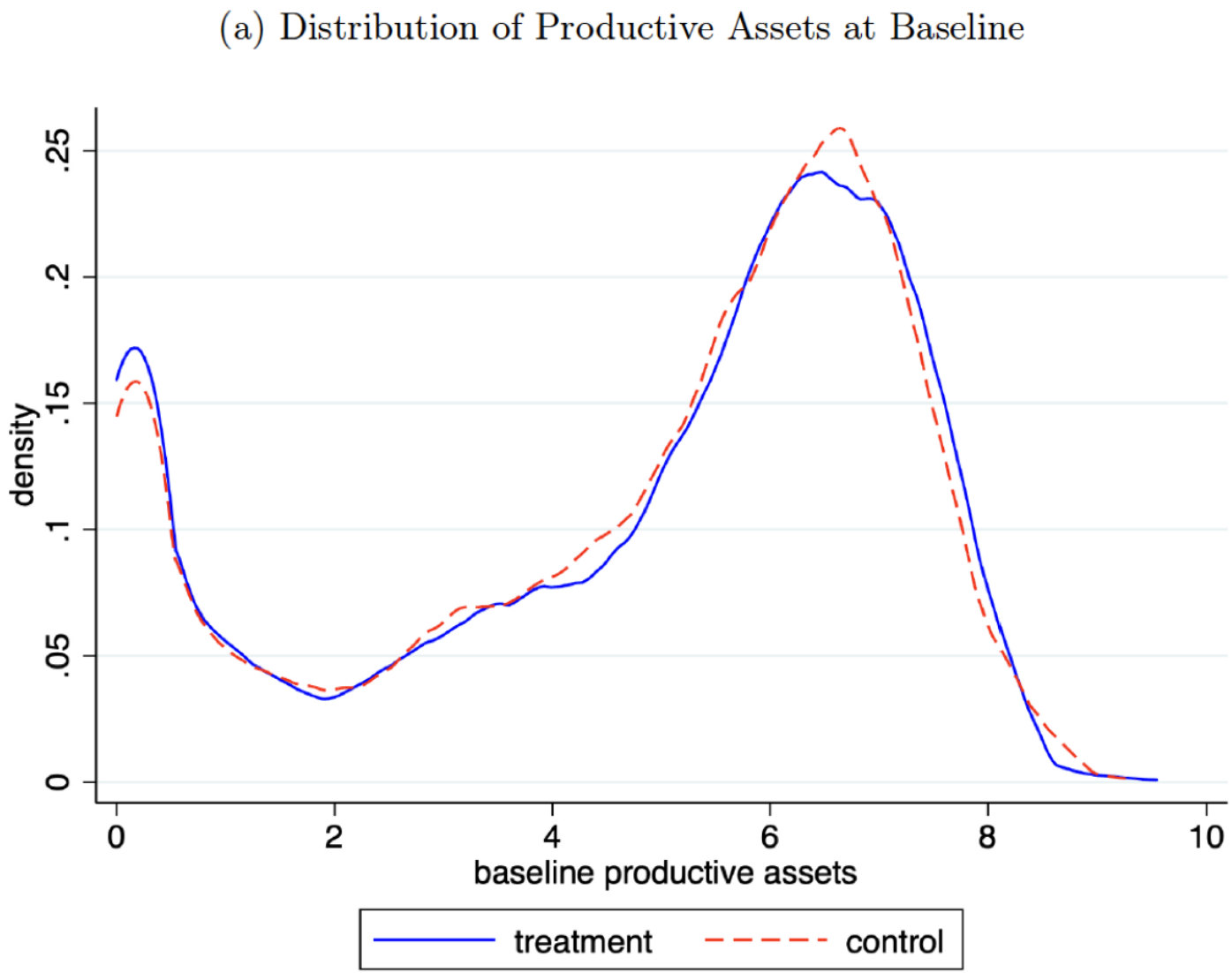
Baseline Asset Distribution



- Baseline distribution of assets
- Interpretation? Does this match the S-shape curve?

Test: Heterogeneous TEs from UIP Intervention

Prediction: poverty trap only unlocked for those with enough baseline wealth to get over the threshold (unstable SS)

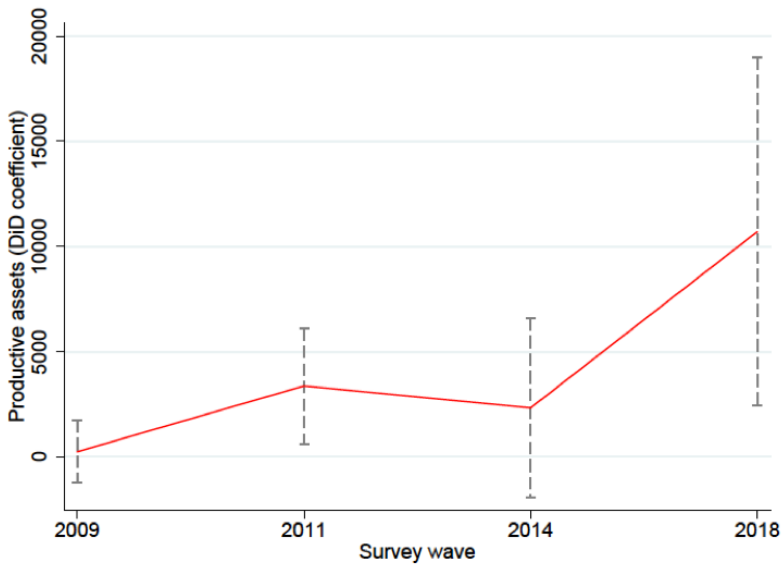
- Largest impacts for those moved just to the right of $\hat{k}$ by the treatment.
- Should expect *negative* treatment effect (net of transfer) on those who can't get to the better SS.
- These poorer recipients should consume the transfer and fall back to low SS.

Short Run Results

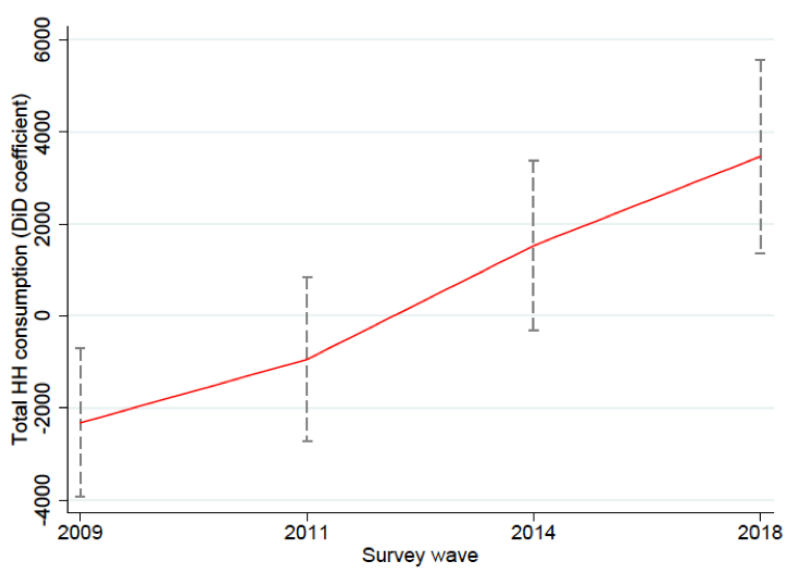
	Dependent variable: Δ_i					
	(1) Treatment	(2) Control	(3) Both	(4) Treatment	(5) Control	(6) Both
above $\hat{k}$	0.297***	-0.020	-0.020	0.475***	-0.097	-0.097
	(0.043)	(0.052)	(0.057)	(0.070)	(0.598)	(0.669)
Treatment			-0.483***			0.398
			(0.059)			(0.664)
above $\hat{k}$ × Treatment			0.318***			0.571
			(0.070)			(0.672)
Baseline assets				-2.199***	-0.463*	-0.463
				(0.698)	(0.266)	(0.298)
above $\hat{k}$ × Baseline assets				1.969***	-0.097	-0.097
				(0.729)	(0.269)	(0.301)
Treatment × Baseline assets						-1.737**
						(0.716)
above $\hat{k}$ × Treatment × Baseline assets						2.067***
						(0.744)
constant	-0.138***	0.345***	0.345***	-0.282***	-0.680	-0.680
	(0.033)	(0.046)	(0.050)	(0.057)	(0.592)	(0.662)
N	3292	2450	5742	3292	2450	5742

- Δ_i: asset diff, k_1 includes value of the transfer (treatment)
- HHs with $k_1 < \hat{k}$ spend down assets
- HHs with $k_1 > \hat{k}$ accumulate *more* assets

Diff-in-Diff Results over Time



(a) Productive Assets



(b) Total Consumption

- D-in-D regressions (T vs. C) - (Above vs. Below $\hat{k}$)
- Left Panel: Productive Assets, Right Panel: Consumption
- Heterogeneous predictions bear out in the data
- Authors conclude that a bigger transfer would have been required to release everybody from ultra-poverty.
- Show that heterogeneity in productivity can't explain results. Allow different thresholds by returns to cows / savings rates, results hold.

Understanding the poverty trap

Balboni et al (2022) present exciting evidence that some sort of asset poverty trap exists:

- Go straight to test for wealth dynamics
- Doesn't require a microfoundation per se
- Different (opposite) approach from our investigation of nutrition-based poverty trap which examines specific microfoundations.
- Strategy solves problem of unstable steady state having little mass

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But what is the mechanism? Recall treatment highly bundled:

- Is a cash transfer sufficient?
- Is an asset transfer sufficient?
- Are the impacts coming from the other parts of the intervention (training, savings etc.)?

Banerjee et al 2020 Working Paper

Ghana study authors look at the other treatment arms Ghana RCT:

> *Abstract: A multi-faceted program comprising a grant of productive assets, training, coaching, and savings has been found to build sustainable income for those in extreme poverty. We focus on two important questions: whether a mere grant of productive assets would generate similar impacts (it does not), and whether access to a savings account and a deposit collection service would generate similar impacts (it does not).*

Implications for cash transfers as "silver bullet"

Roadmap

1. Poverty Traps: Refresher
2. Ultra-Poor Interventions
3. Are the Extreme Poor in a Poverty Trap?
4. Does Microcredit Unlock a Poverty Trap?

Recall Banerjee et al (2022)

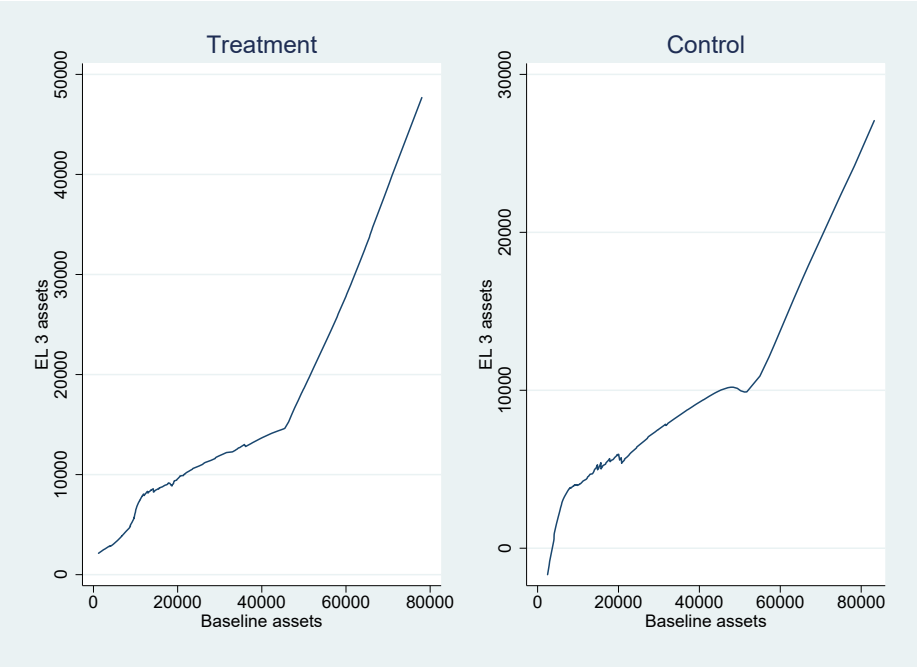
Heterogenous, persistent returns to Microcredit:

	(1) Has a business	(2) Total business assets	(3) Business profits	(4) Total wages paid	(5) Non-business durables
Panel A: Effects of credit					
Treatment	0.038*	1565.222***	576.774***	373.747***	351.696
	(0.020)	(426.789)	(179.375)	(133.018)	(239.737)
Control Mean	0.307	6680.551	2066.436	348.367	8482.853
Control Std. Dev.	0.461	20448.064	6039.441	4700.427	14264.700
Observations	5744	5744	5580	5736	5744
Panel B: Effects of credit by entrepreneurial status					
Treatment	0.024	816.198	263.906	275.264**	-175.322
	(0.018)	(526.966)	(168.567)	(118.604)	(323.643)
Treatment × GE	0.040	2325.597	1004.523**	311.864	1716.980**
	(0.028)	(1483.448)	(501.565)	(368.366)	(725.416)
Gung-ho entrepreneur (GE)	0.422***	8906.264***	3493.457***	488.639*	-513.234
	(0.020)	(973.087)	(350.655)	(266.816)	(563.800)
Treatment + Treat × GE	0.064	3141.795	1268.429	587.127	1541.658
P(Treat + Treat × GE ≠ 0)	0.008	0.011	0.004	0.093	0.007

Is this consistent with a poverty trap for GEs?

Is there a poverty trap for GEs?

Eyeball evidence for S-curve?



Use correlation between BL ('05-06) and EL ('12) assets (wealth):

- the relationship is non-linear (S-surve shape)
- min level of initial wealth associated w/ steeper portion of carve shifts left in T relative to C

3 Cases: Empirical Predictions

1. Fully convex problem (globally concave production function/policy function for asset evolution)
   - Move to optimal scale quickly, limited persistence even for GEs, no amplification over time
   - Inconsistent with data

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3. Non-convexities in production frontier, poverty trap
   - Could potentially see persistence and amplification as firms move across the steep part of the curve
   - Also consistent with data

Business assets and profits effects can't differentiate between cases 2, 3. What can?

Exposure to microfinance

	(1) Borrowed from MFI in last 3 years (EL1 1)	(2) Borrowed from MFI between 2004-10	(3) Outstanding MFI loan (EL 2)	(4) Total MFI loan amt (EL2)	(5) Informal credit (EL3)
Exposure to credit by entrepreneurial status					
Treatment	0.109***	0.036	0.003	677.234	-1683.957
	(0.021)	(0.026)	(0.021)	(508.180)	(4226.917)
Treatment × GE	-0.002	0.020	0.013	754.962	14085.007*
	(0.030)	(0.032)	(0.031)	(929.289)	(7387.176)
Gung-ho entrepreneur (GE)	0.163***	0.110***	0.093***	2557.957***	3647.067
	(0.023)	(0.022)	(0.020)	(671.712)	(5833.084)
Treatment + Treat × GE	0.107	0.057	0.016	1432.197	12401.050
P(Treat + Treat × GE ≠ 0)	0.001	0.091	0.617	0.102	0.046

Note substantial crowd-in of informal credit for GEs

- Why aren't entrepreneurs using this credit supply in control group?
- If no interest rate wedge, inconsistent with poverty trap (no binding borrowing constraint!)
- If large interest rate wedge, still consistent w/ non-convexities

Dynamic Model of Gung-Ho Entrepreneurs

Goals from estimating a model:

1. Is there evidence for production non-convexities?
2. Does the model at *estimated parameters* have a poverty trap?
3. What mass of people does MF move out of low steady state?

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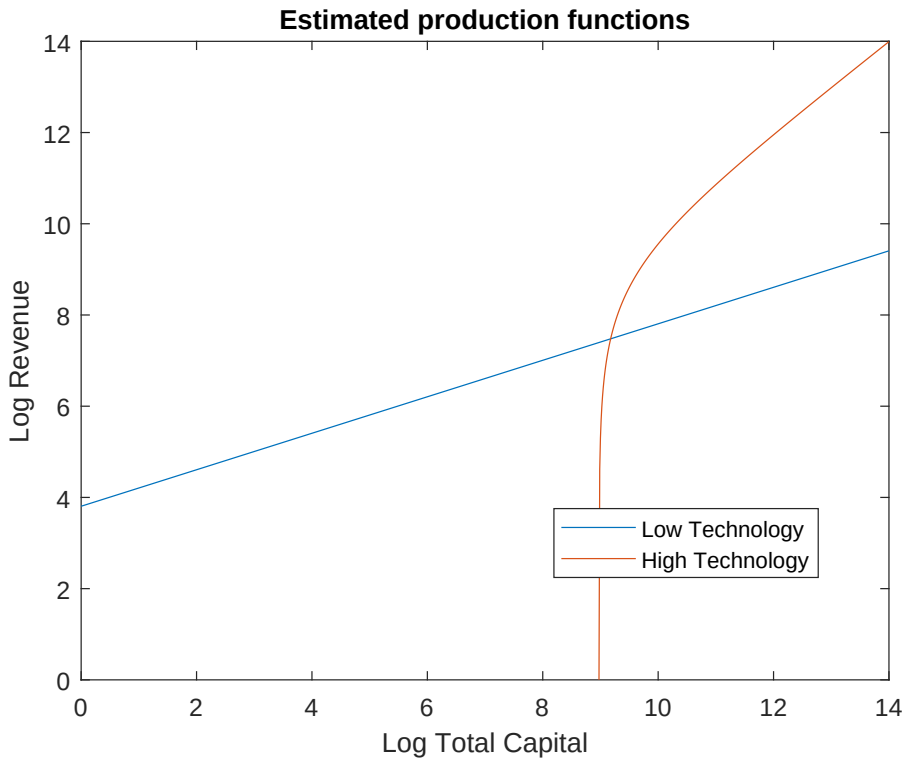
Step 1: Production Function Estimation



Technologies:

$$Y_L(K) = A_L K^{\alpha}$$
$$Y_H(K) = A_H(K - \underline{K})$$

Estimated parameters:

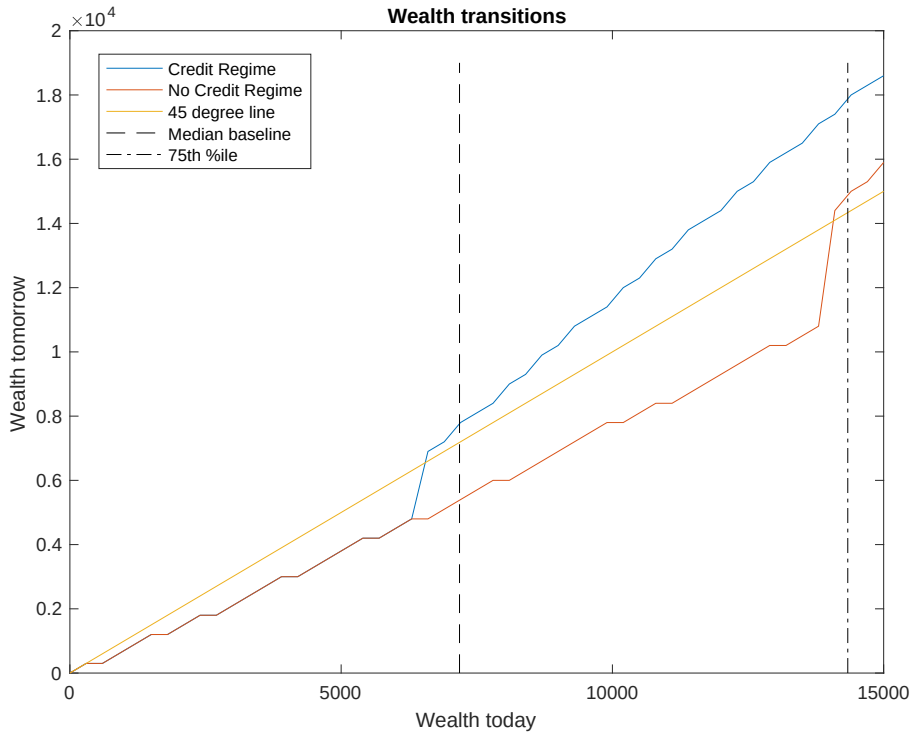
$$A_L = 45$$
$$\alpha = 0.4$$
$$A_H \equiv 1$$
$$\underline{K} = 7900$$

Revenues cross at $K = 9414$.

- Profitable to switch at $K = 13500$ if opportunity cost is saving
- Switch at 18,500 if borrowing

Step 2: Wealth Policy Function

Next, solve the dynamic program given production parameters.



Estimated production function parameters consistent with a poverty trap!

- Wealth policy function S-shaped, crosses 45^o line from below

73% of treatment effect is from unlocking poverty trap, 27% from allowing businesses on growth path to keep expanding