Development Economics

Separation Failures

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AEA Continuing Education

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Roadmap

1. Canonical Benjamin (1992) Model
2. Empirical Tests 1
3. Empirical Tests 2
4. Land Markets

Frictionless Benchmark

Benjamin (1992) begins with a well-known frictionless benchmark

- Static model
- Households earn income in two ways
  - Running a business with production function $F(L^D)$
  - Working for a wage w (L^S on-farm or L^O off-farm)
- Households can hire labor for their businesses at wage w
- Households are endowed with T units of total time which can be used for labor (on farm or off farm) or leisure

Households maximize:

$$\max_{(c,l,L^S,L^D,L^I,L^O)} u(c,l) \tag{1}$$

s.t.

$$T \geq L^S + l \tag{2}$$

$$c \leq wL^S + [F(L^D) - wL^D] \tag{3}$$

$$L^S = L^I + L^O \tag{4}$$

Optimization Problem

WLOG, HHs work on own farm first ($L^D - L^I = 0$ or $L^O = 0$). Constraints (2), (3) binding. Hired labor earns same wage as family labor

Optimization problem simplifies to:

$$\max_{(c,l,L^D)} u(c,l) \tag{5}$$

s.t.

$$c = w(T - l) + [F(L^D) - wL^D] \tag{6}$$

After taking FOCs and rearranging terms:

$$F'(L^D) = w \tag{7}$$

$$\frac{u_2(c,l)}{u_1(c,l)} = w \tag{8}$$

plus the budget constraint (5)

Separation Result

This captures the standard "separation result"

- HHs maximize business profits, *independently* of household characteristics or preferences (Eq. 6)
- Business decisions only enter the household labor-leisure decision through the budget constraint (Eq. 7, 5)
- $\Longrightarrow$ Utility maximization is *separable* from profit maximization

Benjamin: Separation Result

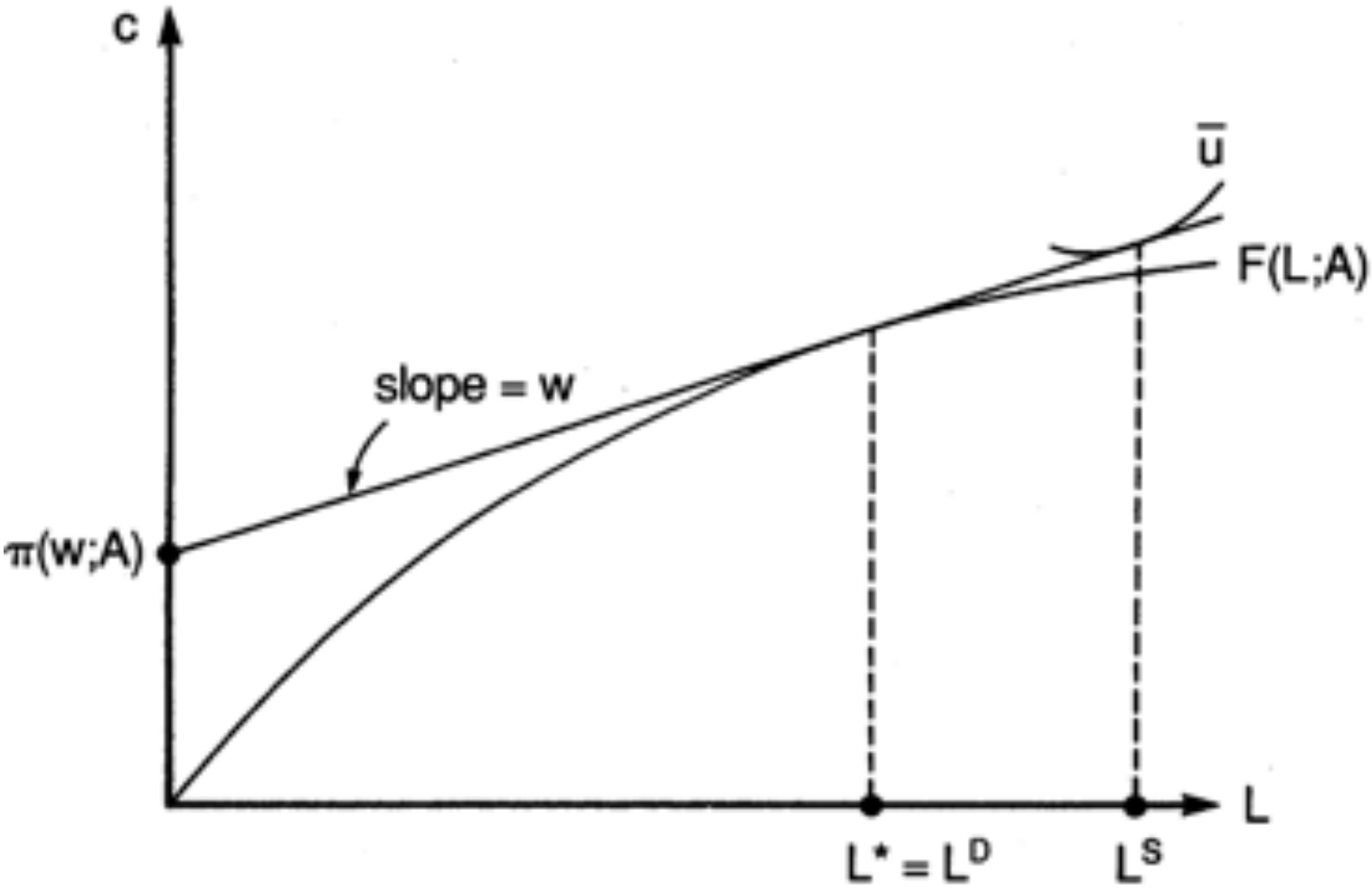


FIGURE 1.—Separation.

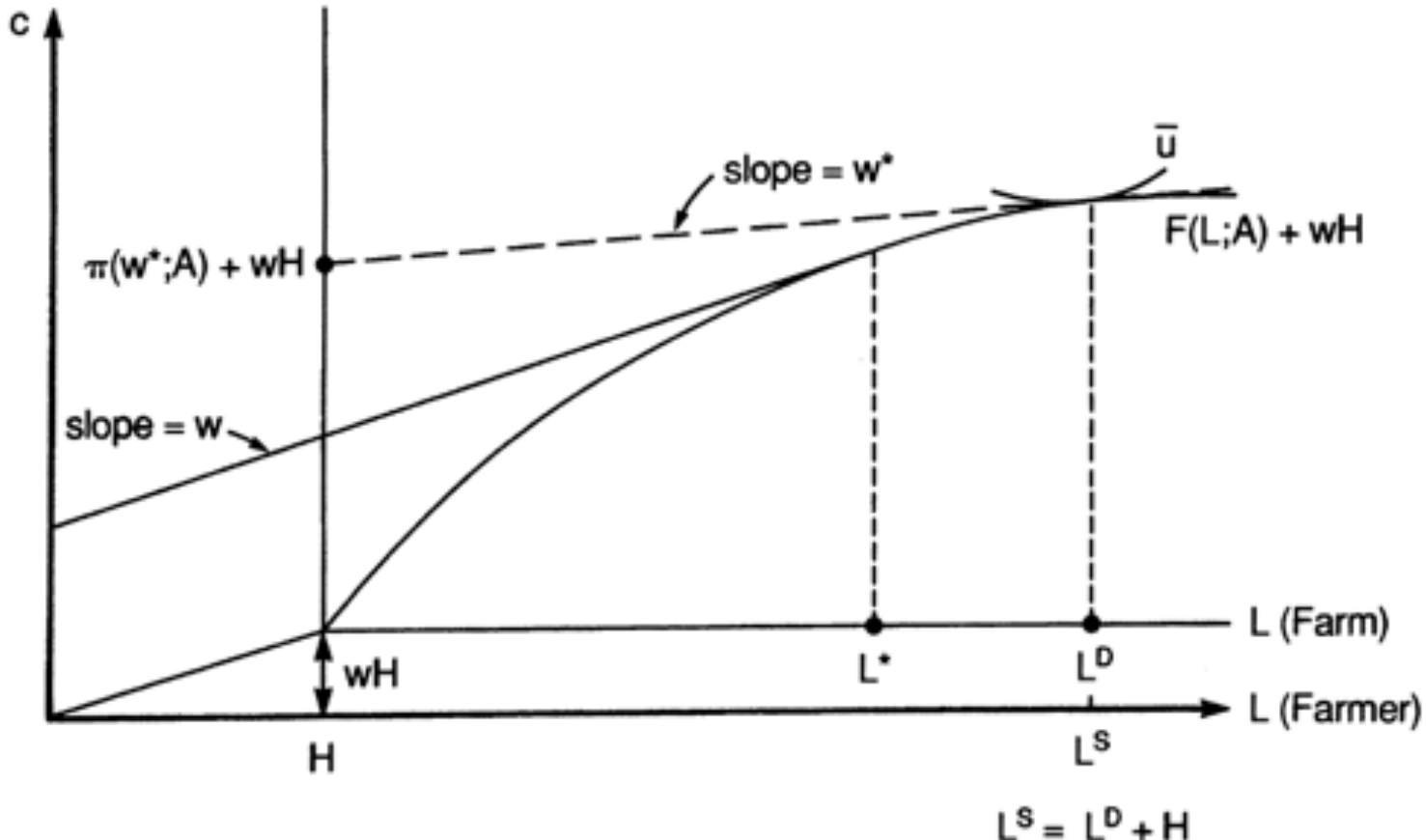
Benjamin: Separation Failures

Benjamin (1992) considers several cases where separation wouldn't hold:

1. Excess labor supply (labor rationing) in the "lean" season
   - Wage doesn't clear the market
2. Excess labor demand (labor shortages) in the "peak" season
   - Wage doesn't clear the market
3. Inside vs. outside wages, more generally

Benjamin: Separation Failure 1 (Excess Supply)

- Maximum hours H that HH members may work off farm
- Ration binds when $(T - l^{eq}) > L^{Deq} + H$
- Business expands to absorb some extra labor supply, shadow wage $w^* < w$



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LaFave and Thomas (2016)

Updates original Benjamin (1992) test with better panel data from Indonesia:

- Much better data! Larger sample (≈4,000 HHs), 11 waves
  - Can introduce farm fixed effects
  - Have power to identify off of changes in age profile of HH
- What to do about wages as a determinant of labor supply in the regression?
  - Can use community x time FEs (also picks up other input and output prices)

Regression specification

$$\ln L_{hjt} = \alpha + \beta N_{hjt} + \delta X_{hjt} + \eta_h + \eta_{jt} + \varepsilon_{hjt} \tag{9}$$

- L_{hjt} tot person days used on the farm in period t
- N_{hjt} household demographics. ($H_0 : \beta = 0$)
- X_{hjt} other farm and household characteristics
- η_h farm fixed effects
- η_{jt} community x time FEs

LaFave and Thomas (2016)

TABLE II

LABOR DEMAND (LOG OF PERSON DAYS PER SEASON) AND HOUSEHOLD COMPOSITION[a]

	A. Pooled Cross-Sections		B. Including Farm Household Fixed Effects					C. Labor Demand by Farm Task		
Household Demographic Composition	N. Household Members (1)	Household Size and Shares (2)	N. Household Members (3)	Variation From Aging Only (4)	Prior Composition (5)	Next Period Composition (6)	1, 2, and 3 Period Lagged Composition as IVs (7)	Land Prep Livestock Dry/Sell/Mill (8)	Weeding Planting Fertilizing (9)	Harvesting (10)
Number of males in farm HH										
0 to 14 years	0.02	–	−0.001	–	−0.03	0.03	0.01	−0.01	−0.01	−0.03
	(0.01)		(0.016)		(0.02)	(0.02)	(0.04)	(0.03)	(0.02)	(0.03)
15 to 19	0.11	0.40	0.09	0.09	0.05	0.07	0.09	0.16	0.07	0.06
	(0.02)	(0.08)	(0.02)	(0.05)	(0.02)	(0.02)	(0.04)	(0.03)	(0.02)	(0.03)
20 to 34	0.17	0.59	0.13	0.15	0.09	0.05	0.21	0.14	0.09	0.12
	(0.01)	(0.07)	(0.02)	(0.11)	(0.02)	(0.02)	(0.05)	(0.03)	(0.02)	(0.03)
35 to 49	0.23	0.65	0.16	0.15	0.09	0.01	0.20	0.17	0.12	0.19
	(0.02)	(0.09)	(0.03)	(0.12)	(0.03)	(0.03)	(0.08)	(0.05)	(0.03)	(0.04)
50 to 64	0.32	0.76	0.22	0.24	0.08	0.08	0.22	0.22	0.16	0.24
	(0.03)	(0.09)	(0.03)	(0.12)	(0.04)	(0.03)	(0.10)	(0.06)	(0.04)	(0.05)
65 and older	0.21	0.45	0.20	0.24	0.06	0.08	0.20	0.17	0.14	0.19
	(0.03)	(0.10)	(0.04)	(0.14)	(0.04)	(0.03)	(0.11)	(0.06)	(0.04)	(0.05)

(*Continues*)

LaFave and Thomas (2016)

TABLE II—*Continued*

Household Demographic Composition	A. Pooled Cross-Sections		B. Including Farm Household Fixed Effects					C. Labor Demand by Farm Task		
	N. Household Members (1)	Household Size and Shares (2)	N. Household Members (3)	Variation From Aging Only (4)	Prior Composition (5)	Next Period Composition (6)	1, 2, and 3 Period Lagged Composition as IVs (7)	Land Prep Livestock Dry/Sell/Mill (8)	Weeding Planting Fertilizing (9)	Harvesting (10)
Number of females in farm HH										
0 to 14 years	−0.02	−0.15	−0.04	–	−0.02	0.003	−0.02	−0.03	−0.05	−0.03
	(0.01)	(0.07)	(0.02)		(0.02)	(0.017)	(0.05)	(0.03)	(0.02)	(0.03)
15 to 19	0.02	0.10	−0.01	0.02	−0.002	−0.001	−0.01	0.01	−0.02	−0.02
	(0.02)	(0.08)	(0.02)	(0.05)	(0.018)	(0.018)	(0.04)	(0.03)	(0.02)	(0.03)
20 to 34	0.04	0.12	0.06	0.23	0.05	0.01	0.04	0.05	0.06	0.07
	(0.02)	(0.09)	(0.02)	(0.10)	(0.02)	(0.02)	(0.05)	(0.03)	(0.02)	(0.03)
35 to 49	0.09	0.30	0.16	0.33	0.12	0.04	0.23	0.07	0.13	0.11
	(0.02)	(0.09)	(0.03)	(0.11)	(0.03)	(0.03)	(0.08)	(0.05)	(0.03)	(0.04)
50 to 64	0.10	0.27	0.13	0.35	0.08	0.06	0.18	0.04	0.13	0.11
	(0.02)	(0.09)	(0.03)	(0.12)	(0.03)	(0.03)	(0.09)	(0.05)	(0.04)	(0.05)
65 and older	−0.05	−0.10	0.05	0.26	0.03	−0.01	0.05	−0.05	0.06	0.07
	(0.02)	(0.09)	(0.03)	(0.13)	(0.03)	(0.03)	(0.09)	(0.05)	(0.03)	(0.05)
Log household size		0.34								
		(0.03)								

(*Continues*)

LaFave and Thomas (2016)

TABLE II—*Continued*

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Household Demographic Composition	N. Household Members (1)	Household Size and Shares (2)	N. Household Members (3)	Variation From Aging Only (4)	Prior Composition (5)	Next Period Composition (6)	1, 2, and 3 Period Lagged Composition as IVs (7)	Land Prep Livestock Dry/Sell/Mill (8)	Weeding Planting Fertilizing (9)	Harvesting (10)
Tests for joint significance of demographic composition										
All groups	37.27	33.65	13.13	2.53	5.01	4.21	2.99	6.19	5.40	4.89
p-value	0.00	0.00	0.00	0.005	0.00	0.00	0.00	0.00	0.00	0.00
Males	49.88	21.67	18.27	1.90	6.08	5.79	3.62	9.71	6.80	6.63
p-value	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00
Females	10.58	10.99	7.70	2.78	3.45	1.95	1.86	1.31	3.84	1.82
p-value	0.00	0.00	0.00	0.02	0.00	0.07	0.08	0.25	0.00	0.09
Prime age adults	45.13	14.55	22.52	2.18	8.88	4.86	5.51	10.02	9.71	7.85
p-value	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00
C-test—1 and 2 period lags (χ^2)							15.19			
p-value							0.92			
Observations	38,189	38,189	38,189	11,594	33,737	33,737	25,739	27,387	33,166	24,353
N. Households	4,452	4,452	4,452	1,584	4,096	4,096	3,783	4,176	4,166	4,022

- Sound rejection of separation in every test $\beta > 0$
- No evidence for monitoring micro-foundation:
  - Hypothesis: HH members easier to monitor, more valuable
  - But, similar effects for harvest (easy to monitor) and other operations

Incomplete Markets

The Benjamin (1992) example of separation failures hinges on frictions in the labor market.

However, if only the labor market were incomplete, separation could still be restored:

- Through land markets!
- Redistribute land (through rental or sales) to larger HHs, equalize shadow wages across farms

Separation failures typically require incompleteness in *more than one market*

- LaFave and Thomas fail to reject separation for the richest households. Hard to know why – but perhaps other markets (e.g., credit, insurance) look more complete for them

So What?

Opens up lots of interesting research questions

LaFave and Thomas (2016) write:

> *Developing empirically tractable models of farm households when markets are incomplete remains an important challenge.*

- Need better applied theory, dynamic models

They also write:

> *It is not possible with a portmanteau test for complete markets to identify the sources of market failure*

- Diagnosing specific market failures is especially hard given that one market might substitute for another.
- Aggregating up the effects of non-separation? Implications for factor mis-allocation?

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Other microfoundations: Incompleteness in insurance markets?

Suppose that:

- Production is risky, θ =mean 1 tfp shock: $y = \theta F(L)$
- Households are risk averse, u' convex
- Incomplete insurance market (non-existant)
- Incomplete credit market (non-existant)
- Households inelastically supply labor endowment E to the market for wage w
- Labor market resolves before θ known

Can this generate a separation failure?

Separation failures and Insurance markets?

Household solves

$$\max_{L \geq 0} E_\theta[u(c)] \tag{10}$$

s.t.

$$c = wE + \theta F(L) - wL \tag{11}$$

FOC:

$$E[u'(c)(\theta F'(L) - w)] = 0 \tag{12}$$

Separation fails! L will be a function of preferences (risk aversion)

- Can show that failure of insurance market generates underinvestment in labor relative to complete markets setting

Inefficient Technology Adoption?

Land and labor or capital market frictions in tandem may lead to inefficient allocations of land and labor (as in Benjamin '92)

- Efficient households / separation holds $\implies$ optimal decisions *on every plot*, AND productive decisions uncorrelated across plots, conditional on productivity.
- Separation failures may induce within-household dependencies across plots
- May further lead to distortions in technology adoption

Jones et al (2022) explore the case of the adoption of irrigation, typically for cash crops, in Rwanda

Context

2 agricultural seasons: rainy and dry

- Rainy season: can produce staple crops – maize and beans – irrigation not very useful
- Dry season: too short for staple crop cycle, can produce horticulture (eggplant, tomatoes,...) only with irrigation
- Alternative: year-round perennial banana plants, activity does not require irrigation

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Rwandan government implemented irrigation projects to increase agricultural productivity

- Channels cut on hillside from water source
- Command Area (CA): any plots down-hill from the channel
- Irrigation requires water pressure, so any plots above the channel can't benefit
- $\approx 30\%$ adoption of irrigation in CA
- Authors try to understand if this is too low

Irrigation project

Part 1: Impact Evaluation

Paper proceeds in 3 parts. Part 1: what is the impact of irrigation on inputs, yields and profits?

- Regression Discontinuity above and below channel
- Idea: placement of channel determined by engineering specs, so as good as random. Survey just above and just below.

Basic RD:

$$y_{ist}^{SP} = \beta_1 CA_{is}^{SP} + \beta_2 Dist_{is}^{SP} + \beta_3 Dist_{is}^{SP} * CA_{is}^{SP} + \alpha_{st} + \gamma X_{is}^{SP} + \varepsilon_{1ist}^{SP}$$

- 1 indicates RD sample plot, s site (of 3), t season, i household

Also use alternate specification with spatial fixed effects

RD Results: Dry Season

AND SALES; PROFITABILITY DEPENDS ON HOUSEHOLD'S SHADOW WAGE

	Cultivated (1)	Irrigated (2)	Horticulture (3)	Banana (4)	HH labor/ha (5)	Input exp./ha (6)	Hired labor exp./ha (7)	Yield (8)	Sales/ha (9)	Profits/ha Shadow wage = 0 (10)	Profits/ha Shadow wage = 800 (11)
Panel A. Dry season (SP, dry season, discontinuity sample)											
RDD (site-by-season fixed effects, specification (1))											
SP CA	0.004	0.163	0.137	−0.138	71.6	6.1	3.2	64.8	50.2	56.3	2.2
	(0.041)	(0.024)	(0.024)	(0.037)	(18.2)	(1.5)	(1.9)	(23.0)	(14.3)	(20.9)	(16.5)
	[0.917]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.100]	[0.005]	[0.000]	[0.007]	[0.893]
SFE (spatial fixed effects, specification (2))											
SP CA	0.028	0.177	0.158	−0.144	79.2	4.6	2.5	48.1	42.8	42.4	−8.5
	(0.043)	(0.030)	(0.028)	(0.034)	(21.2)	(1.8)	(2.4)	(26.9)	(17.4)	(24.4)	(20.2)
	[0.516]	[0.000]	[0.000]	[0.000]	[0.000]	[0.012]	[0.285]	[0.074]	[0.014]	[0.082]	[0.676]
Observations	2,439	2,439	2,438	2,438	2,428	2,431	2,431	2,307	2,431	2,307	2,305
Clusters	173	173	173	173	173	173	173	173	173	173	173
Control mean	0.383	0.051	0.058	0.244	60.1	2.4	3.1	80.5	47.3	75.2	31.6

- Substantial increase in irrigation, though far from universal
- Increase in horticulture, decrease in banana
- Increase in HH and hired labor (mainly for irrigation, upkeep)
- Increase in yields and sales

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Control mean	0.383	0.051	0.058	0.244	60.1	2.4	3.1	80.5	47.3	75.2	31.6

- Under separation failures, difficult to calculate HH biz profits.
  - What is relevant wage for HH labor?
- Often, profits negative if HH labor valued at market wage
  - Recall, in excess labor supply example of Benjamin (1992), shadow wage of HH labor *lower* than market wage
  - Access to irrigation causes an increase in cash profits, no (or -) increase if market wage assumed for HH labor

Part 2: Cross-Plot Spillovers

Efficient HHs / separation $\Longrightarrow$ optimal decisions *on each plot*

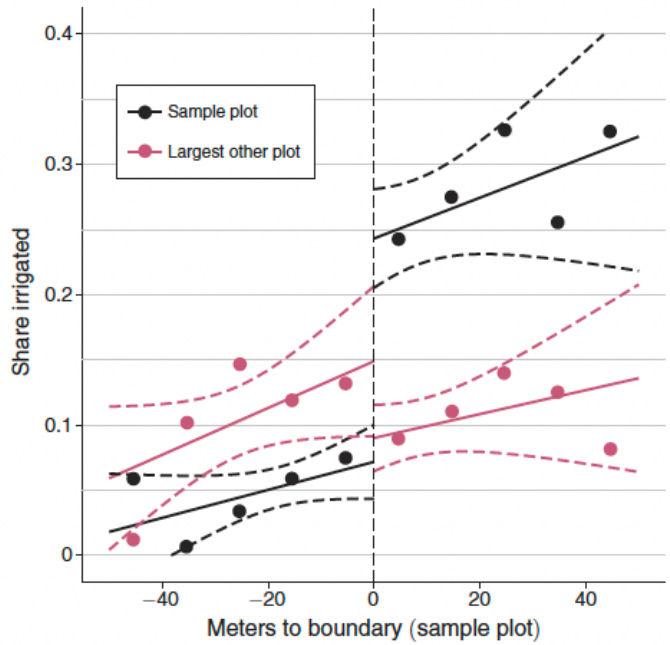

FIGURE 4. SEPARATION FAILS, AS ACCESS TO IRRIGATION ON THE SAMPLE PLOT CAUSES SUBSTITUTION OF IRRIGATION USE AWAY FROM THE LARGEST OTHER PLOT

- Black: RD sample; Pink: largest other plot (LOP) for HHs in discontinuity sample
- Substantial substitution across plots $\Longrightarrow$ inefficiency

Part 3: Cause of Separation Failure?

- Results consistent with separation failure. HH labor pulled off of largest other plot and diverted to sample plot.
  - Inefficiencies in land markets. Reallocation could increase adoption/yields.
  - Back of the envelope exercise shows that having only 1 plot in the CA (rather than 2) would increase adoption by 5.5pp

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- Results consistent with separation failure. HH labor pulled off of largest other plot and diverted to sample plot.
  - Inefficiencies in land markets. Reallocation could increase adoption/yields.
  - Back of the envelope exercise shows that having only 1 plot in the CA (rather than 2) would increase adoption by 5.5pp
- However, for separation failure, a second market also needs to fail. 3 possibilities:
  - Incompleteness in insurance market: irrigated crops may be riskier
  - Incompleteness in input markets: (e.g., access to credit for input purchases)
  - Incompleteness in labor market: excess labor supply

Part 3: Cause of Separation Failure?

- Idea: Different market failures have different profile of heterogeneous treatment effects with wealth and HH labor endowment on *LOP*
  - Incompleteness in insurance market, credit market or other input market
    - Wealthier households should be less responsive
    - Larger households should be less responsive (larger incomes)
  - Incompleteness in labor market: excess labor supply
    - Relationship with wealth unsigned. If poor households have more elastic on-farm labor supply, poorer households should look less responsive
    - Larger households should look less responsive (also assuming larger households are more elastic)

Part 3: Cause of Separation Failure

	LOP, dry season, discontinuity sample						
	Cultivated (1)	Irrigated (2)	Horticulture (3)	Banana (4)	HH labor/ha (5)	Input exp./ha (6)	Hired labor exp./ha (7)
SFE (spatial FE, specification (5))							
SP CA	−0.183	−0.117	−0.130	−0.058	−83.6	−9.3	−4.8
	(0.099)	(0.051)	(0.046)	(0.084)	(39.9)	(4.2)	(3.2)
	[0.065]	[0.021]	[0.005]	[0.489]	[0.036]	[0.026]	[0.138]
SP CA × No. of HH members	0.038	0.016	0.018	0.025	10.0	0.6	0.9
	(0.015)	(0.008)	(0.008)	(0.015)	(4.7)	(0.5)	(0.4)
	[0.010]	[0.049]	[0.016]	[0.088]	[0.032]	[0.269]	[0.019]
SP CA × asset index	−0.038	−0.037	−0.030	−0.009	−22.6	−4.0	−0.5
	(0.032)	(0.018)	(0.020)	(0.027)	(12.3)	(1.6)	(1.4)
	[0.232]	[0.044]	[0.139]	[0.737]	[0.067]	[0.016]	[0.734]
Joint F-stat $[p]$	3.0	2.4	2.7	2.3	2.0	2.5	2.0
	[0.031]	[0.069]	[0.045]	[0.072]	[0.110]	[0.055]	[0.115]
Average effect	0.002	−0.041	−0.042	0.067	−36.2	−6.6	−0.1
Observations	2,104	2,104	2,104	2,104	2,091	2,094	2,094
Clusters	165	165	165	165	165	165	165
Control mean	0.368	0.114	0.107	0.201	68.1	5.4	3.7

- Positive relationship with household labor endowment
- Negative relationship with household wealth

"Strong evidence for the existence of labor market failures that generate separation failures, which in turn cause inefficient adoption of irrigation"

Take-aways

- Jones et al (2022) show quasi-experimental evidence consistent with separation failures
- Positive technology shock on one plot draws resources away from others
- So having 2 suitable plots for adoption leads to less per-plot adoption than having only 1 suitable plot
- $\Longrightarrow$ Market failures can lead on net to under-adoption of new, otherwise profitable technologies
    - More adoption makes original investment more justifiable, sustainable

Rationing project: evidence consistent with separation

Table 8—: Self-Employment

	(1) Self empl.	(2) Self: non-agri	(3) Self: agri	(4) Self: agri
Hiring shock	-0.0336	-0.0333	-0.0300	-0.0715
	(0.019)	(0.011)	(0.023)	(0.028)
Hiring shock * Above Median Land Per Capita				0.0689
				(0.049)
Hiring shock * Semi-peak	0.00289	-0.00337	0.0207	0.118
	(0.027)	(0.019)	(0.027)	(0.036)
Hiring shock * Semi-peak * Above Median Land Per Capita				-0.182
				(0.059)
Sample	Spillover	Spillover	Spillover	Spillover
Baseline controls	Yes	Yes	Yes	Yes
Pval: Shock + Shock*Semi-peak	0.118	0.0213	0.548	0.0537
SE: Shock + Shock*Semi-peak	0.0193	0.0151	0.0154	0.0237
Control mean: lean	0.139	0.0443	0.149	0.149
Control mean: semi-peak	0.109	0.0441	0.0823	0.0823

- Recall: hiring shock in lean season reduces self-employment
- Non-separation might be relevant for households with low land / HH size
- Indeed, reduction in self-employment larger for those HHs

Roadmap

1. Canonical Benjamin (1992) Model
2. Empirical Tests 1
3. Empirical Tests 2
4. Land Markets

Burchardi et al 2018: Tenancy contracts

Burchardi et al 2018 "Moral Hazard: Experimental Evidence from Tenancy Contracts"

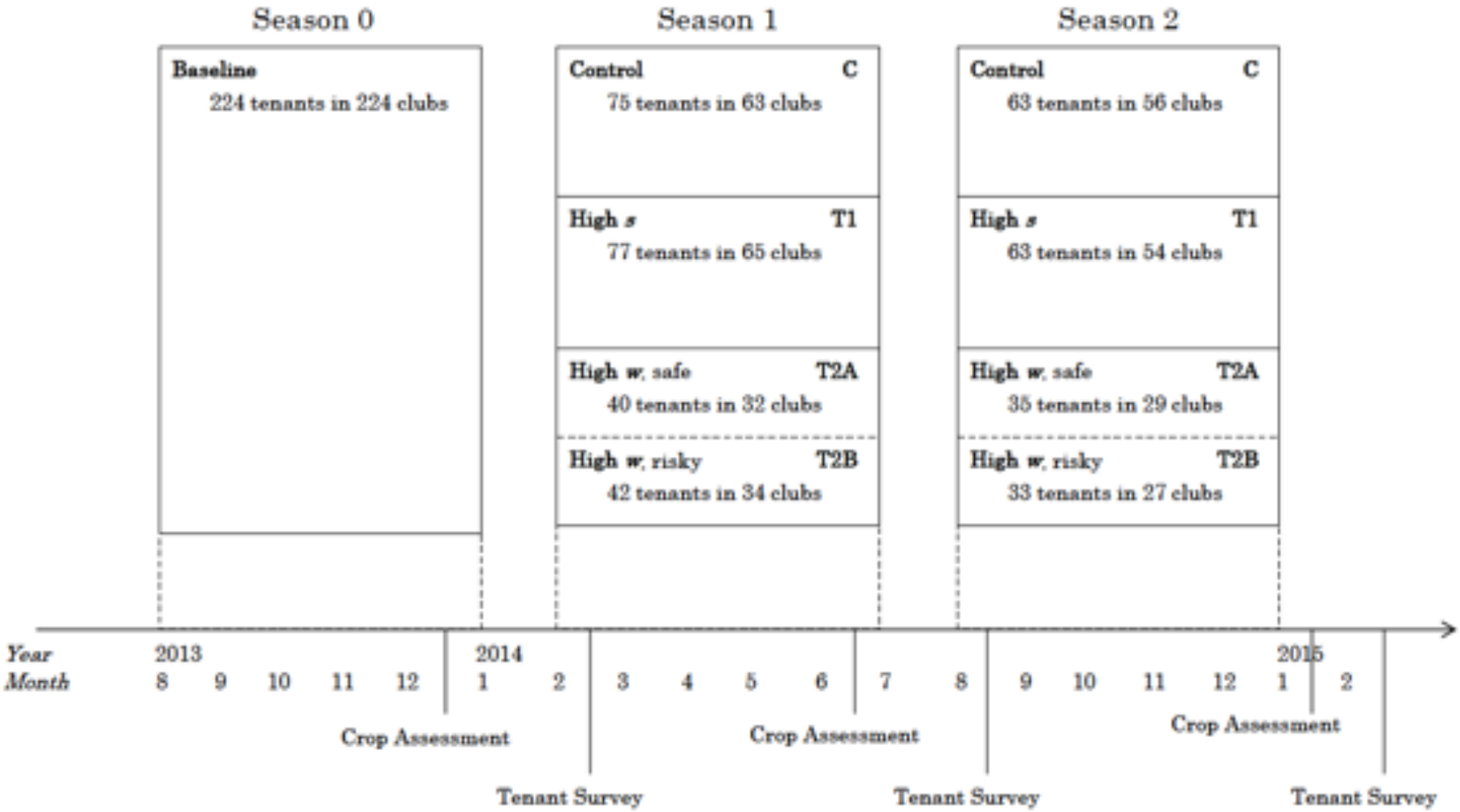
- Interested in the causal impact of the tenancy contract terms on effort in rural Uganda
- What is the impact of randomly changing share tenant receives from 50% to 75%?

Potential effects:

- Incentive effect: more "skin in the game"
- Wealth effect
- Risk quantity effect

Treatments aim to separate these effects

Burchardi et al 2018: Treatments



Burchardi et al 2018: Inputs and Output

	Capital (1)	Labor hours (2)	Land size (3)	Output (4)
Panel A:		*In Levels*		
High s (T1)	12.43**	72.94*	71.37	56.28***
	(5.07)	(38.34)	(59.95)	(18.52)
	[0.027]	[0.086]	[0.277]	[0.004]
High w (T2)	2.10	14.91	31.17	5.36
	(4.28)	(34.32)	(57.09)	(17.17)
	[0.661]	[0.686]	[0.639]	[0.765]
H_0: T1 = T2	0.045	0.167	0.481	0.023
Mean Outcome (C)	39.90	338.68	607.13	95.13
Observations	432	417	473	473

Increasing the share increases output by 60%!

Burchardi et al 2018: Other HH Outcomes

	Labor income (1)	Consumpt. (2)	Cash savings (3)	Household income (4)	Household assets (5)
High s (T1)	4.07	4.43	56.83	33.04*	656.54*
	(7.33)	(9.60)	(35.39)	(18.34)	(332.13)
	[0.626]	[0.678]	[0.127]	[0.076]	[0.060]
High w (T2)	14.98*	-3.98	66.12	0.49	183.46
	(8.35)	(7.84)	(39.27)	(18.04)	(209.29)
	[0.086]	[0.652]	[0.102]	[0.982]	[0.396]
H_0: T1 = T2	0.214	0.372	0.852	0.064	0.164
Mean Outcome (C)	36.65	115.34	143.63	181.80	1242.61
Observations	424	421	427	398	427

Burchardi et al 2018: Comments

Summary:

- The form of the tenancy contract does have impacts on effort
- Higher shares translate into more usage of capital and labor inputs
- Effects aren't coming from a simple wealth effect
- Increased share + increased output $\Longrightarrow$ higher total incomes and more HH assets

Policy Implications?

- Does this mean that land owners should offer more generous contracts? No - in paper, expected loss to landlord 20%
- Is land reform a good idea? (i.e, redistributing land from rich to poor).