Decentralized Targeting of Agricultural Credit Programs: Private versus Political Intermediaries

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An Alternative Approach to Agricultural Credit

- Build on what we have learn from the success/failure of microfinance
- Remove joint liability
- Retain the advantage of community information
- Delegate borrower selection to local agents
- Align agents' incentives with lender's (MFI's) objective of loan recovery

- Agent Intermediated Lending

Agent-Intermediated Lending (AIL) Schemes

- Designed to allow borrowers to finance cash crop cultivation
- Individual liability loans
- Local agents select borrowers
- Contract Features: (to control abuse of power):
  - Recommended farmers must own ≤ 1.5 acres of land
  - A subset are chosen via lottery to receive loan offers
  - Agents have no other formal role; loan transactions handled by MFI
  - Carrot: commission $= 75\%$ interest paid by recommended clients
  - Stick: forfeit upfront deposit if client defaults

Context for Empirical Work: West Bengal, India

- Potatoes: highest value-added per acre, subject to high price and yield risk
- Smallholder farmers: 47% $\leq$ 1.5 acres of land
- Crop growing cycle: 4 months
- Informal loans in sowing season; repay upon harvest
- Many sell output to local trader, who resells in distant markets

- Left-wing state government (1977—2011)
- Redistributive ideology; Clientelistic politics; Politicised local village councils

Comparison: Private versus Public Sector Intermediaries

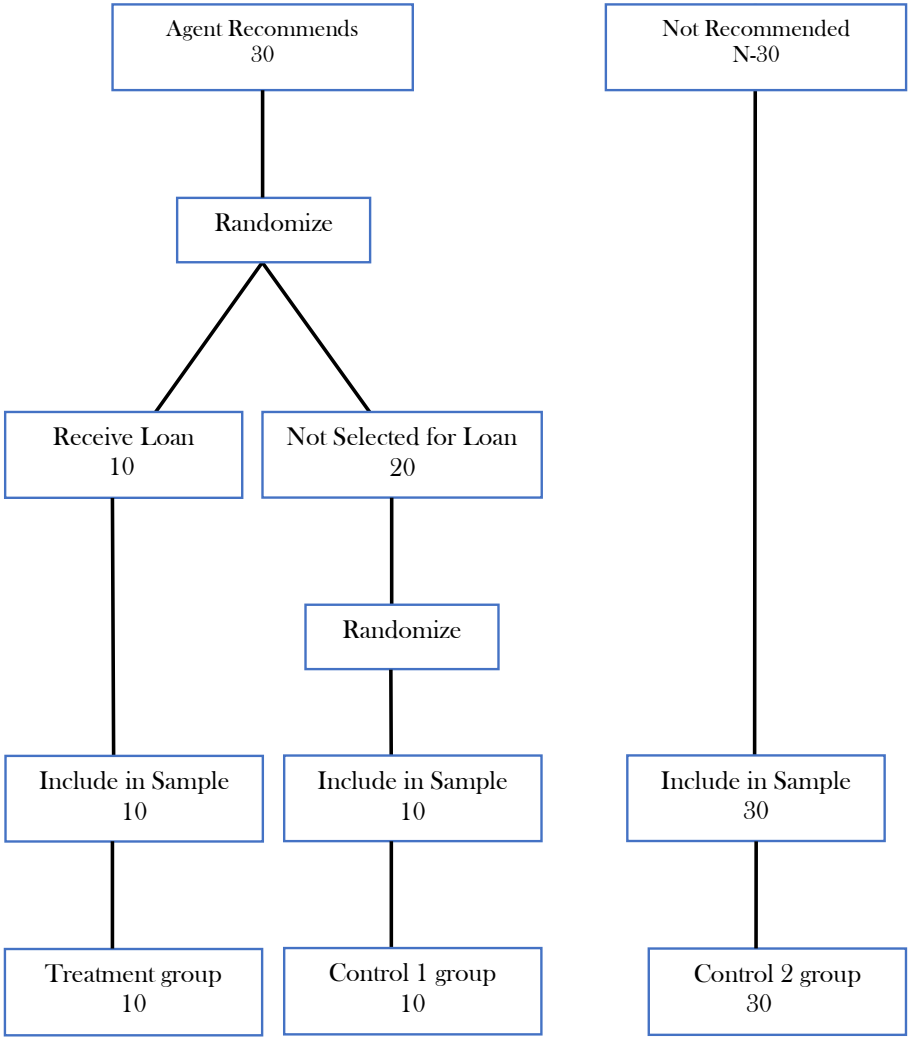
- Compares two versions of AIL, with different agent types:
  - private trader (TRader Agent Intermediated Lending or TRAIL)
  - political appointee (GRam panchayat Agent Intermediated Lending or GRAIL)
- Identical delegation contracts
- Agents differ in terms of:

1. Expertise: TRAIL agents have business expertise and economic interactions with households
2. (Non-Program) Incentives: TRAIL agents have profit motive; GRAIL agents have political/ideological motives

Experimental Setting

- Focus on potatoes, leading cash crop in West Bengal
- Two leading potato-growing districts: Hugli and West Medinipur
  - TRAIL: 24 villages
  - GRAIL: 24 villages
- Experiment during Sept 2010–July 2013
- Farm survey of 50 households per village, every 4 months:
  - 10 treated (Treatment)
  - 10 recommended, not treated farmers (Control 1)
  - 30 non-recommended, with landholding $\leq$ 1.5 acres (Control 2)

Experiment Design and Sample



Loan Features

- Low interest rate 18% APR
  - prevailing informal interest rates 21-29%
- 4-month duration, coinciding with crop cycles
- Individual liability
- No groups, meetings or savings requirements
- All transactions within village
- October 2010–July 2013: 8 loan cycles
- Dynamic repayment incentives:
  - Rs. 2000 starting loan, 33% increase each cycle
  - Continued access conditional on repayment
  - Termination if $\leq$ 50% repaid
- Partial insurance against potato price/yield risk

Agent Characteristics

	GRAIL	TRAIL	Difference
Cultivator	0.375	0.042	0.33***
Shop/business	0.208	0.958	-0.667***
Other	0.417	0.000	0.125*
Ag. land owned	2.63	3.29	-0.667**
Above primary school	0.958	0.792	0.167*
Weekly income (Rs.)	1102.895	1668.75	-565.855
Village society member	0.292	0.083	0.208*
Party hierarchy member	0.167	0.000	0.167**
Village council member	0.125	0.000	0.125*
Ran for village head	0.083	0.000	0.083

- TRAIL agent: shop / business
- GRAIL agent: cultivation/service; civil society / politics

- GRAIL agent: politically more connected

Agent-Farmer Relationships at Baseline (All households)

	TRAIL	GRAIL	Difference *(p-value)*
Agent and household belong to:			
Same Occupation	0.014	0.287	*0.000*
Same Caste Category	0.577	0.654	*0.35*
Same Religion	0.797	0.950	*0.025*
Agent is an important:			
Money Lender	0.169	0.087	*0.252*
Input Supplier	0.184	0.077	*0.095*
Output Buyer	0.185	0.024	*0.009*
In the past 3 years, household has:			
Bought from Agent	0.330	0.047	*0.000*
Borrowed from Agent	0.154	0.052	*0.036*
Worked for Agent	0.102	0.093	*0.849*
Currently:			
Household knows Agent	0.911	0.910	*0.995*
Sample Size	1029	1050	

- Both agent types are equally well-known
- TRAIL agent:
  - Traded inputs/output
  - Sold/lent to households
- GRAIL agent:
  - Similar occupation and religion as the household

Loan Performance

	Take-up	Program Loan Amount	Default
TRAIL	0.07	467.91	-0.003
	(0.011)	(79.75)	(0.010)
	0.000	*0.000*	*0.506*
Mean GRAIL	0.87	4140.86	0.07
R^2	0.06	0.452	0.05
Sample Size	2667	2667	2422

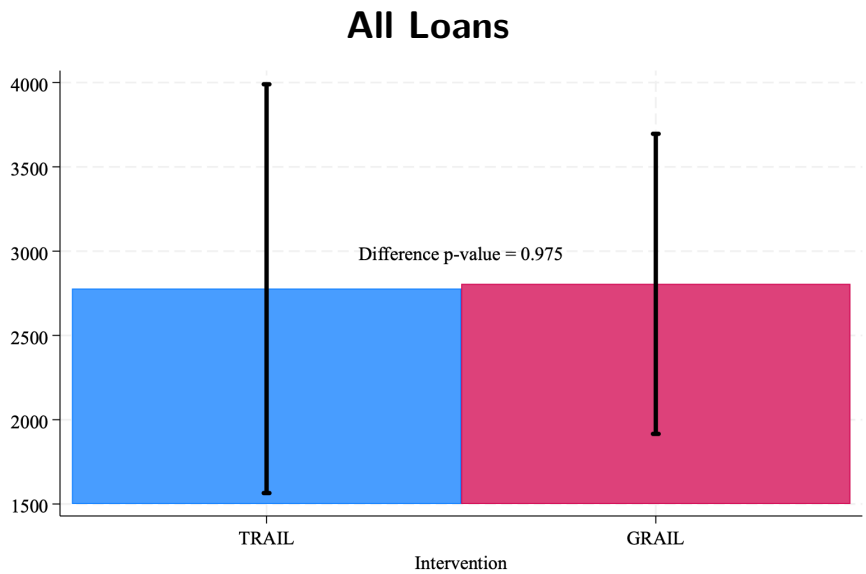
- High take-up rates in both schemes
- Amount borrowed:
  - GRAIL: 62% of max.
  - TRAIL: 69% of max.
- Default rates 7% in both GRAIL and TRAIL

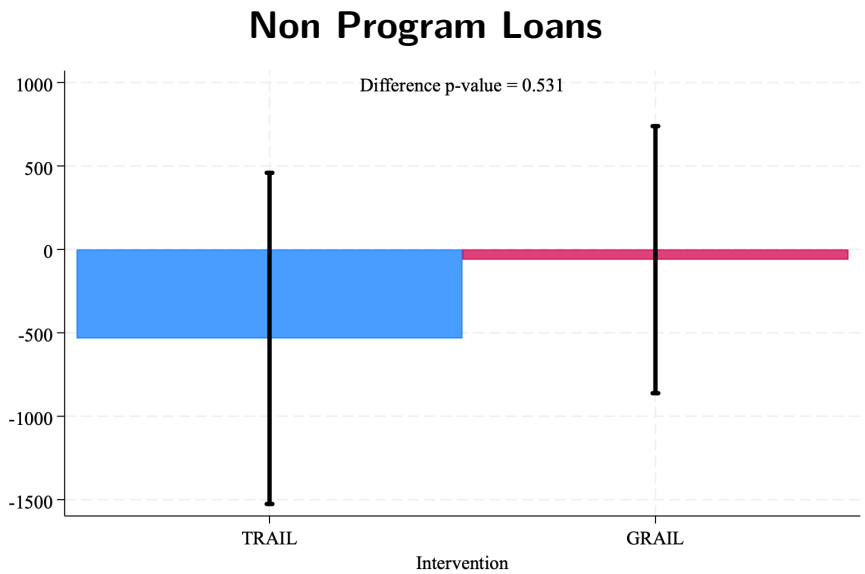
Average Treatment Effects on Farmer Inputs and Outcomes

$$
\begin{aligned}
y_{ivt} = \quad & \beta_0 + \beta_1 \text{TRAIL}_v + \beta_2(\text{TRAIL}_v \times \text{Treatment}_{iv}) + \beta_3(\text{TRAIL}_v \times \text{Control 1}_{iv}) \\
+ \quad & \beta_4(\text{GRAIL}_v \times \text{Treatment}_{iv}) + \beta_5(\text{GRAIL}_v \times \text{Control 1}_{iv}) \\
+ \quad & \gamma \, \mathbf{X}_{iv} + T_t + \varepsilon_{ivt}
\end{aligned}
$$

- Intention to treat estimates *conditional on selection*: Treatment v. Control 1
  - TRAIL: $\beta_2 - \beta_3$
  - GRAIL: $\beta_4 - \beta_5$
- Selection differences: Control 1 v. Control 2
  - TRAIL: $\beta_3 - \beta_1$
  - GRAIL: β_5
- Controls: age, education, occupation of oldest male, land owned, year dummies, price information intervention
- Standard errors clustered at village level
- FDR q-values to correct for multiple hypotheses testing

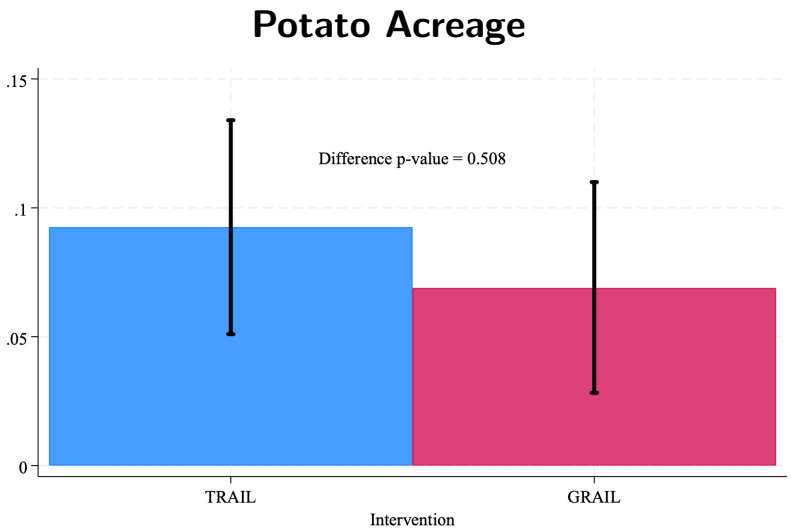
Average Treatment Effects on Agricultural Borrowing

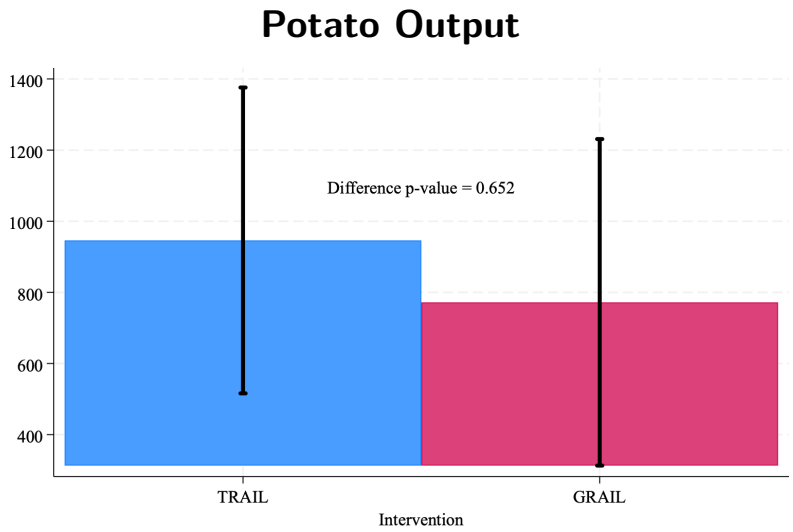


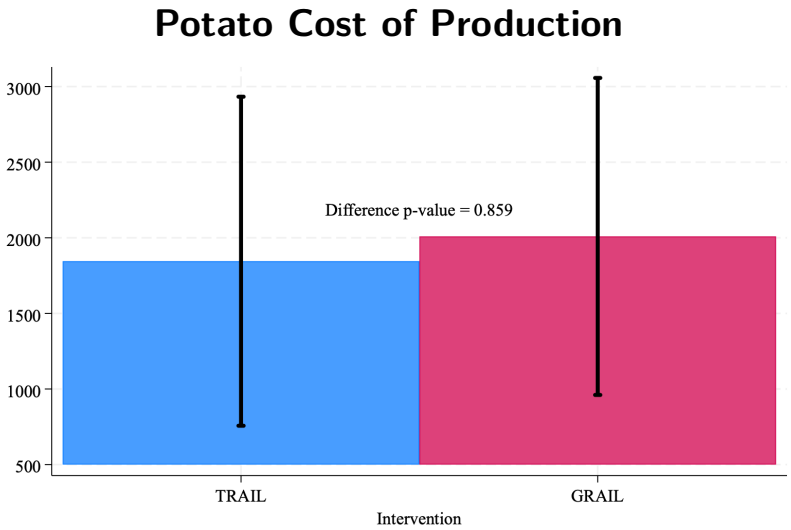


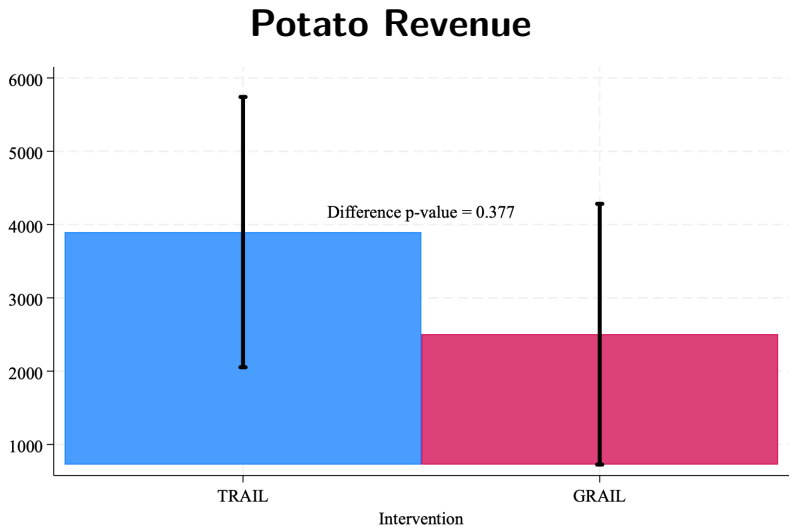
Estimated Treatment Effect and 90% Confidence Interval presented.

Average Treatment Effects









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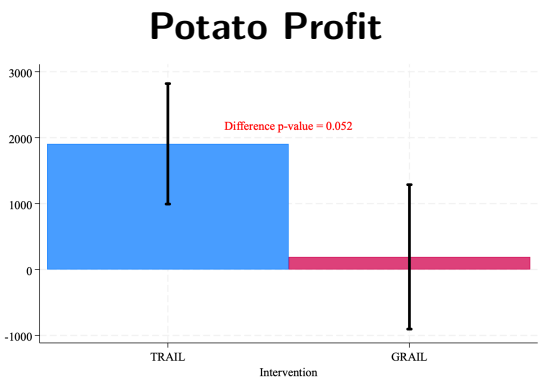

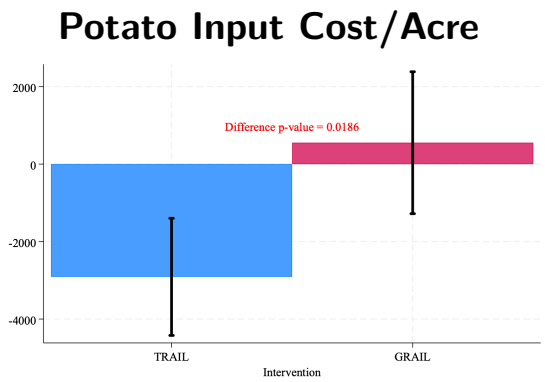

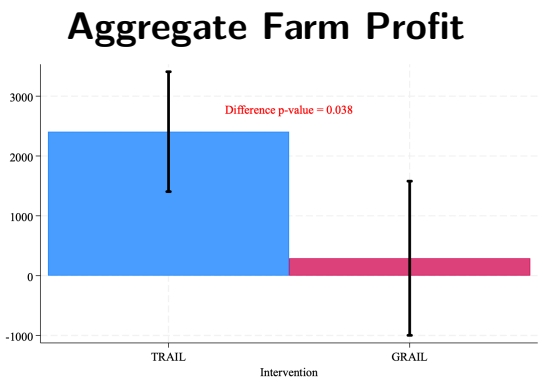

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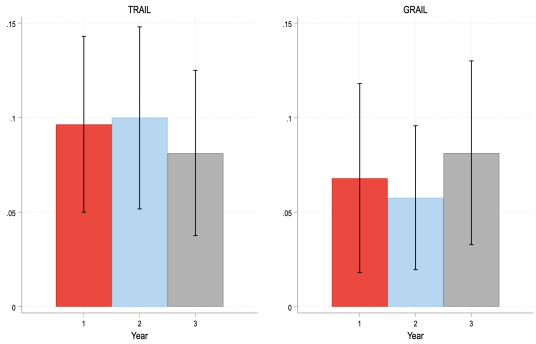
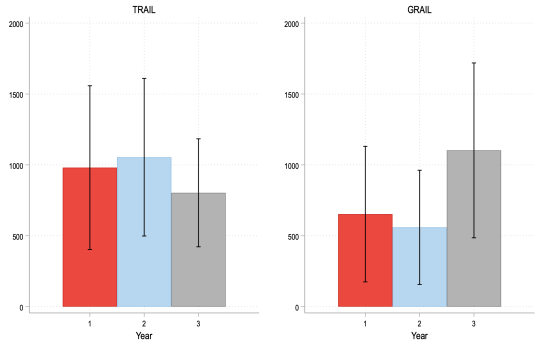
Year Specific Effects

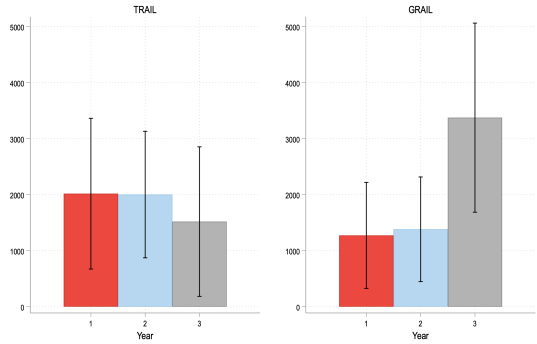
Potato Acreage



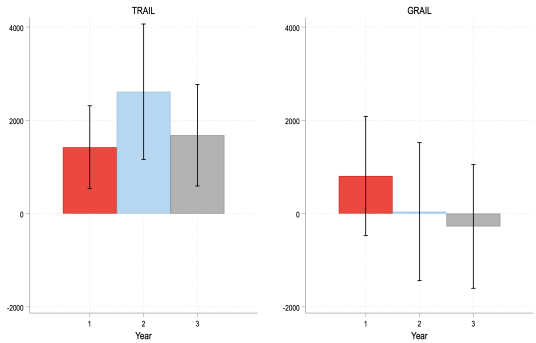
Potato Output



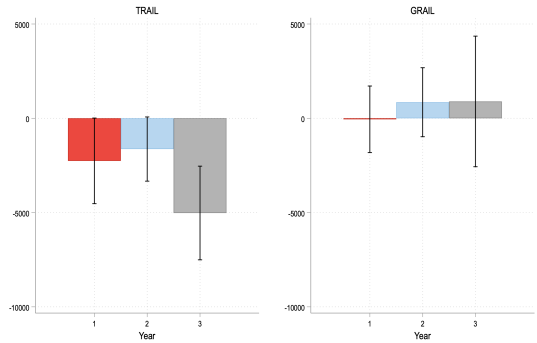
Potato Cost



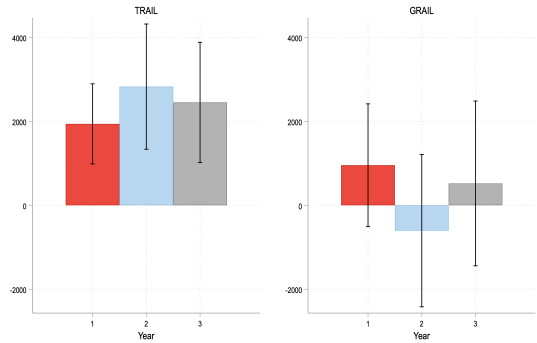
Potato Profit



Potato Input Cost/acre



Aggregate Farm Profit



Explaining ATE Differences

- Selection Effect:
  - Agents selected borrower of different abilities
- (Conditional) Treatment Effect:
  - Even if same ability, agents in two schemes could have behaved differently

Selection Differences in Explaining ATE Differences

- Evidence suggests that TRAIL agents select borrowers of higher ability
  ▸ Estimating Ability ▸ Differences in Ability
- Decompose the TRAIL vs GRAIL ATE difference on potato profits into:
  1. Contribution of Selection Effect
  2. Contribution of Conditional Treatment Effect
- Selection Differences contribute less than 15% of the difference in ATEs
  ▸ Decomposition Procedure ▸ Decomposition
- Conditional Treatment Effect Differences (differences in agent behaviour, post selection) appears more important.

Theoretical Model of Agent Supervision

- Why do equally able farmers have different outcomes in TRAIL vs. GRAIL?
- Agents' occupations and non-program motivations differ
  - TRAIL agent is trader:
    - stands to gain if farmers increase output and sales
  - GRAIL agent is political appointee:
    - stands to lose if farmers default on program loans
- Assume that agents can:
  - Help: provide business advice:
    - better quality or cheaper inputs
    - lowers unit costs
  - Monitor: changes in cultivation practices
    - pesticides or hardier varieties
    - increases crop success rates
    - reduces expected farm output

Sketch of Agent Supervision Model: Baseline

- Risk-neutral farmer and trader
- Interlinked credit-output contract
- Crop success rate increases in farmer ability
- Supervision / Engagement with Farmer:
  - Involves time cost for trader / agent
  - Monitoring: increases crop success rate;
    - increases cultivation costs
    - lowers expected farm profit
  - Help/advice: lowers unit costs
    - induces more cultivation
    - increases output and farm profit

TRAIL Scheme: Outcomes for Treated Farmers

- Scheme provides additional credit at subsidised rate
- Agent commission depends on interest payment by farmer

- Trader is now TRAIL agent
  - Subsidised credit $\Rightarrow$ treated farmer expands scale
  - Help and scale are complementary: agent helps more
  - Scale increases more if able farmer: agent helps able farmers more

GRAIL Scheme: Outcomes for Treated Farmers

- GRAIL agent is NOT a trader
- Cannot provide advice; can only monitor
  - Ideological / political motives to avoid loan default
  - Places higher weight on crop success of less able farmers
- Monitoring increases crop success rate, lowers expected productivity

- GRAIL agent monitors farmers
- Monitoring is more effective with less able farmers: monitors them more

Predictions

- TRAIL:
  - Increases engagement with more able farmers (help) ▸ Evidence
  - TRAIL increases: acreage, output and farmer profit; reduces: unit costs
  - TRAIL effects are larger for more able farmers ▸ Evidence
- GRAIL:
  - Increases engagement with less able farmers (monitor) ▸ Evidence
  - Low ability GRAIL borrowers default less than low ability TRAIL borrowers ▸ Evidence
  - Conditional on ability, TRAIL ATEs larger than GRAIL ATEs (acreage, output, profit, unit cost). ▸ Evidence

Concluding Comments

- Supervision explanation is broadly consistent with empirical facts.
  - Alternative explanations may be possible.
- Key point:
  - Selection effects alone are unlikely to explain the results.
  - Agents' actions have a role.

- Key takeaways for delegated programme design:
  - Private traders can enable development impacts.
  - Can create larger gains than politically-appointed agents.
  - Beyond selecting programme beneficiaries, agents' informal role also important.
  - Network connections and relationships matter...
  - ...and could themselves be affected by development interventions.

Thank You!

Estimating Farmer Ability: Control Households

- Semi-structural approach (Olley and Pakes (1996); Levinsohn and Petrin (2003); Ackerberg et al. (2015); Shenoy (2021))
- Cobb-Douglas production technology; decreasing returns to scale
- No input market frictions
- Control (untreated) farmer i in village v in year t earns revenues given by:

$$R_{ivt} = p_{vt} a_i [\frac{1}{1-\alpha} I_{ivt}^{1-\alpha}]$$

- Farmer ability (or TFP) a_i: exogenous and follows a common distribution in TRAIL and GRAIL
- Ability may depend on farmer's skill as well as land holding and other complementary assets.
- Ability assumed to be a farmer-specific time-invariant characteristic

Estimating Farmer Ability: Control Households

- No input market frictions: cost of production per unit area c is constant and identical across farmers
- In village v, a control group farmer borrows from the informal money lender at a common cost of capital ρ_{vt}
- Fixed cost to cultivate potatoes $F\mathcal{I}_{l>0}$ $(\mathcal{I}_{l>0} = 1 \text{ if } l > 0; 0 \text{ otherwise})$
- Farmer chooses $l = l^c_{ivt}$ to maximize

$$p_{vt} a_i \frac{l^{1-\alpha}}{1-\alpha} - \rho_{vt} c l - F\mathcal{I}_{l>0}$$

- If farmers are sufficiently able, then it is optimal for them to select a positive cultivation scale given by:

$$\log l^c_{ivt} = \frac{1}{\alpha} \log \frac{a_i}{c} + \frac{1}{\alpha} [\log p_{vt} - \log \rho_{vt}]$$

- Estimate the ability of Control famers as the household fixed effect in a household-year level panel regression where the log acreage of potato cultivation is regressed on farmer, village and year dummies.

Estimating Farmer Ability: Treatment Households

- Acreage of treated farmers is affected by the treatment
- Order Preserving Assumption:
  - Intervention may increase Treatment households' acreage, but not change relative ranking (Athey and Imbens (2006); validated later)
- Assign the productivity estimate of Control 1 household at that rank in distribution

Explanation

- Assuming: program size limits are not binding for any farmer:
- Cost of production per unit area c is constant and identical across farmers.
- All farmers expand their scale of cultivation and profits by the same proportion (holds for both TRAIL and GRAIL)
- Base levels of these measures are larger for more able farmers

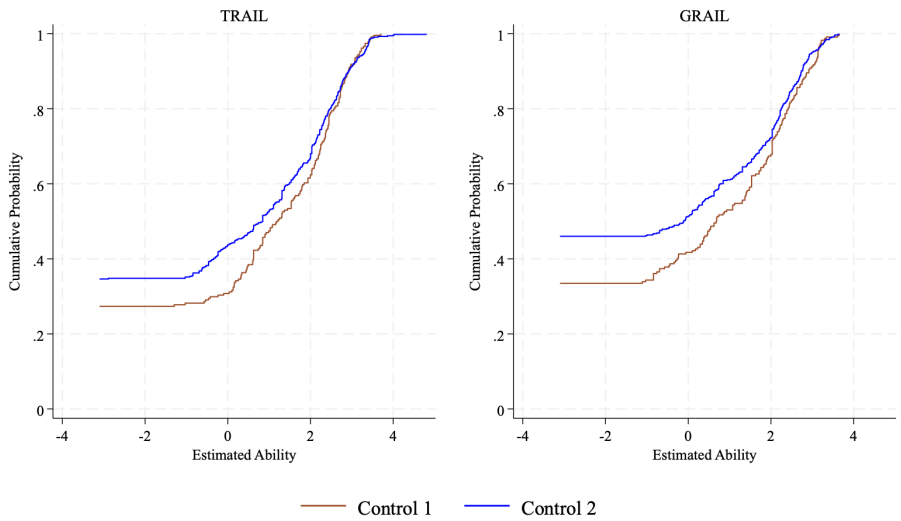
$\Longrightarrow$ Reduced input cost also increases the cultivated area and profits of the more able farmers

- But cannot explain the larger drop in input cost for TRAIL

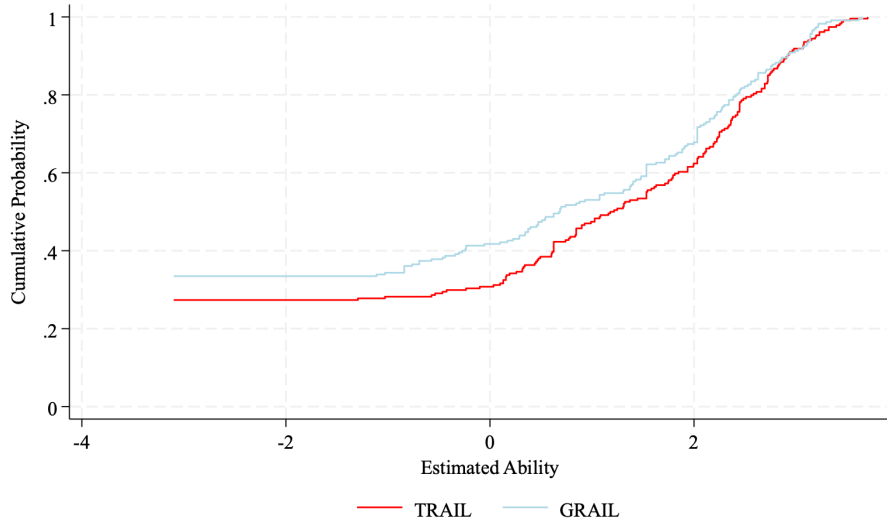
Back

Borrower Selection on Estimated Ability in TRAIL and GRAIL Schemes

Recommended v. Non-Recommended households



Recommended households: TRAIL vs GRAI



- Recommended more productive than non-recommended
  - TRAIL p-value = 0.00
  - GRAIL p-value = 0.00
- TRAIL-recommended more productive than GRAIL-recommended (p-value = 0.00).

Back to Selection

Decomposition Procedure

- Group Treatment and Control 1 households into three ability bins
  - Bin 1: Non-cultivators (ability below a threshold)
  - Bin 2: Below median ability cultivators
  - Bin 3: Above median ability cultivators
- Estimate heterogeneous treatment effects on potato (aggregate farm) profits by ability bin
- Contribution of Selection Effect:
  - How much would TRAIL ATE shrink if:
    - TRAIL borrower composition were changed to match that in GRAIL ...
    - ... but within each bin, treatment effects were still as in TRAIL
- Contribution of Conditional Treatment Effect:
  - How much would GRAIL ATE increase if:
    - GRAIL borrower composition remained the same ...
    - ... but with each bin, treatment effects changed to match that in TRAIL.

Back

Decomposition of ATE Differences in Profit from Potato Cultivation. TRAIL v. GRAIL

Bin (k)	Proportions in Bin σ_k^T	σ_k^G	$\sigma_k^T - \sigma_k^G$	HTEs TRAIL (T_k^T)	GRAIL (T_k^G)	TRAIL – GRAIL ($T_k^T - T_k^G$)	$(\sigma_k^T - \sigma_k^G) \times T_k^T$	$\sigma_k^G \times (T_k^T - T_k^G)$
1	0.31	0.40	-0.09	350.60	227.10	123.50	-32.08	49.47
2	0.32	0.29	0.03	934.45	140.07	794.38	27.10	231.88
3	0.37	0.31	0.06	3244.27	1591.17	1653.10	202.77	508.33
ATE				1906	191.4	1714.6		
% of Difference in ATE due to Selection								11.54
% of Difference in ATE due to CTE								46.06

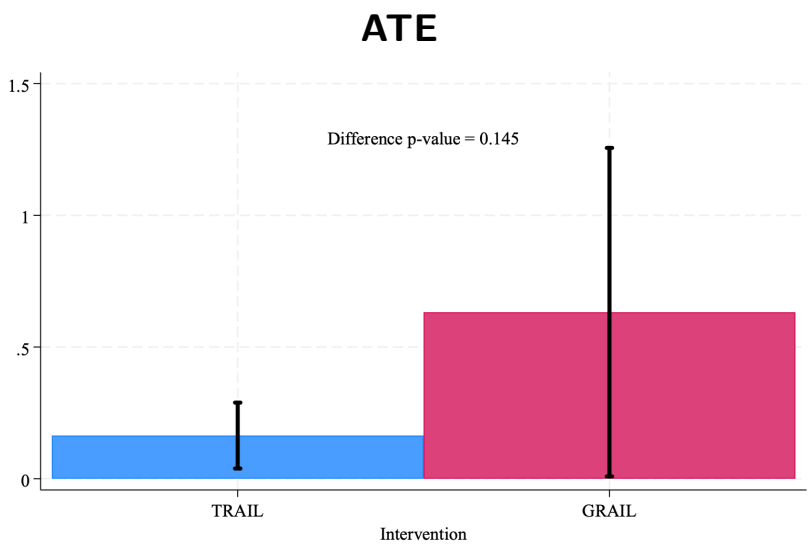
Back

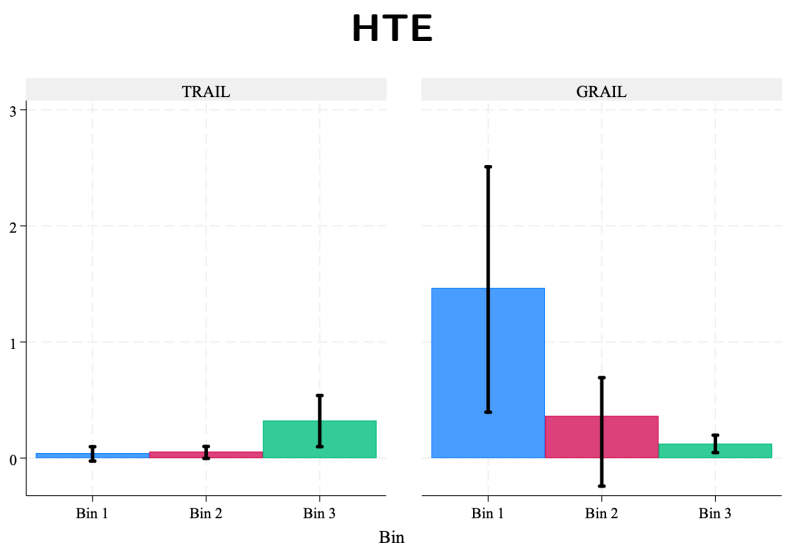
Decomposition of ATE Differences in Aggregate Farm Profit. TRAIL v. GRAIL

Bin (k)	Proportions in Bin σ_k^T	σ_k^G	$\sigma_k^T - \sigma_k^G$	HTEs TRAIL (T_k^T)	GRAIL (T_k^G)	TRAIL – GRAIL $(T_k^T - T_k^G)$	$(\sigma_k^T - \sigma_k^G) \times T_k^T$	$\sigma_k^G \times (T_k^T - T_k^G)$
1	0.31	0.40	-0.09	217.74	1035.18	-817.44	-19.92	-327.47
2	0.32	0.29	0.03	956.07	712.04	244.03	27.73	71.23
3	0.37	0.31	0.06	4274.66	1368.14	2906.52	267.17	893.75
ATE				2406	290.3	2115.7		
% of Difference in ATE due to Selection								13.00
% of Difference in ATE due to CTE								30.13

Back

Engagement with Agent. ATE and HTE

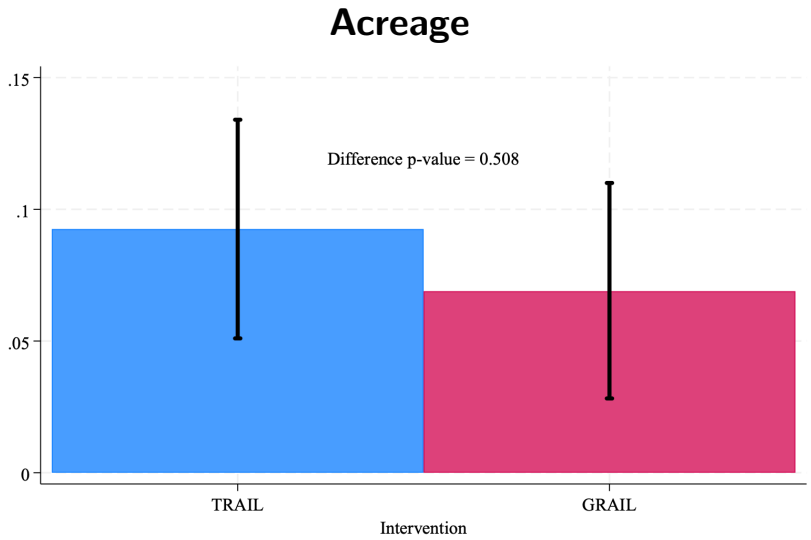


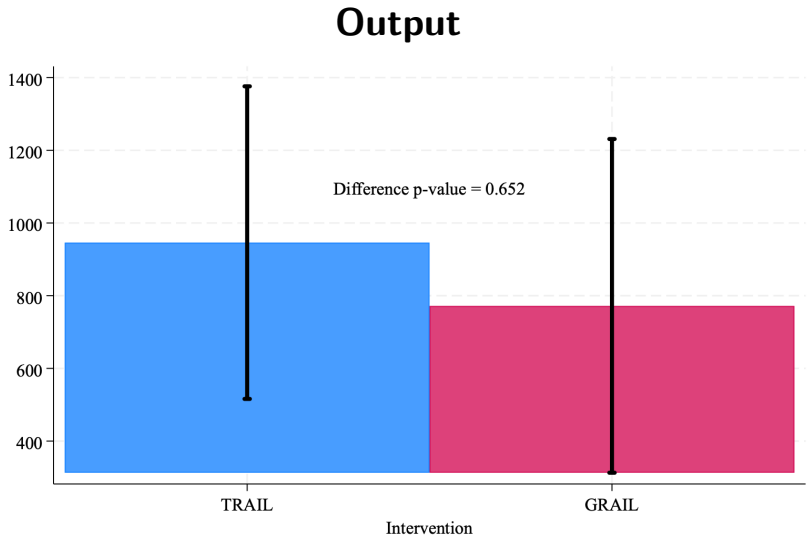


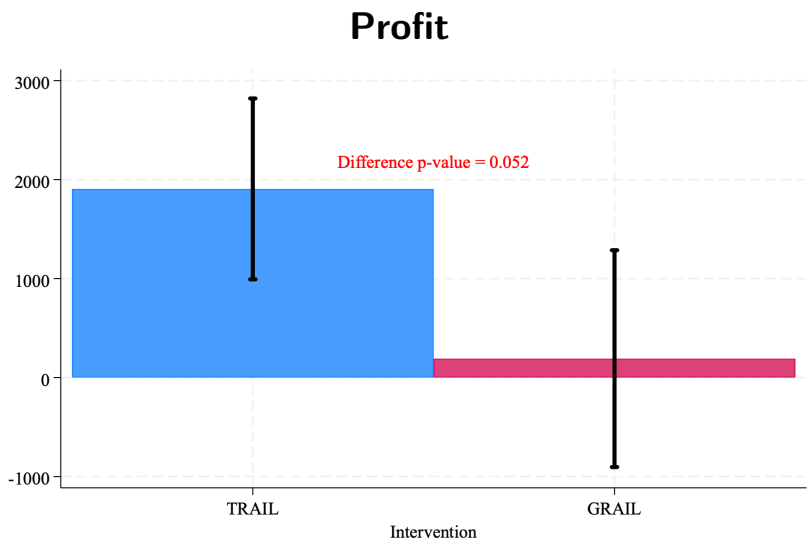
Estimated Treatment Effect and 90% Confidence Interval presented.

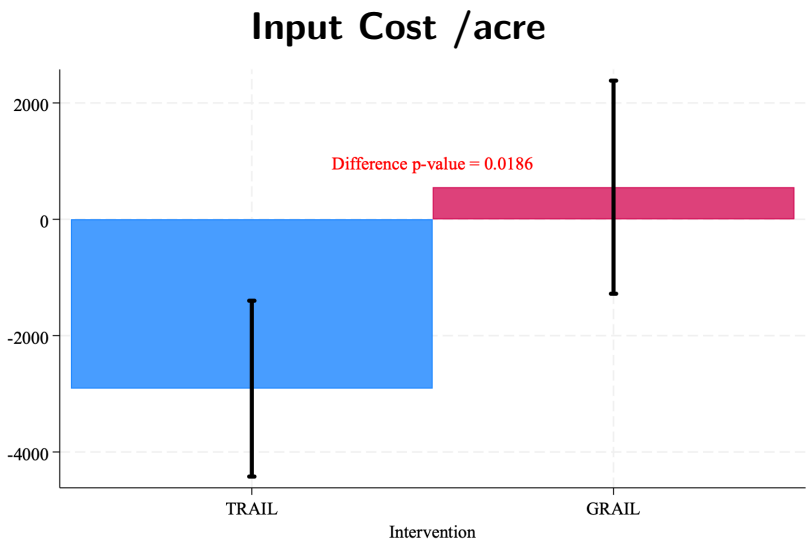
Back to Predictions

TRAIL ATEs (Potatoes)



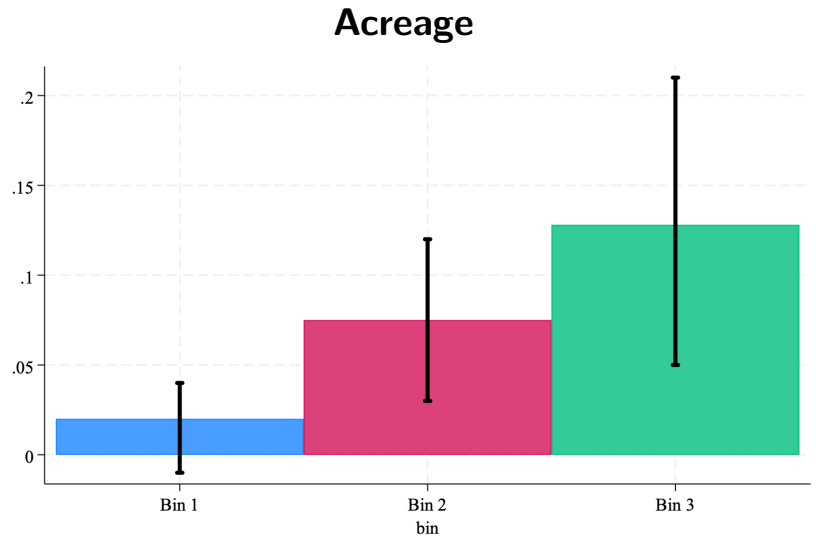


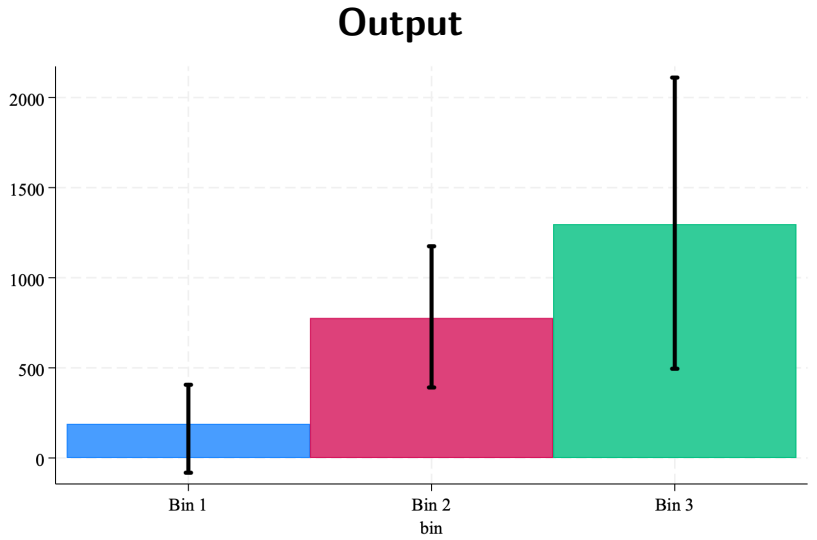


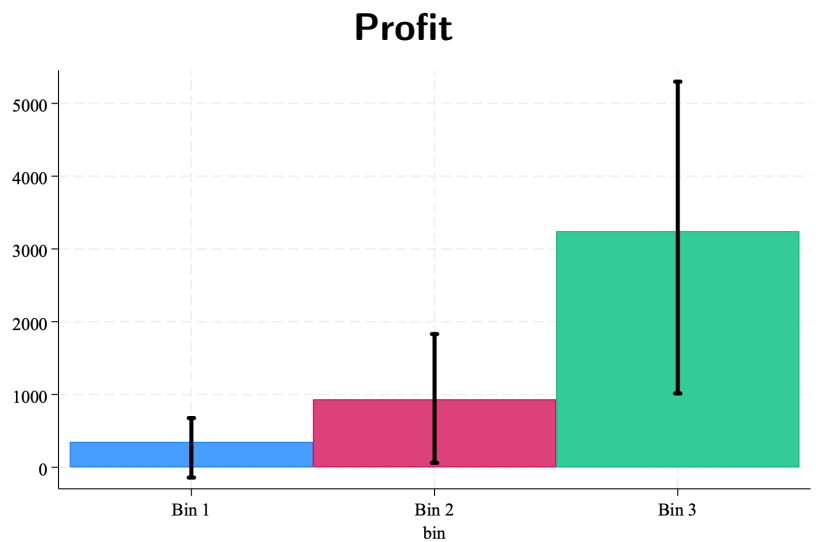


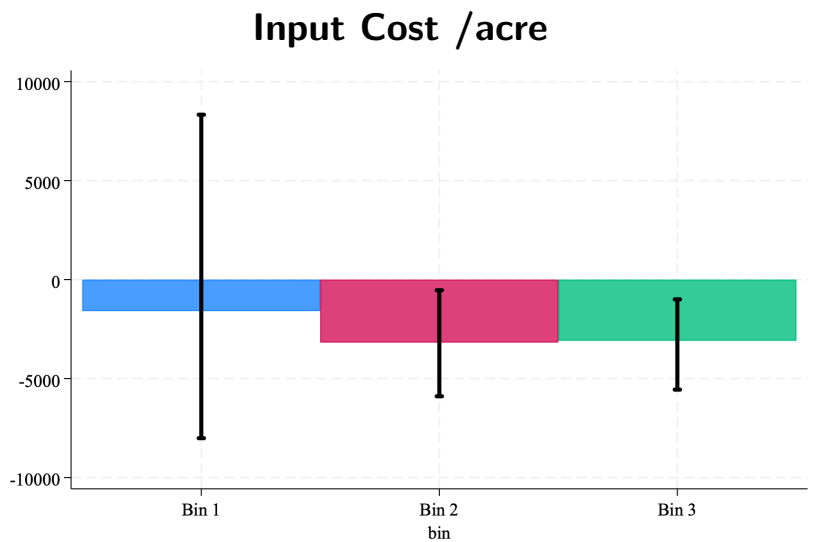
Back to Predictions

TRAIL HTEs (Potatoes)









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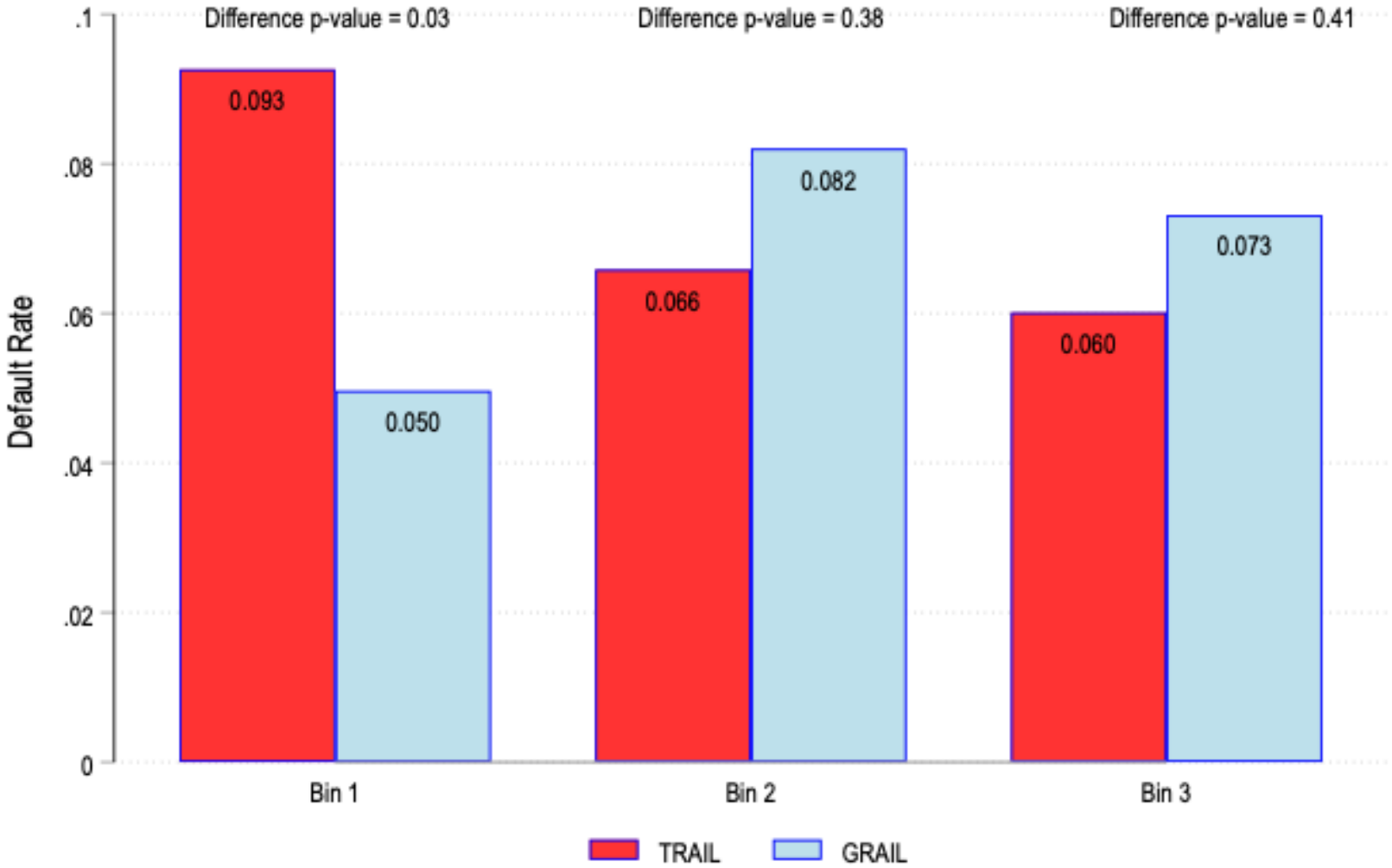
Default on Program Loans



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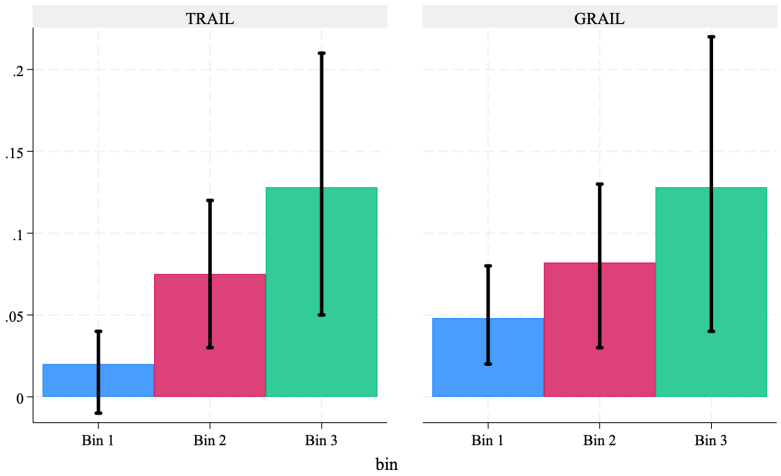
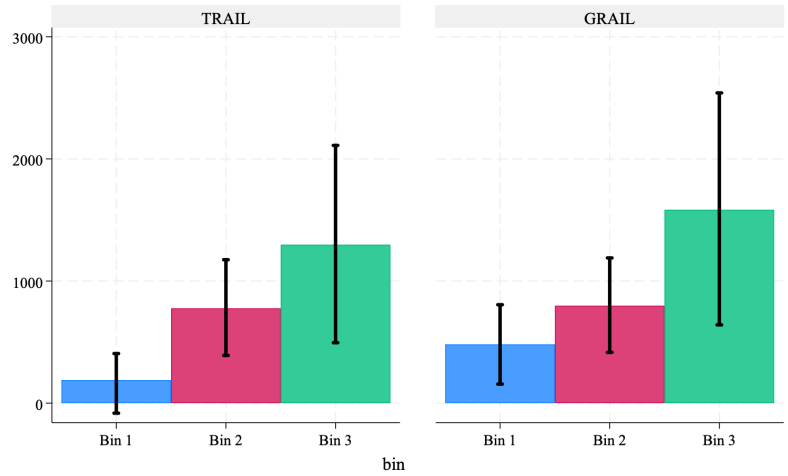
HTEs on Outcomes: TRAIL vs. GRAIL

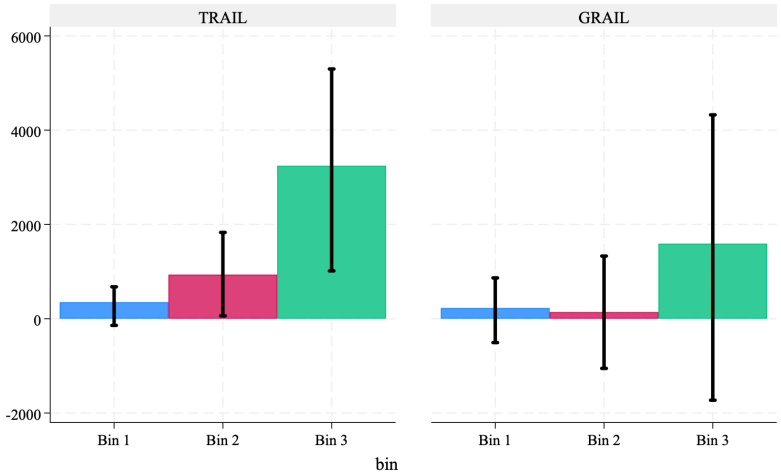
Acreage



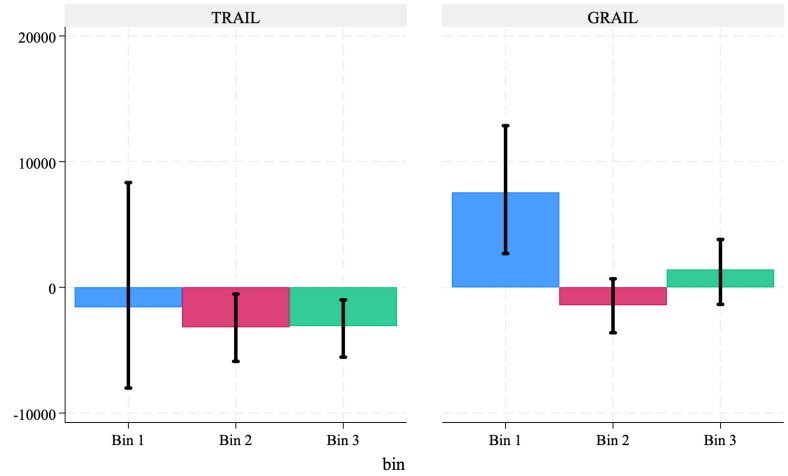
Output



Profit



Input Cost /acre



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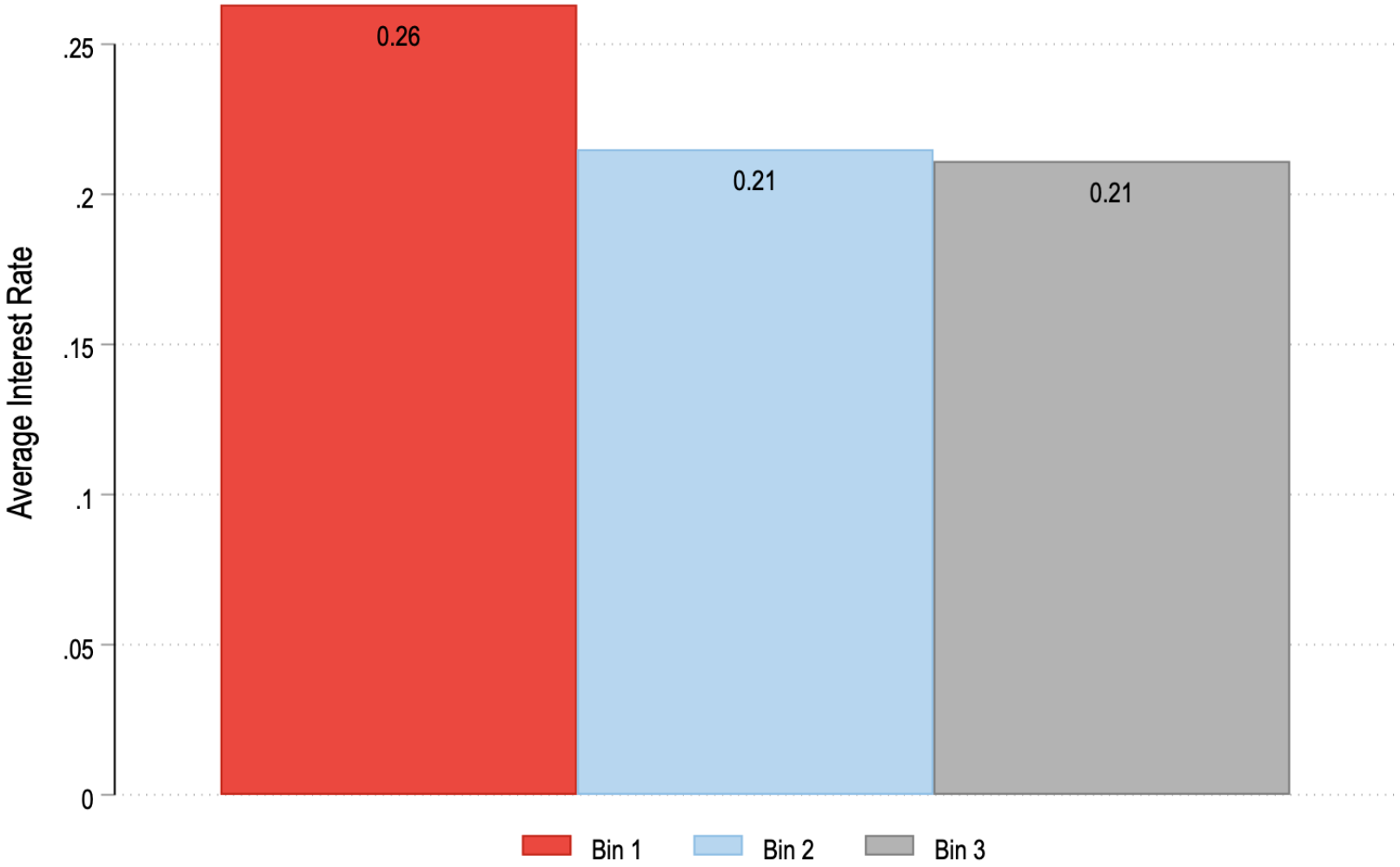
Interest rates (Control farmers)



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Output and Input costs/acre (Control farmers)

	Output (Kgs)	Input Cost (per Acre)
Productivity	1,581.207	-328.293
	[1471.39, 1691.94]	[-836.99, 240.26]
Productivity Squared	595.400	-318.959
	[496.68, 681.93]	[-617.85, -53.56]
Sample Size	4,890	3,011
R^2	0.717	0.260

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Model with No Input Market Frictions

- Investigate possible differences inselection patterns on unobservable traits
- Farmers vary in unobservable ability, that there are no frictions in input markets, and that there are diminishing returns to scale in potato cultivation.
- Back out ability estimates from farmer fixed effects in a panel regression of cultivated area.

Selection Model with Credit Rationing and Land Market Frictions

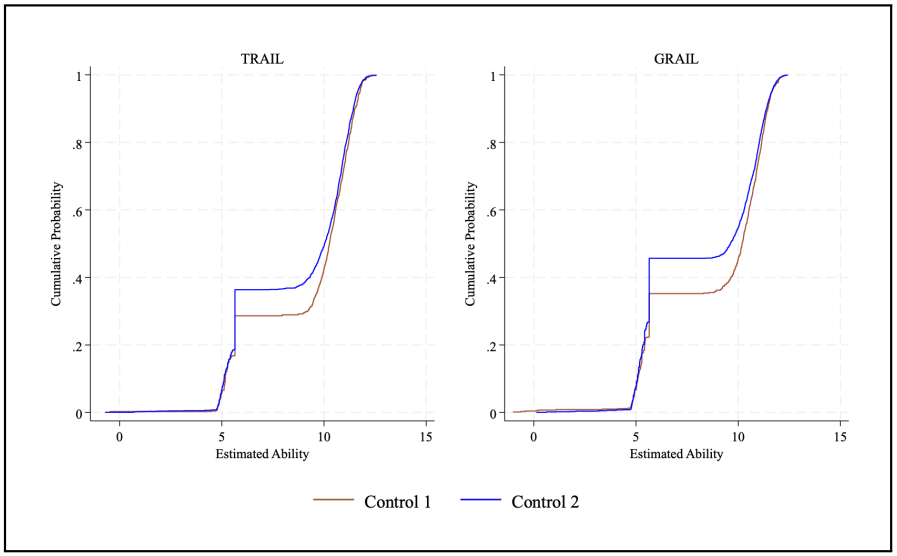
- The assumption of no input market frictions could be construed as restrictive.
    - If TRAIL agents selected farmers who were more credit constrained, then their larger treatment effect could simply be the effect of relaxing this constraint.
    - If land markets are thin, then farmers with more land would earn larger returns to program loans.
- Aternative model of selection
    - Incorporates credit rationing, both in the informal credit market as well as in program loans, and also frictions in the land market
- Pre-program cultivation scale (of "comparable" control group farmers) defines heterogeneity.
- An estimate of this dimension would deliver the same ability estimate as in the previous exercise

Extended Model: Selection on Multiple Dimensions and Returns to Scale

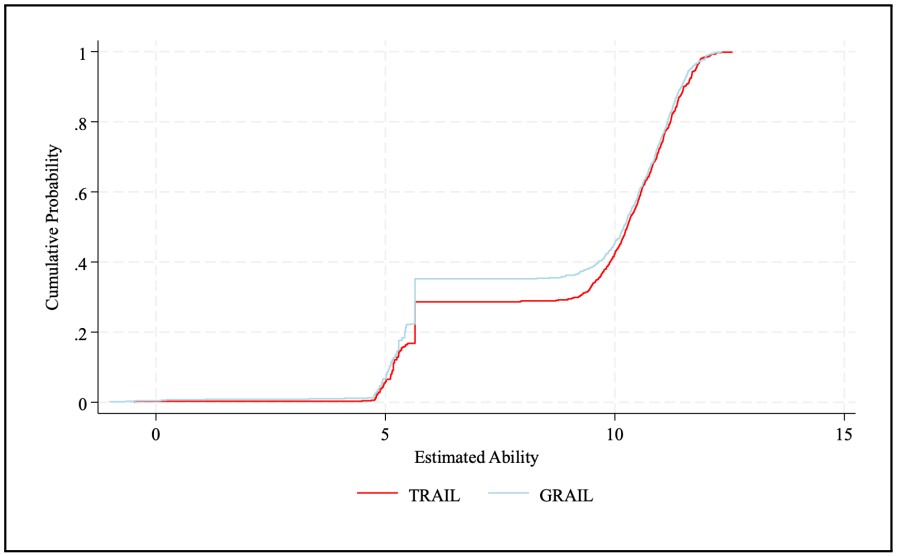
- Farmers differ on multiple dimensions: ability, wealth (which affects credit limits that are binding), and business skill (affecting factor prices).
- Relax our previous assumption of diminishing returns to scale by allowing for technological and pecuniary returns to scale, represented by constant elasticities of potato revenues and unit costs with respect to the scale of cultivation.
- Extended model cannot satisfactorily account for the observedpatterns of average treatment effects in the data

Allowing Farmer Ability to Vary Over Time. TRAIL v. GRAIL

Panel A: Estimated Ability Distribution Selected v. Non-selected households



Panel B: Estimated Ability Distribution Selected households: TRAIL vs GRAIL



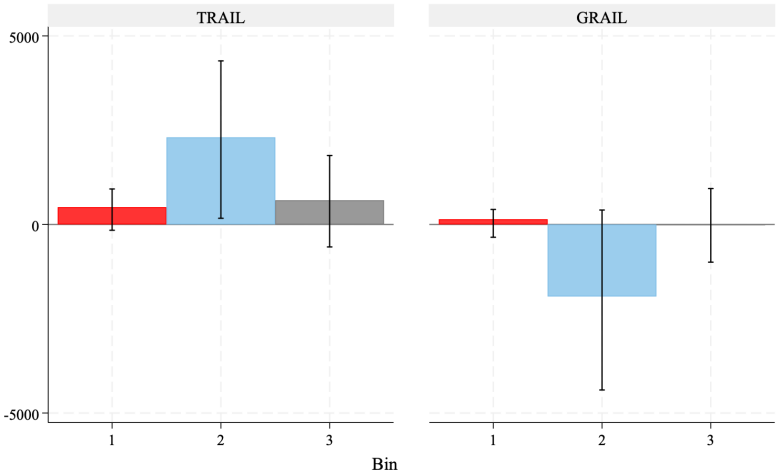
- Recommended more productive than non-recommended
  - TRAIL p-value = 0.000
  - GRAIL p-value = 0.000

TRAIL-recommended more productive than GRAIL- recommended:

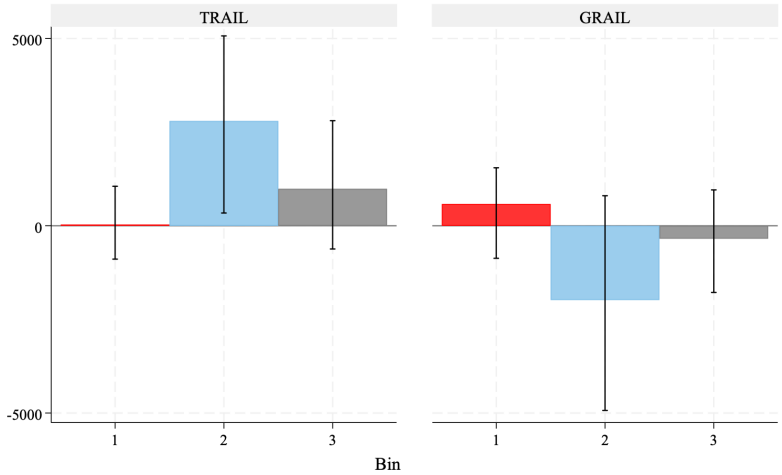
- p-value = 0.064

Allowing Farmer Ability to Vary Over Time. HTEs by Ability category. TRAIL v. GRAIL

Panel A: Potato Profit



Panel B: Aggregate Farm Profit



Decomposition of ATE Differences in Potato Profit. TRAIL v. GRAIL

Allowing Farmer Ability to Vary over Time

Bin (k)	Proportions in Bin σ_k^T	σ_k^G	$\sigma_k^T - \sigma_k^G$	HTEs TRAIL (T_k^T)	GRAIL (T_k^G)	TRAIL – GRAIL $(T_k^T - T_k^G)$	$(\sigma_k^T - \sigma_k^G) \times T_k^T$	$\sigma_k^G \times (T_k^T - T_k^G)$
1	0.32	0.38	-0.06	457.74	138.36	319.38	-27.42	121.11
2	0.34	0.29	0.05	2309.71	-1909.54	4219.24	107.63	1230.33
3	0.34	0.33	0.01	643.16	-14.41	657.57	8.62	216.41
ATE				1906	191.4	1714.6		
% of Difference in ATE due to Selection								5.18
% of Difference in ATE due to CTE								91.44

Decomposition of ATE Differences in Aggregate Farm Profit. TRAIL v. GRAIL

Allowing Farmer Ability to Vary over Time

Bin (k)	Proportions in Bin σ_k^T	σ_k^G	$\sigma_k^T - \sigma_k^G$	HTEs TRAIL (T_k^T)	GRAIL (T_k^G)	TRAIL – GRAIL $(T_k^T - T_k^G)$	$(\sigma_k^T - \sigma_k^G) \times T_k^T$	$\sigma_k^G \times (T_k^T - T_k^G)$
1	0.32	0.38	-0.06	32.02	580.29	-548.28	-1.92	-207.91
2	0.34	0.29	0.05	2797.10	-1982.36	4779.46	130.34	1393.69
3	0.34	0.33	0.01	985.85	-346.44	1332.29	13.21	438.46
ATE				2406	290.3	2115.7		
% of Difference in ATE due to Selection								6.69
% of Difference in ATE due to CTE								76.77