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Technical efficiency and technological change of value chains in five Nigerian states

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RESEARCH AND IMPACT

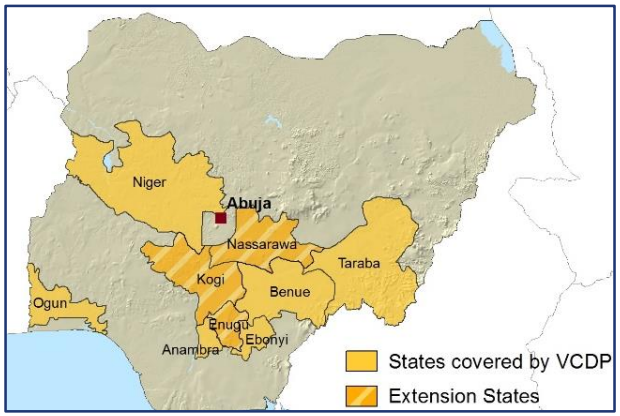
Motivation

- Many of the poor worldwide are small-scale producers.
- They face numerous production constraints and market frictions.
- Strengthening access to markets and participating in value chains can contribute to improving productivity and income.
- Mid-stream segment of value chains often under-researched.
- Market access allows adding value to raw crops after harvest, through higher demand for processed commodities.
- Context: Value Chain Development Programme (VCDP) in Nigeria

Literature

- Addressing bias form unobservable characteristics (Bravo-Ureta et al. 2012)
- Applications of the Selectivity-Corrected Stochastic Production Frontier (SC-SPF) method in agricultural development studies (Abdul-Rahaman et al. 2021, Bravo-Ureta et al. 2020, Olagunju et al. 2021, Issahaku and Abdulai 2020)
- Applications of the stochastic metafrontier (SMF) framework to agricultural production studies (Lawin and Tamini 2019, Ngango and Hong 2021)

Value Chain Development Programme (VCDP)



Time frame:
2012- 2022

Total population reached:
100,000 households

Goal: Sustainably enhance incomes and food security of poor rural households engaged in production, processing, and marketing of rice and cassava in targeted states

Budget: US$ 329.5 million from IFAD (65%), other co-financiers (11%), local private sector (16%), and beneficiaries (7%)

Project activities:

- ***Agricultural Marketing Development:*** Support to value addition and market linkages; support to market infrastructure
- ***Smallholder Productivity Enhancement***: Strengthening of farmers organizations (facilitating access to inputs, improved technologies, credit, and information); support to smallholder production

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Data

- Source: Household and producer organization survey collected as part of impact evaluation of VCDP
- Interview time: February-March 2020
- Sample: 1,784 Households and 228 FOs in 5 states
  - 879 treatment households
  - 905 control households

Counterfactual construction

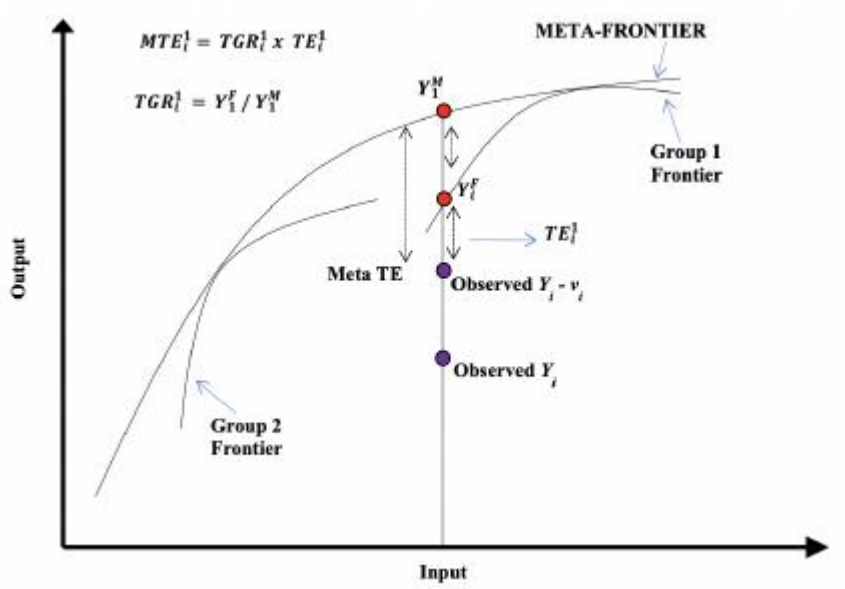
- M&E data used to identify treated FOs, and randomly selected them stratified by state and crop
- Selection of extension wards with characteristics suitable for rice and cassava cultivation
- Control FOs randomly selected based in extension wards, proportionally balanced to treated sample

Methodology

1. Pre-processing: Probit model to match treatment and control households based on:
   - Household-level pre-treatment socio-economic characteristics
   - Community-level access to infrastructures
2. Controlling for differences in unobservables: SC-SPF
   - One-step estimation of a probit sample selection model and an SPF model with a two-sided error term
   - Selectivity is expressed by the correlation between the error term in the sample selection and the two-sided error in the stochastic frontier
   - Cobb-Douglas functional form with production theory

Methodology (cont.)

3. Stochastic Meta-Frontier (SMF)
   - Common benchmark to compare technical efficiency of two groups



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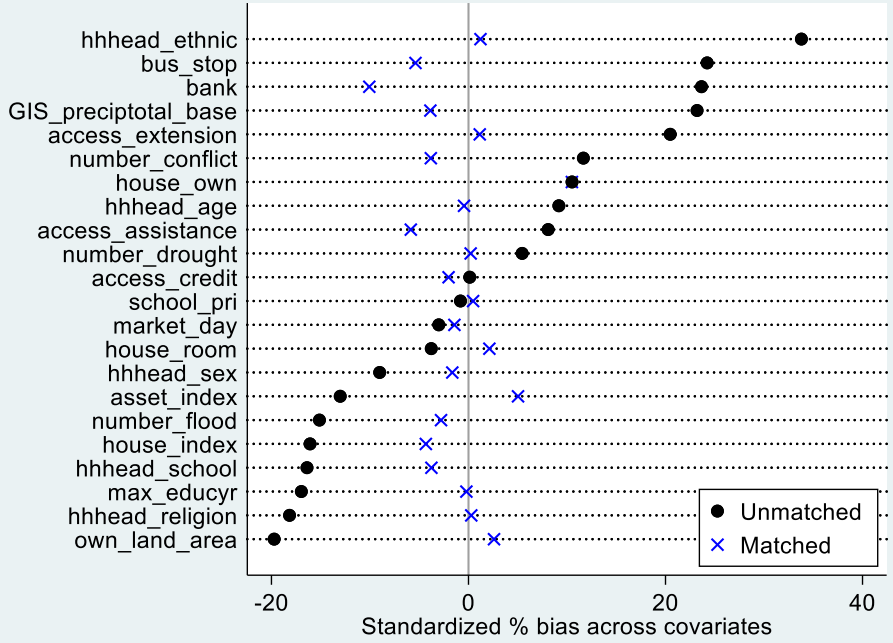
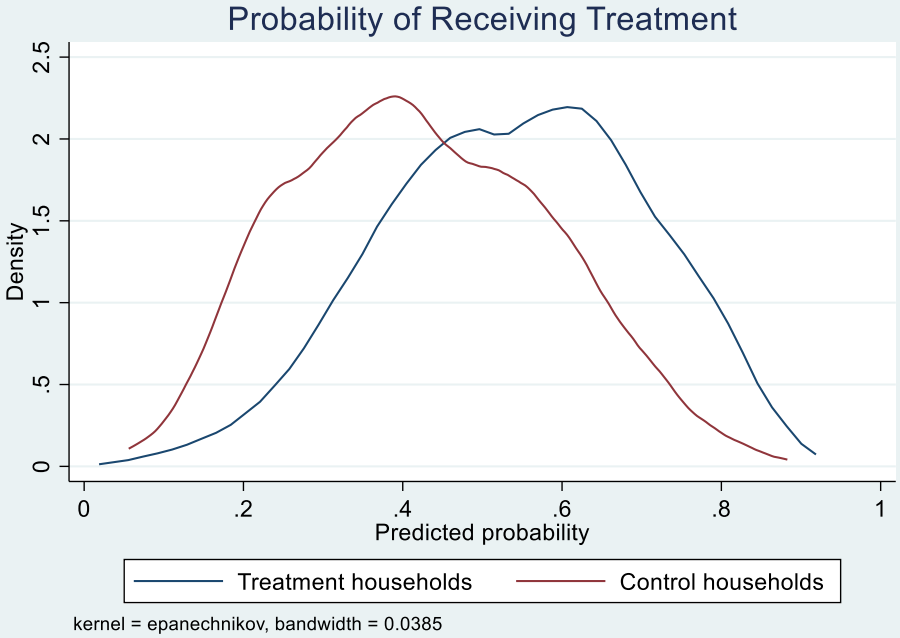
Results: Probit model





- Bias minimized by the matching algorithm
- Substantial common support between treated and control households

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Results: Conventional SPF

Variables	(1) Conventional SPF Basic	(2) Conventional SPF Pooled	(3) Conventional SPF Treatment	(4) Conventional SPF Control
Treatment	0.273***	0.228***		
	(0.0810)	(0.0712)		
Land	0.764***	0.725***	0.551***	0.867***
	(0.0768)	(0.0728)	(0.0916)	(0.108)
Labor	0.246***	0.210***	0.201***	0.211***
	(0.0358)	(0.0338)	(0.0437)	(0.0539)
Purchased inputs (binary)	0.620***	0.559***	0.574**	0.520***
	(0.171)	(0.158)	(0.244)	(0.198)
Constant	5.208***	5.172***	5.873***	4.974***
	(0.307)	(0.461)	(0.717)	(0.530)
Other controls	Yes	Yes	Yes	Yes
Technical efficiency (TE)	49%	50%	50%	48%
Observations	1,454	1,454	718	736
Clustered standard errors in parentheses				
*** p<0.01, ** p<0.05, * p<0.1				

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- Land, labor, and purchased inputs are all statistically significant

Preliminary findings

- Statistically significant parameters within the expected range
- Parameters estimates suggest increasing returns to scale
- TE gap between treated and control households, though small (2 percentage points)

Next steps

- Implement SC-SPF model and compare results with conventional SPF model to assess the role of (and quantify) sample selection
- Implement SMF model
- Calculate metafrontier efficiency scores
- Conduct heterogeneity analysis across sub-groups (e.g. by farm size, by education level, etc.)
- Provide sensitivity analysis based on different model specifications to check robustness of results

Any questions?

Thank you!

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