"Modelling Technology Adoption and Technical Efficiency in Maize Production in Rural Ethiopia"

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Technology Adoption and Technical Efficiency

in Maize Production in Ethiopia

Discussion:

1. What does this paper do?
    - Document some very interesting patterns in the data
    - Exercise could be more transparent
2. What do we learn from that?
    - Contribute to a very important 'big question'
    - There is more to learn from these data than is in the paper

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Does technology adoption increase efficiency?

- Ethiopia, 2011
  - Improved Maize Varieties (IMV), adoption rate 35%
  - Survey $\approx 2,500$ maize-producing farm households (cross-sectional)

Variables	*Definition*	*Improved Maize (N= 1954)*	*Local maize (N=409)*
		Mean	Mean
Maize Output	Total maize yield (in kg)	2821.80 (21121.50)	876.80 (1634.40)
Inputs:			
Labour	Family and hired labour (in male-days)	38.12 (41.61)	29.12 (79.44)
Land	Area for maize cultivation, in hectare	0.91 (0.86)	0.6 (0.9)

Stochastic frontier analysis

- Maize output of farmer i

$$\ln Y_i = \underbrace{\ln Y_i^*}_{\text{technology frontier}} - \underbrace{u_i}_{\text{technical inefficiency}}$$

- Technology frontier equation

$$\ln Y_i^* = f(X_i; \beta) + v_i$$

  - X_i = labour, land, fertilizer, ...
  - v_i = production inputs outside of farmer's control (weather, ...) $\sim i.i.d.N$

- Technological efficiency equation

$$u_i = \alpha_0 + Z_i'\delta - \theta\ IMV_i + \omega_i$$

  - Z_i = farmer's human capital, farm quality, wealth and information
  - $u_i > 0 \sim i.i.d.\text{truncated}N$

Stochastic frontier analysis

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- Substituting

$$\ln Y_i = \underbrace{f(X_i; \beta) + v_i}_{\text{technology frontier}} \underbrace{- \alpha_0 - Z_i'\delta + \theta\ IMV_i - \omega_i}_{\text{technical inefficiency}}$$

Stochastic frontier analysis

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- *Suggestion 1:* Estimate this equation (also) with OLS
  - Intercept α_0 biased with OLS, but not interesting nor credibly identified
  - MLE is (slightly) more efficient, but requires more assumptions
  - Transparency is important!

Stochastic frontier analysis

- Maize output of farmer i

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- *Suggestion 1:* Estimate this equation (also) with OLS
- *Suggestion 2*: Think about parameter estimates, not 'TE scores'
  - Technical Efficiency (TE)

$$u_i = \alpha_0 - Z_i'\delta + \theta\ IMV_i - \omega_i$$

  - ω_i not identified (error term is $v_i + \omega_i$)
  - Mean TE is not interesting, differences are (between adopters and non-adopters, between regions, etc.)
  - Transparency is important!

Stochastic frontier analysis

- Maize output of farmer i

$$\ln Y_i = \underbrace{f\left(X_i;\beta\right) + v_i}_{\text{technology frontier}} \underbrace{- \alpha_0 - Z_i'\delta + \theta\ IMV_i - \omega_i}_{\text{technical inefficiency}}$$

- *Suggestion 1:* Estimate this equation (also) with OLS
- *Suggestion 2*: Think about parameter estimates, not 'TE scores'
- Econometric issues
  - IMV_i is endogenous (selection) $\Rightarrow$ PSM
  - Heterogeneous technology

$$\ln Y_i = \underbrace{f\left(X_i;\beta_1\right) + f\left(X_i;\beta_2\right) * IMV_i + v_i}_{\text{technology frontier}} \underbrace{- \alpha_0 - Z_i'\delta + \theta\ IMV_i - \omega_i}_{\text{technical inefficiency}}$$

Does technology adoption increase efficiency?

Table 8: Average Treatment Effect of IMV on TE

Technology assumption			IMV growers (treated)	Local maize growers (control)	Difference
Homogenous technology assumed for IMV and local maize	ATT	Unmatched	0.683	0.588	0.095***
		Matched	0.684	0.596	0.088***
	# of farmers	On support	1578	313	
		Off support	5	0	
Different technologies	ATT	Unmatched	0.675	0.624	0.051***
		Matched	0.675	0.632	0.043***
		On support	1578	313	
		Off support	5	0	

Notes: * p<0.1, ** p<0.05, *** p<0.01.

SE stands for robust standard error. *psmatch2 command in* Stata 14 was used for matching.

Conclusion: IMV adoption increases maize output by 4.3%

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The big question & contribution of this paper

- Why low technology adoption in agriculture in SSA?
  - Agriculture important part of the economy, food security is an issue
  - Widely available technologies dramatically increase yields (adoption $\approx 100\%$ in other countries)
- Answer: costs and benefits are heterogeneous (Suri, Ema 2011)
  - Poor infrastructure, credit constraints, lack of commitment devices, information barriers, learning
  - Absolute and comparative advantage in production efficiency
- This paper:
  - Examine link between technology adoption and production efficiency

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  - Absolute and comparative advantage in production efficiency
- This paper:
  - Examine link between technology adoption and production efficiency
  - *Suggestion 3*: Document heterogeneity in effect adoption on efficiency (Who has a comparative advantage in adopting IMV?)

Heterogeneity in effect technology adoption on efficiency

- Estimation equation

$$\ln Y_i = f\left(X_i, IMV_i; \beta_1, \beta_2\right) + v_i - \alpha_0 - Z_i'\delta + \theta\ IMV_i - \omega_i$$

  - θ = average effect of adoption
  - β_2 = difference in technology between adopters and non-adopters
  - δ = determinants of efficiency (adopters and non-adopters)

- *Suggestion 4*: Extended estimation equation

$$\ln Y_i = f\left(X_i, IMV_i; \beta_1, \beta_2\right) + v_i - \alpha_0 - Z_i'\delta + \theta_0\ IMV_i + \underline{\left(Z_i * IMV_i\right)'\theta_1} - \omega_i$$

  - θ_1 = difference in effect adoption across characteristics farm(er)
  - Who has comparative advantage in IMV adoption?

- Econometric issues
  - PSM makes control and treatment group similar
  - *Suggestion 5*: Selection model? (PS equation is the selection equation)

Other comments (for the author)

- Clean up the writing! Many typos, and hard to understand what you are doing.
- Robust standard errors cannot solve endogeneity issue (p.11)
- Gamma estimate (p.14, footnote 11): How is σ_u identified from σ_v? Does this assume that $\sigma_\omega = 0$? If not, is that a reasonable assumption?
- Robustness checks need to be reported somewhere, e.g. in an appendix. Cannot just claim that e.g. you estimated the model using a Cobb-Douglas specification and the results were similar.
- Main result (ATT) should be in the abstract, instead of minor result (effect covariates).
- Discuss covariates in the preferred specification instead of in the homogeneous technology one.