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Is morbidity technology changing? Evidence from Burkina Faso

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Motivation

- It has been proposed that over time a country may not employ the same technique when transforming inputs into outputs (Mundlak 1989)
- That is, time variant state variables may exist that explain the choice of technology at a certain point in time.
- Human capital variables may constitute one category of technology changing variables.
- Applying Mundlak's proposition at the micro level would mean questioning whether all households use the same technology
- And we can let go of that restrictive assumption what are potential state variables that can explain heterogeneity in technology.

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Motivation

- The role of human capital in agricultural production has widely been acknowledged
- Agricultural production functions often include human capital either as an input in an augmented production function or as a technology shifter affecting production efficiency
- Morbidity is one aspect of human capital, people weakened by illness may, for example, be less able to make the right managerial decisions.
- However, the question that remains to be answered is whether morbidity could change both the slope and the intercept of a production function
- I.e. is morbidity technology changing?

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Empirical model

- Cobb-Douglas production technology

$$y = A \prod_{i=1}^{n} x_i^{\beta_i} \qquad (1)$$

Where

$$\log A = \alpha_0 + \sum_{k=1}^{m} \alpha_k \tau_k + \mu_0 \qquad k = 1, \ldots \ldots m \qquad (1a)$$

$$\beta_i = \gamma_{i0} + \sum_{k=1}^{m} \gamma_{ik} \tau_k + \mu_i \qquad i = 1, \ldots \ldots n \qquad (1b)$$

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Empirical model ctd.

- In (1) y is output produced by inputs, x,
- τ_k's are the technology changing variables,
- $\alpha's$ and $\gamma's$ are fixed coefficients,
- μ_0 is a random variable distributed independently of the $x_i's$ and $\tau_k's$,
- the $\mu_i's$ are random variables independent of the τ_k with mean zero and a finite positive semi-definite covariance matrix.
- The $\beta_i's$ represent elasticities of output with respect to each of the input variables
- The technology changing variables determine the production elasticities and are taken by households as parameters for the current production period.

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Empirical model ctd.

- Expressing equation (1) in logs, we obtain the convenient econometric model

$$\log y = \alpha_0 + \sum_{k=1}^{m} \alpha_k \tau_k + \sum_{i=1}^{n} \gamma_{i0} log x_i + \sum_{i=1}^{n} \sum_{k=1}^{m} \gamma_{ik} \tau_k log x_i + \sum_{i=1}^{n} \mu_i log x_i + \mu_0 \quad (2)$$

- The elasticity of productivity of the technology changing variables for this function is evaluated as:

- $\psi_k = \sum_{i=1}^{n} \gamma_{ik} log x_i + \alpha_k \quad (3)$

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Estimation

- Households maximize a production function in an imperfect market environment
- Missing markets for land, labor and finance
- Land endowment can be taken as fixed, not a choice variable in the production process
- Capital endowment taken as fixed in the short run although may change over longer time periods
- However the quantity of labor and fertilizer applied may be endogenous to this process
- Morbidity also likely to endogenous
- OLS estimates of the production function thus biased

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Estimation ctd.

- Need to instrument for variable inputs and morbidity
- Identification strategy: exogenous variables that can explain application of inputs and share of household members affected by morbidity but do not independently explain agricultural output
- For labor: household size (not likely to vary in the short run), number of dependents and religion
- For fertilizer: dummy for cultivation of waterside plots (horticulture), household's distance to dirt road, ethnicity.
- For morbidity: dummy for improved material used in construction of residence of household head, years of formal education for non-head household members, number of children and a community level crowding variable.

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Data

- Data IFPRI-LAQADS collected in Jan-Feb 2011
- 540 households drawn in 36 villages in eight provinces.
- Sampling: households selected by a random draw from 6 strata that cover Burkina's rural areas
- Strata drawn up on the basis of the quality of social indicators (health, education, nutrition, access to potable water) of their inhabitants and the concentration of NGOs
- Eight out of Burkina Faso's 45 provinces were selected
- In each province, two districts were randomly drawn and in each district four or five villages depending on the size of the department were randomly selected

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Data ctd.

Table 1: Human capital indicators

Variable	Mean	Std. Dev.	Min	Max
Morbidity (share of household members that have been sick during the past 12 months)	0.25	0.21	0	1.00
Education (years of formal education of head of household)	0.62	1.99	0	20

Table 2: Agricultural production data

Variable	Mean	Std. Dev.	Min	Max
Output (kg)	1 848	2 197	0	15 150
Weighted value of output (FCFA)	371 734	534 367	0	5 646 136
Land (ha)	3.57	2.89	0	21.27
Labor (days)	310	309	0	3 545
Fertilizer (kg)	117	284	0	2 485
Current value of equipment (FCFA)	58 005	84 038	0	700 700
Number of observations	540			

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Data

Table 3: Correlations human capital variables and agricultural production

	Morbidity	Education
Output (kg)	-0.08*	0.01
Weighted value of output (FCFA)	-0.05	-0.00
Yield (kg/ha)	0.02	0.10**
Labor (days/ha)	0.06	0.03
Fertilizer (kg/ha)	-0.01	0.13**

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Results

Table 1 First stage estimation results	Log of household labor (days)	Log of fertilizer (kg)	Log morbidity (share of members)
Log land (ha)	0.53 (0.08)**	0.73 (0.15)**	-0.01 (0.06)
Log value of equipment (FCFA)	0.02 (0.02)	0.22 (0.06)**	-0.08 (0.02)**
Log formal education head (years)	-0.004 (0.07)	0.22 (0.17)	0.07 (0.07)
Household size	0.07 (0.01)**		
Number of dependents	-0.48 (0.19)**		-0.09 (0.02)**
Waterside plots (1=yes)		1.01 (0.30)**	
Improved material head's residence (1=yes)			0.17 (0.10)*
Ethnicity (1=Mossi)	0.23 (0.08)**	1.00 (0.20)**	
Religion (1=Muslim)	0.14 (0.09)*		
Distance to dirt road (km)		-0.02 (0.01)**	
Formal education (years)			-0.02 (0.004)**
Community level population density			0.005 (0.002)**
R-squared	0.39	0.51	0.15
Hansen J-statistic (p-value)	0.11	0.20	0.16
Kleibergen-Paap Wald rk F statistic	20.43	14.38	13.58
Stock-Yogo critical values			
15% maximal IV size	13.91	13.91	16.85
20% maximal IV size	9.08	9.08	10.27
25% maximal IV sizes	6.46	6.46	6.71
Endogeneity test (p-value) (H0: variable is exogenous)	0.04	0.58	0.05

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Results ctd.

Table 5: Cobb-Douglas production with technology changing variables

	Linear	Morbidity	Formal education of head
Land	0.72** (0.18)[a]	0.16 (0.13)	-0.26** (0.11)
Machinery	-0.04 (0.06)	-0.09** (0.05)	0.01 (0.04)
Inputs	0.12** (0.06)	0.01 (0.04)	-0.00 (0.02)
Household labor	0.01 (0.13)	-0.08** (0.04)	0.16 (0.13)
Intercepts	11.06** (0.83)	0.93* (0.45)	-0.61 (0.60)
Breusch-Pagan test for heteroskedasticity (P-value)			0.38
F-test random effects on intercept (P-value)			0.08
F-test random effects on coefficient (P-value)			0.05

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Results ctd.

Table 6:Productivity and production elasticities for technology changing variables

	Variable coefficient[a]	Fixed coefficient[b]
Productivity elasticity for technology changing variable		
Morbidity (share of members)	-0.237 (0.135)*	
Formal education of head	0.113 (0.048)**	
Production elasticity for traditional input variable		
Land	0.522 (0.093)**	0.447 (0.082)**
Household labor	0.110 (0.118)	0.275 (0.086)**
Machinery	0.074 (0.025)**	0.079(0.025)**
Fertilizer	0.116 (0.017)**	0.127 (0.017)**
Sum (traditional inputs)	0.822	0.928

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Conclusions

- Human capital variables are technology changing – affect slope and intercept of production function
- Morbidity lowers the returns to labor – sickness leads workers to be less able to apply their labor effectively
- Formal education of household head lowers the returns to land – this could be a loss of interest in agriculture due to non- or off-farm opportunities.

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