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Off-Farm Labor Supply Effects of Farm Mechanization

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1. Motivation

- Movement of surplus labor from agriculture to the non-farm sector is considered as an important feature of economic development.
- Due to rise of non-farm employment opportunities in rural area, farm operators may relocate their labor hours between farm and non-farm uses.
- The use of labor-saving technology such as tractors, threshers, husking machines etc., has created scope for releasing labor time for higher productive off-farm works.
- Much focus has been on modeling and examining the off-farm labor supply effects of farming efficiency, and farm income; off-farm labor supply effects of agricultural mechanization remain unexplored.

2. Objective

The main objective of the paper is to examine the impact of farm mechanization on off-farm labor supply decision of farm operators?

3. Conceptual Framework

- An agricultural household model (Singh et al., 1986; Sadoulet and deJanvry, 1995) is used to establish the relationship between farm mechanization and off-farm labor supply.
- We introduce mechanization into production technology in agricultural household model.
- Farm Household Maximizes Utility Function:
$$U = U(q, l; z)$$
- Subject to:
- Income Constraint: $p_c q + rX(T) = p_f Q + wM$
- Technology Constraint: $Q = Q\{X(T), F(T), D\}$
- Time Constraint: $T = M + F(T) + l$
(Here q is quantity consumed, Q is quantity produced, l is leisure, z is other household characteristics, X is vector of inputs, T is mechanization level used in production process, F is farm labor hour; and M is off-farm labor hours.)
- Solution of the above Household's model lead to the following generic derived supply of off-farm labor:
$$M^* = M(r, w, p, p_f, T, D, z)$$
- We have estimated a simplified reduced form model of labor supply.

4. Models and Data

- Econometric Model for Participation Status & Level of Off-Farm Labor Supply
$$Y_i^* = T\alpha + X_i\beta + \epsilon_i \quad \text{Where } Y_i = 1, \text{ if } Y_i^* \geq 0 \quad \text{and } Y_i = 0, \text{ if } Y_i^* < 0$$
- We use adoption of tractor by a farm household as proxy variable for mechanization. Thus T stands for tractor use dummy and X stands for other observable household characteristics.
- The corner solution implied in the off-farm labor supply decision raises the issue of censoring or selection issues. The censoring is recognized through the adoption of the Tobit model.
- To test Off-farm labor supply effects of farm mechanization, we use Household survey data from Bangladesh.

5. Results

	Probit Estimates	Probit: Effects	Marginal	Tobit Estimates
Tractor Use (Yes=1) (d)	0.0898** (0.0466)	0.0349** (0.018)		206.3*** (92.4)
Log (Distance from Dhaka (km))	-0.054* (0.033)	-0.021* (0.0128)		-100.14* (60.93)
Non- Crop Cultivation (Yes=1) (d)	-0.093 (0.0897)	-0.036 (0.034)		-119.93 (170.17)
Age of Household Head	0.00045 (0.0089)	0.000175 (0.0035)		5.19 (18.11)
Squared Age	-0.00002 (0.000087)	-0.00007 (0.00003)		-0.764 (0.177)
Completed 8th Grade (Yes=1) (d)	-0.0014 (0.053)	-0.00054 (0.0205)		21.93 (106.2)
Receiving Foreign Remittance (Yes=1) (d)	0.2196*** (0.088)	0.0834*** (0.03235)		427*** (161.2)
Log (Amount of Operating Land)	0.0016 (0.0217)	0.0006 (0.0085)		-1.925 (43.85)
Other Member working Off-farm (Yes=1)	-0.0609 (0.0478)	-0.0238 (0.0187)		-128.82 (96.71)
Number Children under 15 Yrs	-0.0184 (0.0182)	-0.0072 (0.007)		-66.75* (36.81)
Constant				1490.7*** (571.93)
Smith-Blundell test of exogeneity of Tractor: Chi-sqr(1)= 0.2365				F(1,3293)= 0.160
/sigma				2378*** (33.95)
Observations	3304	3304		3304

5. Results

- Adoption of tractor, the proxy variable for farm mechanization, raise the probability of participation of farm operators in off-farm works by 3.5 percent.
 - Similar to the participation decision, farm operators who adopt tractor in farming work on average 206 hours more in off-farm employment compared to the farm operators who do not adopt tractor in farming.
 - The Smith-Blundell tests for exogeneity of tractor fail to reject the null hypothesis of exogeneity of tractor use for both Probit and Tobit models.
 - Farm operators who live far from the capital are less likely to participate in the off-farm works as density of non-farm activities declines with the distance from the capital.
 - Foreign remittance recipient farm operators are 8.3 percent more likely to participate in non-farm works as foreign remittance may ease the credit constraint for starting new businesses.
 - Education does not have a significant effect on the off-farm labor supply of farm operators. This result consistent with earlier literature (Sumner, 1982; and Mishra & Goodwin, 1997).
- ## 6. Conclusion and Policy Implications
- The results confirm that tractor use in cultivation could raise both the probability of participation in off-farm works and the amount of hours worked in the off-farm employment.
 - As off-farm works are generally more remunerative, welfare of farm households could be raised through rapid agricultural mechanization.
 - Developing economies with high growth in non-agriculture could promote mechanization through subsidized mechanized farm equipments to release surplus farm-labor.

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