Farm Productivity and Energy Intake in Rural India[*]

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ABSTRACT

This paper attempts to verify whether the existence of the poverty nutrition trap has implications for agricultural productivity in rural India. We find evidence that energy intake has affected farm productivity in rural India irrespective of whether we do robust regression or control for self-selection issues through a Heckman procedure. Thus improving energy intake would help improve farm productivity in rural India.

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I. Introduction and Methodology

Another policy implication of a poverty nutrition trap is that farm output could be affected by calorie intake. To verify this we estimate the following form of a farm level production function.

This is specified as:

$$\text{Log } Q_i = d \log L^*_i + \mathbf{f} \log \mathbf{X}_i + g \log \mathbf{K}_{i+} \varepsilon_i \qquad \text{……..(1)}$$

Where Q_i is ith household farm output, L^*_i is effective labour input supply measured as $L^*_i = h(.) L_i$, and $h = E_i^{di}$, (where E_i is IV estimate of average calorie intake of a family worker, **X** is a vector of other variable inputs (e.g. hired labour, bullocks, fertiliser), K is a vector of fixed inputs (e.g. land, tractors), and ε_i is an i.i.d error term.

Equivalently,

$$\text{Log } Q_i = d_1 \, d \log E_i + d \log L_i + \mathbf{f} \log \mathbf{X}_i + g \log \mathbf{K}_{i+} \varepsilon_i \quad (2)$$

Note that in addition, we could use schooling years of household head, ethnic background, age and age square, education, regional dummies, proportion of area irrigated, and whether the village has any development programmes. We could experiment with a quadratic energy intake. In this case $h = E_i^{d2}.(E_i^{2})^{d2}$ and another term enters equation 2 additively.

II. Results

We use a multinomial logit estimation to predict the probability of being a cultivator. The data used in this paper comes from the National Council for Applied Economic Research (NCAER). This data were collected through a multi-purpose household survey spread over six months, from January to June 1994. The data were collected using varied

reference periods based on some conventional rules. The results from the estimation of the multinomial are reported in Table 1.

Table 1: Multinomial Logit Model for predicting probability of being a cultivating Household

Multinomial logistic regression			Number of obs	=7112
Log pseudo-likelihood =	.		Wald chi2(48) = Prob > chi2	= =
Employed	Coef.	Robust Std. Err.	z	P>z
1				
Headage	0.017842	0.114209	0.16	0.876
headage2	-0.00017	0.00085	-0.2	0.838
Amale	-0.09194	0.549474	-0.17	0.867
Afemale	-0.18747	0.202135	-0.93	0.354
Hhgrp	1.201737	2.601734	0.46	0.644
HINDU	-0.84549	6.809308	-0.12	0.901
MUSLIM	-1.25798	9.687174	-0.13	0.897
CHRISTIAN	-0.0176	8.360935	0	0.998
SIKH	-1.4929	3.501264	-0.43	0.67
TRIBAL	-167.967	.	.	.
JAIN	1.890682	11.77738	0.16	0.872
land_own	0.034654	1.002856	0.03	0.972
land_own2	-6E-05	0.001693	-0.04	0.972
RAINFALLINDEX	0.00065	0.000261	2.49	0.013
Bimaru	-0.56459	1.02514	-0.55	0.582
FEMALEHEADHH	0.181989	2.022334	0.09	0.928
Coastal	-0.21157	2.031909	-0.1	0.917
_cons	3.266708	7.660754	0.43	0.67
2				
Headage	0.020846	0.108413	0.19	0.848
headage2	-0.00019	0.000824	-0.23	0.82
Amale	-0.13012	0.496927	-0.26	0.793
Afemale	-0.07067	0.191068	-0.37	0.711
Hhgrp	0.533542	2.345021	0.23	0.82
HINDU	-0.83303	6.507863	-0.13	0.898
MUSLIM	-0.83584	9.186911	-0.09	0.928
CHRISTIAN	-1.02427	8.026529	-0.13	0.898
SIKH	-3.60296	3.598008	-1	0.317
TRIBAL	-181.351	.	.	.
JAIN	-1.13723	11.08407	-0.1	0.918
land_own	0.003394	0.942384	0	0.997
land_own2	-2.3E-05	0.001501	-0.02	0.988
RAINFALLINDEX	0.000336	0.000294	1.14	0.254

Bimaru	-0.38736	0.892982	-0.43	0.664
FEMALEHEADHH	0.075132	1.87373	0.04	0.968
Coastal	0.067288	1.914682	0.04	0.972
_cons	1.042045	7.305637	0.14	0.887
	4			
Headage	-0.0389	0.146185	-0.27	0.79
headage2	0.000309	0.001232	0.25	0.802
Amale	-0.43862	0.713786	-0.61	0.539
Afemale	-0.0976	0.378217	-0.26	0.796
Hhgrp	2.138696	3.318063	0.64	0.519
HINDU	1.782214	6.932591	0.26	0.797
MUSLIM	2.646517	9.634771	0.27	0.784
CHRISTIAN	7.490437	10.70612	0.7	0.484
SIKH	-0.8308	3.651146	-0.23	0.82
TRIBAL	42.48592	.	.	.
JAIN	5.257467	14.74744	0.36	0.721
land_own	0.311153	1.031832	0.3	0.763
land_own2	-0.00097	0.001961	-0.49	0.622
RAINFALLINDEX	0.000635	0.000619	1.03	0.305
Bimaru	-1.25843	1.792535	-0.7	0.483
FEMALEHEADHH	2.201646	3.197906	0.69	0.491
Coastal	0.592066	2.167332	0.27	0.785
_cons	-4.50328	10.38256	-0.43	0.664

p1 is the probability the household is a cultivating household, p2 is the probability of being employed in non-agriculture, p3 of being self employed and p4 of being employed in other sectors. Occupation 3 is taken as the default category.

The estimated probabilities are then used in the farm output regression (2). However, since there is the possibility of zero output we have a sample selection problem and the analysis has to be based on robust or robust regression methods. We report results on these in Tables 2 and 3 below.

Table 2: Robust Regression of Farm Productivity

Robust Regression

Regression	with	robust	standard	errors
Number of obs	=	340		
F(12, 327)	=	139.89		
Prob > F	=	0		
R-squared	=	0.8675		
Root MSE	=	0.38154		
		Robust		
Loutput	Coef.	Std. Err.	T	P>t
Enepchat	1.738396	0.772253	2.25	0.025
enepchat2	-1.74E-07	5.16E-08	-3.37	0.001
Loggrosscroppedarea	0.961107	0.03104	30.96	0
Logpropnirrigatedland	0.242948	0.048428	5.02	0
SC/ST	0.114476	0.060252	1.9	0.058
Logtotagland	-0.01121	0.036961	-0.3	0.762
Lithead	-0.07739	0.052789	-1.47	0.144
Ownbullockcart	0.236019	0.050886	4.64	0
Headage	0.00222	0.009739	0.23	0.82
headage2	-7.3E-05	9.93E-05	-0.73	0.464
Probcultivatinghousehold	0.115716	0.113882	1.02	0.31
FEMALEHEADHH	0.066474	0.123247	0.54	0.59
_cons	-5.90131	5.579786	-1.06	0.291

Table 3: Heckman Selection Results on Farm Productivity

Heckman selection	model -- two-step estimates	Number of obs	=	2803
(regression model	with sample selection)	Censored obs	=	2466
		Uncensored obs	=	337
		Wald chi2(16)	=	1169.02
		Prob > chi2	=	0
	Coef.	Std. Err.	z	P>z
Loutput				
Enepchat	1.091935	0.445747	2.45	0.014
enepchat2	-1.06E-07	4.01E-08	-2.65	0.008
loggrosscroppedarea	0.922893	0.028984	31.84	0
logpropnirrigatedland	0.306527	0.05008	6.12	0
SC/ST	0.092081	0.052779	1.74	0.081
Logtotagland	-0.00022	0.037806	-0.01	0.995
Lithead	-0.05011	0.0503	-1	0.319
Ownbullockcart	0.114048	0.053643	2.13	0.033
Headage	0.00077	0.009106	0.08	0.933
headage2	-4.8E-05	0.000097	-0.49	0.623
p1	0.226262	0.095587	2.37	0.018
FEMALEHEADHH	0.12134	0.083436	1.45	0.146
_cons	-1.1337	3.241675	-0.35	0.727
Select				
Employed	-1.04739	0.172198	-6.08	0
Headage	0.02937	0.022441	1.31	0.191
headage2	-0.00033	0.000243	-1.34	0.18
Amale	-0.02295	0.063169	-0.36	0.716
Afemale	0.126189	0.074949	1.68	0.092
SC/ST	-0.27471	0.098659	-2.78	0.005
HINDU	1.409911	0.614248	2.3	0.022
MUSLIM	0.999224	0.634523	1.57	0.115
CHRISTIAN	1.472492	0.68705	2.14	0.032
SIKH	1.765184	1.445415	1.22	0.222
TRIBAL	2.714948	1.075691	2.52	0.012
JAIN	-2.92752	.	.	.
Land_own	0.180378	0.008128	22.19	0
Land_own2	-0.00054	2.89E-05	-18.69	0
RAINFALLINDEX	-0.00105	0.000179	-5.88	0
Bimaru	-0.12459	0.121928	-1.02	0.307
FEMALEHEADHH	-0.0063	0.200306	-0.03	0.975
Coastal	0.243072	0.126637	1.92	0.055
_cons	-2.568	0.823431	-3.12	0.002

Mills				
Lambda	-0.18441	0.038604	-4.78	0
Rho	-0.48455			
Sigma	0.380579			
Lambda	-0.18441	0.038604		

In both the Heckman and the robust regression versions of the model enepchat appears as a strong and significant determinant of output. Thus higher energy intake leads to higher output. This results further corroborates our contention that energy intake is affecting farm productivity in rural India.

III. Conclusions

This paper has supported our contention that energy intake has affected farm productivity in rural India. Whether one does robust regression or controls for self-selection issues through a Heckman procedure we get strong effects of energy intake on farm productivity. Thus improving energy intake would help improve farm productivity in rural India.