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Technical Efficiency of Paddy Farmers in Cauvery Delta Zone - A Comparative Study of Corrected Ordinary Least Square and Maximum Likelihood Estimates

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Abstract

The study employed a corrected ordinary least square and maximum likelihood estimate approach to find the technical efficiency of the production of rice in the Cauvery delta zone of Tamil Nadu. The data collected for two years (2009-10 and 2010-11) under the Cost of Cultivation Scheme of Tamil Nadu Centre were used for the study. The results of OLS and MLE of technical efficiencies were compared. The result showed that 97% of farmers having their technical efficiency above 0.5 in maximum likelihood estimates but 88% of farmers were falls in this range in Corrected OLS estimates. The output oriented mean technical efficiency was found to be 81% in maximum likelihood estimates whereas 86% corrected OLS estimates. This shows that Maximum likelihood estimates are more consistent over corrected OLS estimates.

Introduction

Rice is the stable food of over half the world's population. Rice is one of the most important food crops of India contributing to 43 percent of total food grains production in the country. The rice harvesting area in India is the world's largest. The major rice growing States are West Bengal, Uttar Pradesh, Andhra Pradesh, Punjab, Tamil Nadu, Orissa, Bihar and Chhattisgarh, which together contribute about 72 percent of the total area and 76 percent of the total production in the country. In Tamil Nadu, rice is grown over an area of 18 lakh to 20 lakh hectares annually primarily in tank irrigated conditions.

The present study undertaken in Cauvery delta in the state of Tamil Nadu has estimated the technical efficiency in rice production under canal irrigated farms and comparison made among the Corrected Ordinary least square method and Maximum likelihood estimates. Technical efficiency is an indicator of the productivity of the farm and the variation in technical efficiency can reflect the productivity difference across farms.

Sampling and Data Collection

Cauvery delta zone was selected purposively for this study. The sample holdings for analysis in the present study were fixed ultimately based on the fact that these had grown paddy in the two years (2009-10 and 2010-11). The data collected under the cost of cultivation scheme were used. Under the scheme a stratified random sampling method was adopted. In Cauvery delta zone totally seven taluks were selected for the present study to represent canal irrigation. The number of farmers in canal irrigation is 109. Total number of samples cultivating paddy in both the years were fixed at 218.

Materials and Methods

In the present study, the corrected OLS technique were used to measure Technical efficiency of rice cultivating farms (V.P Sharma, 1997; A. Sani, 2013; A. F. Lawal *et. al*, 2013). In analyzing technical efficiency, it is not the average output, but the maximum possible output obtainable from a given bundle of inputs, is of importance. The two OLS (Ordinary Least Square) approaches are Corrected OLS (COLS), developed by Winsten (1957) and Greene (1980) and Modified OLS (MOLS) by Richmond (1974). Both of these methods rely on OLS to estimate the production function parameters, but differ in their treatment of the OLS residuals (ϵ_i).

A slightly different approach than OLS involves shifting the line towards the best performing company, which is called Corrected Least Squares methodology (COLS). In a general sense, COLS is merely a shifted average function. Two steps are needed, one to get the expected value of the error term and another to shift or to “center” the equation. The COLS estimator is obtained by turning the least squares estimator into a deterministic frontier model. This is done by shifting the intercept in the OLS estimator upward (for a production frontier) or downward (for a cost frontier) so that all points lie either below or above the estimated function.

The COLS procedure shifts the frontier up by the amount of the largest residual, thus generating a frontier that truly envelops the data. As an example, using our notation, at the first stage a (log-linear) production model such as the following would be estimated by OLS.

$$\ln y_i = \beta_0 + \sum \beta_j \ln x_i + \epsilon_i$$

In the second stage the residuals would be utilized to shift the frontier to envelop the data. The maximum residual is denoted as $\epsilon_{max} = \max(\epsilon_i)$

The COLS intercept would be estimated as,

$$\beta_{COLS} = \beta_0 + \epsilon_{max}$$

This shifts the frontier up so that the observation coinciding with the largest positive residual will be on the frontier, with other observations under the frontier. Efficiency analysis in this approach can be viewed as a receiving efficiency scores relative to the fully efficient observation. Also notable is the fact that the COLS frontier does not necessarily bounds the data from above as closely as possible as the corrected frontier is parallel to the OLS frontier by definition. The technical efficiency of production for the i^{th} firm at the t^{th} time period is given by,

$$TE_{it} = \exp(-z_{it}\delta - w_{it})$$

Results and Discussion

Empirical Model

In the present study, both Cobb-Douglas production functions were initially considered to study the technical efficiency among rice farms.

$$\ln y_i = \beta_0 + \sum_j \beta_j \ln x_j, \quad j = 1, 2, 3, \dots, 6 \quad (\text{Cobb- Douglas type})$$

$$\mu = \delta_0 + \sum_{i=1}^6 \delta_i z_i \quad (\text{Linear type})$$

Where, y = Yield of paddy (quintal/ha);

Seed (x_1) = Quantity of seeds (kg/ha);

Fer (x_2) = Quantity of NPK nutrients (kg/ha);

Lab (x_3) = Human labour (hrs/ha);

Mach (x_4) = Machine hours (hrs/ha);

Pes (x_5) = Cost of plant protection (Rs./ha);

Age (z_1) = Age of the farmer in years;

Farm Size (z_2) = Area in hectares;

Edn (z_3) = Education of the farmer [illiterate (1), up to primary (2), upto secondary (3), up to collegiate (4) and post graduate (5)];

Table 1: Frequency distribution of Technical efficiency

Technical Efficiency	COLS			MLE		
	Number of Farms		Percentage	Number of farms		Percentage
	2009-10	2010-11		2009-10	2010-11	
<40	7	1	3.67	0	0	0
40-50	6	12	8.26	1	0	0.46
50-60	30	51	37.16	3	1	1.83
60-70	47	25	33.03	5	2	3.21
70-80	17	11	12.84	9	19	12.84
80-90	2	7	4.13	43	55	44.95
90-100	0	2	0.92	48	32	36.70
Total	109	109	218	109	109	218
Mean TE	0.81			0.86		

Household size (z_4) = Size of the farmer's household (number of family members);

Sea 1 (z_5) = Season dummy variable indicating season 1 (June-Sept.); 0 otherwise;

Sea 2 (z_6) = Season dummy variable indicating season 2 (Oct.-Jan.); 0 otherwise.

The Technical efficiency estimates based on the above input variables of canal irrigated paddy farms of COLS & MLE are presented in the following (Table 1) in the form of frequency distribution within a deciles range. The estimated mean output oriented technical efficiency is found to be 81% in corrected OLS method and 86% in Maximum likelihood estimates. Most farms were in the efficiency range of 50-60 percent followed by 60-70 percent in Corrected OLS estimates whereas in the case of Maximum likelihood estimates 80-90 percent followed by 90-100 percent. It is also found that only 1.83 percent of farmers were lies in the efficiency range less than 50 percent in Maximum likelihood estimated, but in Corrected OLS estimates it is found to be 8.26 percent farmers fall in that efficiency range.

Conclusion

In terms of distribution of technical efficiency among the farmers, the result showed that 97% of farmers having their technical efficiency above 0.5 in maximum likelihood estimates but 88% of farmers were falls in this range in

Corrected OLS estimates. The output oriented mean technical efficiency was found to be 81% in maximum likelihood estimates whereas 86% Corrected OLS estimates. The study results also implied that the technical efficiency of farmers in canal irrigation under maximum likelihood estimates becomes relatively more consistent, comparing to the corrected ordinary least square methods.

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