

RESEARCH NOTE

Sri Lanka Journal of Agrarian Studies 3 (2), 1982, 110-116.

THE EFFICIENCY OF FARM HOLDING SIZE AND TENANCY STATUS IN GIRITALE, POLONNARUWA DISTRICT (SRI LANKA)

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ABSTRACT

The pricing efficiency of the small and large size farms is equal in the study area. However, inefficiency occurs in the use of resources in these farms. In terms of profit maximizing the large farms are absolute price efficient. The owner operators are more price efficient and they maximize their profits with respect to the use of farm resources. Such a conclusion is not evident for tenant cultivators in the study area.

The government policies in Sri Lanka have emphasized on rice production to reduce dependence on imports and to effect saving of considerable foreign exchange. The farm size and tenancy in lowland paddy farming in the dry zone are important issues in Sri Lanka. As farms of less than 1 hectare in extent are predominant in the rural sector, the average yield of paddy per hectare is mainly influenced by the efficiency of the resource use of these small farms as implied by the nature of their production functions. The tenancy status relates to the adoption of the new rice technology by the rice farmers, and is an important issue with regard to the level of efficiency. As a significant portion of the dry zone paddy land is under tenurial arrangements, analytical information of this nature is required by policy makers to assess the need to modify the existing reform and tenurial legislation.

The efficiency may be either technical or pricing efficiencies. To examine the technical efficiency consider two production functions given by,

$$\begin{aligned} Q_1 &= A^1 f(X^1, Z^1) \text{ and} \\ Q_2 &= A^2 f(X^2, Z^2) \end{aligned} \quad (1)$$

where, Q is a vector of output; X is a vector of variable inputs; and Z is a vector of fixed inputs. f is twice continuously differentiable, concave production function. If $A^1 = A^2$, then both types of production are equally technically efficient.

To examine pricing efficiency define factor k as the degree to which the entrepreneurs in the two groups do not equate their value of the marginal product of a factor to the input price. The first order condition of the two groups is represented by

$$\frac{\partial A^1 f(X^1, Z^1)}{\partial X^1_j} = k^1_j, q_{j1} \quad (2)$$

$$\text{and} \quad \frac{\partial A^2 f(X^2, Z^2)}{\partial X^2_j} = k^2_j, q_{j2} \quad (3)$$

$$k^1_j > 0, k^2_j > 0, \quad j = 1, \dots, r$$

where all variables are defined as previously. The proportionality factor k represents the degree to which profit maximization conditions do not hold for a given firm.

The dual transformation relation between the production function and the profit function can be utilized to generate the empirical test of relative efficiency. Consider a normalized profit function given in the form,

$$G(q, z) = \text{Max } f(X, Z) - q \cdot X \tag{4}$$

where,

q = vector of input prices;
 X, Z = as defined above.

The demand for each factor input is obtained by differentiating the normalized restricted profit function with respect to the normalized factor price (Hotellings lemma).

$$X_i = \frac{-\delta G}{\delta q_i} \quad \text{for } i = 1, 2, \dots, n \tag{5}$$

To convert this into elasticity, multiply both sides of the equation

(5) by $\frac{q_i}{G}$

$$\frac{-q_i X_i}{G} = \frac{\delta G}{\delta q_i} = a_i^* \quad \text{for } i = 1, 2, \dots, n \tag{6}$$

Assuming a Cobb-Douglas technology with two variable inputs, and two fixed inputs,

$$f(X, Z) = I X_1^{a_1} X_2^{a_2} Z_1^{b_1} Z_2^{b_2} \tag{7}$$

The normalized restricted profit function in the logarithmic form for the above production function will be of the form,

$$\ln G = \ln I + a_1^* \ln q_1 + a_2^* \ln q_2 + b_1^* \ln z_1 + b_2^* \ln z_2 - 1 \tag{8}$$

where, $I = (1 - a_1 - a_2) \left(\frac{a_1}{1} \right)^{a_1(1 - a_1 - a_2)}$

$$\left(\frac{a_2}{1} \right)^{a_2(1 - a_1 - a_2)}$$

$$a_1^* = -a_1(1 - a_1 - a_2)$$

$$a_2^* = -a_2(1 - a_1 - a_2)$$

$$b_1^* = b_1 (1 - a_1 - a_2)^{-1}$$

$$b_2^* = b (1 - a_1 - a_2)^{-1}$$

Equation (6) of this function is of the form,

$$a_1^* = \frac{\partial \ln G}{\partial \ln q_1} = -\frac{q_1 X_1^*}{G} \quad (9)$$

$$\text{and } a_2^* = \frac{\partial \ln G}{\partial \ln q_2} = -\frac{a_2 X_2^*}{G} \quad (10)$$

Data collection and variables used

In 1980/81 *Maha* season the data for this study were collected from the Giritale colonization scheme in Polonnaruwa district. Information on nearly 80 variables was obtained by a questionnaire from 120 randomly sampled farms in the study area. On the basis of tenancy status 39 of these were owner cultivators, and 52 were under tenancy arrangements. From the original sample farms of mixed tenancy categories as "owner-tenant", and "tenant-owners" were rejected—a total of 91 holding sizes. Of these 59 were classified in terms of farms of less than 0.85 hectares and 32 as farm sizes of greater than 0.90 hectares (Table 1).

Table 1—TENANCY STATUS BY FARM HOLDING SIZES IN THE STUDY AREA

Tenancy categories	Farm sizes	
	Less than 0.85 hectares	Greater than 0.90 hectares
Tenants	43	9
Owners	16	23

The variables used in the estimated models include,

L = Total amount of labour used per farm in man days. This includes the amount of family, *attam* labour and hired labour used per farm for paddy operations;

F = Total cost of NPK fertilizers used per farm in rupees;

C = Total cost of plant protection and farm power in rupees per farm;

T = Proportional transplanted paddy area per farm. This includes the area under both row and random planting;

W = Wage rate per man day. This includes the wage rate of hired labour used in farm operations;

P_f = Average price of NPK fertilizers per farm in rupees;

e₁, e₂, e₃ are the error terms.

The inclusion of independent variables as rent for irrigation, interest for agricultural credit used by the farmers in the profit function provided poor estimates. This may have been related to the specification errors among variables, errors in data etc.

The covariance of the errors of any of the above equations may not yield zero, and hence estimation by ordinary least squares will result in consistent but not necessarily efficient estimators. Hence Zellners Seemingly Unrelated regression technique is used in estimating the parameters of the simultaneous equation system (8) to (10). The results are presented in Tables 2 to 5.

Results and discussion

Table 2 shows the results of the profit and factor demand function using the dummy for the holding sizes. The results of the profit function and the factor demand function using the dummy for tenancy are shown in Table 3. The results of the different restrictions hypothesized of the above models as presented in Tables 2 and 3 are shown in Tables 4 and 5.

Farm holding size model

The variables as cost of fertilizer, proportional area transplanted are significant in the unrestricted model for holding size. A decrease of 1 percent of the price of the fertilizers in farm will result in less than 1 percent of increase in profits. In addition, a similar increase in the area transplanted yields an increase of 0.5 percent of the profits per farm basis.

The hypothesis (1) of Table 4 tests for the pricing efficiency of different farm holding sizes. The estimates are not significant at 5 percent level, and this suggests that the pricing efficiency of farms greater than 0.90 hectares and less than 0.89 hectares are equal, i.e. both these holding sizes equate their value of the marginal products of the inputs with respect to the value of their factor prices. The hypothesis (2) tests for the resource use in these farm holdings. This is rejected at 1 percent level and this suggests that there is no relative technical efficiency existing in these two holding sizes, i.e. inefficiency exists in terms of resource use. The hypothesis (3) suggests that the holding sizes of greater than 0.90 hectares have absolute price efficiency of all inputs, i.e. they maximize profits by equating the value of marginal product of labour and fertilizer to their respective prices. A similar hypothesis (4) tested for smaller holding sizes is rejected indicating that these farms are inefficient in terms of maximizing their profits.

Tenancy model

The dummy for tenancy, the cost of fertilizer, and the proportional area transplanted were significant in the unrestricted model. All the coefficients were of the correct sign as in the farm holding size model. The use of the dummy for tenancy did not contribute to greater changes in the coefficients of the variables used in the model. In Table 5, the hypothesis (5) is tested to determine the price efficiency of the owner operated and tenant farms. The results suggest that the owner operated farms are more efficient than the tenant farms. The results of the hypothesis (6) indicate that the owner operators maximize their profits with respect to the use of both labour and fertilizer in their farms. However, such a result is not evident for tenant cultivators.

In summary, the pricing efficiency of the two different sizes of farm holdings considered in this study in Giritala is equal. However inefficiency exists in the use of resources in these farms. In terms of profit maximizing the larger farms are absolute price efficient. The owner operators are more price efficient and they maximize their profits with respect to the use of farm resources. Such a conclusion is not evident for tenant cultivators.

Table 2—RESULTS OF THE PROFIT FUNCTION AND FACTOR DEMAND FUNCTION FOR THE FARM SIZE MODEL

I. PROFIT FUNCTION

Variables	ParameterSeemingly Unrelated Regression.....		
		Unrestricted	One 1 Restriction	Two 2 Restriction
Constant	In 1*	0.924 (2.644)	0.924 (2.782)	0.864 (2.911)
Dummy for farm size	a ₁ *	-0.2640 (1.483)	-0.2594 (1.323)	-0.2660 (0.946)
Labour	a ₂ *	-0.0430 (0.728)	-0.0400 (0.513)	-0.1190 (0.620)
Cost of fertilizer	a ₃ *	0.0613 (4.780)	0.0613 (3.629)	0.0600 (4.162)
Cost of plant protection and farm power	a ₄ *	0.1301 (1.967)	0.1300 (1.845)	0.1147 (2.012)
Proportional area transplanted	a ₅ *	0.5062 (4.719)	0.5060 (3.781)	0.4932 (2.967)

II. FACTOR DEMAND

Labour	a *	-0.2946 (4.620)		
	L1			
	a *	-0.3071 (9.620)		
	a ₂ *		-0.2697 (7.620)	-0.2696 (7.599)
Fertilizer	a _{fl} *	-0.1167 (1.094)		
	a *	-0.0930 (1.946)		
	f2			
	a ₄ *		-0.0650 (3.700)	-0.0650 (3.700)

Figures in paranthesis are the 't' values of the coefficients

1	a ₁ *	a ₂ *	2	a ₁ *	a ₂ *	a ₃ *
	L1	L2		L1	L2	2
	a ₁ *	a ₂ *		a ₁ *	a ₂ *	a ₃ *
	f1	f2		f1	f2	3

Table 3—RESULTS OF THE PROFIT FUNCTION AND FACTOR DEMAND FUNCTION FOR THE TENANCY MODEL

I. PROFIT FUNCTION

Variables	Parameter	Unrestricted	One 3 Restriction	One 4 Restriction
Constant	In 1 *	1,9780 (3.967)	1,9780 (3.967)	1,9687 (2.980)
Dummy for tenancy	a ₆ *	-0.0670 (2.457)	-0.0650 (2.457)	0.0345 (1.980)
Labour	a ₇ *	0.3127 (0.117)	0.3120 (0.117)	0.1279 (0.046)
Cost of fertilizer	a ₈ *	-0.2458 (2.329)	0.2458 (2.311)	0.1879 (1.897)
Cost of plant protection and farm power	a ₉ *	0.1010 (1.911)	0.1010 (1.896)	0.9789 (0.997)
Proportional area transplanted ...	a ₁₀ *	0.9973 (8.978)	0.9968 (8.970)	0.9768 (5.968)

II. FACTOR DEMAND

Labour	a^*	-0.3958
	LT	(4.789)
	a^*	-0.4598
	LO	(3.900)
Fertilizer	a^*	-0.0987
	fT	(2.239)
	a^*	-0.1987
	fO	(2.449)

Figures in parenthesis are the 't' values of the coefficients

$$\begin{array}{ll}
 3 \quad a^* = a^* & 4 \quad a^* = a^* = a^* \\
 \quad \quad \quad \text{LT} \quad \text{LO} & \quad \quad \quad \text{LT} \quad \text{LO} \quad 7 \\
 \\
 a^* = a^* & a^* = a^* = a^* \\
 \text{fT} \quad \text{fO} & \text{fT} \quad \text{fO} \quad 8
 \end{array}$$

Table 4—RESTRICTIONS USED AND THE TESTING OF HYPOTHESES IN THE FARM SIZE MODEL

Tested Hypotheses	Computed 'F' Value	Critical 'F' Value at 0.05 level
(1) $a^* = a^*$ L1 L2 a f 1 = a f 2	1.306	3.07
(2) $a_T^* = 0$	6.490	3.92
(3) $a^* = a^*$ L1 3 a* = a* f1 4	2.216	3.07
(4) $a^* = a^*$ L2 3 a* = a* f2 4	5.530	3.07

Table 5—RESTRICTIONS USED AND THE TESTING OF HYPOTHESES IN THE TENANCY MODEL

Tested Hypotheses	Computed 'F' Value	Critical 'F' Value at 0.05 level
(3) $a^* = a^*$ LT LO a* = a* fT fO	4.70	3.07
(6) $a^* = a^*$ LT 7 a* = a* fT 8	2.06	3.07
(7) $a^* = a^*$ LT 7 a* = a* fT 8	6.17	3.07

Note: Subscript T refers to the tenant farms and O refers to the owner cultivated farms.

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