Ethiopian Journal of Development Research, Vol. 11, No. 1, April 1989

ORGANIZATIONAL AND INPUT LEVEL EFFECTS ON PRODUCTIVITY DIFFERENTIAL BETWEEN PRIVATE AND COLLECTIVE FARMS IN ETHIOPIA[1]

Yeshitila Teferra* and
S. Bisaliah**

ABSTRACT. This study is an attempt to decompose the productivity differential observed between the private farm and collective farm organization in Arsi into two: broad effects - organizational input level effect. It shows that private farms have higher productivity as a result of input saving and extra output gains. The imprical analysis conducted shows that the private farms could increase production and save input. However the paper argues that the estimated gains of the private farms in no way discount the importance of tangible and intangible gains of collective management.

1. INTRODUCTION

Peasant agriculture in Ethiopia is made up of a large number of small holder private farms, and a few but growing collectives.[2] The form of organization viz.; private vs collective is believed to have a substantial bearing on the overall economic performance of these groups of farms and thereby on the development performance of the national economy. Saith (1985), for instance, argues in favour of socialist collectives by considering collectivization as an appropriate strategy to internalise economic and social externalities not reaped by private small holder farms. Infact, collectivization is considered essentially the basis for transforming agriculture and ensuring socialist production relations

*Head, Planning and Programming Service, Ministry of Agriculure, South Eastern Agricultural Development Zone Office, Former CADU/ARDU, P.O.Box 3376, Addis Ababa, Ethiopia.

**Professor and Head, Department of Economics, University of Agricultural Sciences, Bangalore, GKVK 560 065 India.

in the country side. The strategy[3] for developing peasant agriculture is centred around these socialised collectives that are believed to bringout increased production, expansion of industry, accumulation of capital and mobilization of human resources to sustain economic development [See 5]. But the proponents[4] of the small holder strategy, which is based on individual free holds, feel that the collective strategy may not generate a substantial increase in agricultural productivity and substantial economic development, mainly because policies pursued by government lower incentives to produce.

These arguments apart, the present study attempts to account for 25.9 per cent positive productivity differential per hectare registered by private farms over collectives in terms of shift in the production surface and movement along the new production surface. The specific objective of this paper is to partition this productivity differential into two major components: organizational[5] and input level effects. The derived objective of the study is to estimate the input saving effected and extra output produced due to the superior productivity of private farms over collectives.

2. METHODOLOGY

2.1 Sample and Data[6]

Sampling of small holder private farms was done at two stages. At the first stage, a random sample of 3 Peasant Associations (PAs) were considered from among 57 PAs found in Hetosa Wareda, the area of present study coming under Arsi Region. At the second stage, a random sample of 30 private farms were chosen from each sample PA, forming a total sample of 90 bullock operated small private farms. A total of 23 collective farms comprising of 12 partly mechanised and 11 bullock-operated were also selected for the purpose of performance contrast. Cross section data for the year 1986-87 on these private and collective farms were obtained by interview method with the help of structured questionnaire and from unpublished official documents.

2.2. Economic and Empirical Models

The objectives setout for the present study could be assessed with production function framework. For chosing the appropriate production function form, a CES production function has been estimated both for private and collective farms using Kmenta's (1967) approximation method. Results[7] obtained have suggested that the Cobb-Douglas form would adequately estimate the input-output relationship. Moreover, a return to scale test has also been performed inorder to satisfy conditions for estimating per hectare production function. The results[8] obtained have indicated that constant returns to scale would characterise the functional relationship. Besides, a test of equality of parameters[9] governing the production relationships between private and collective farms has suggested that the regression equations for these two types of farms are different with respect to both intercept and slopes. Thus the results obtained have supported a further analysis to decompose the total change in productivity into components of organizational and input level effects.

The form of the Cobb-Douglas model used for the purpose is specified as follows:

$$TR = A\ LAB^{a}\ PWR^{b}\ FER^{c}\ SED^{d}\ e^{u} \quad \ldots\ldots(1)$$

Where:

TR : Per hectare total gross return (Productivity) from crop production in Birr[10];

A : Scale parameter;

LAB : Per hectare labour input measured in man-days;

PWR : Per hectare bullock and/or machinery power used measured in Birr;

FER : Per hectare chemical fertilizer used, measured in quintals;

SED : Per hectare seed used, measured in Birr;

U : The random disturbance term independently and normally distributed with zero mean and finite variance.

a,b,c,d, : Total return elasticities of labour, power, fertilizer and seed respectively.

The parameter of the regression equation in (1) are estimated by Ordinary Least Square method in natural logarithms.

Since corresponding parameters governing the production functions for private and collective farms have been found different[11], the exercise of partitioning the total productivity differential has been performed. For this purpose of decomposition the logarithmic form of the Cobb-Douglas production function for private and collective farm organizations are given in (2) and (3) below respectively.

$$\text{Ln } TR_1 = \text{Ln } A_1 + a_1 \text{ Ln } LAB_1 + b_1 \text{ Ln } PWR_1 + C_1 \text{ Ln } FER_1 + d_1 SED_1 + u_1 \quad (2)$$

$$\text{Ln } TR_2 = \text{Ln } A_2 + a_2 \text{ Ln } LAB_2 + b_2 \text{ Ln } PWR_2 + C_2 \text{ Ln } FER_2 + d_2 SED_2 + u_2 \quad (3)$$

Following Bisaliah [1], the decomposition model specified in (4) below is used. Taking the difference between (2) and (3) and adding some terms and subtracting the same terms:

$$\text{Ln}TR_1 - \text{Ln } TR_2 = (\text{Ln } A_1 - \text{Ln}A_2) + (a_1 \text{Ln } LAB_1 + a_2 \text{ Ln } LAB_2) + a_1 \text{Ln } LAB_2 - a_1 \text{ Ln } LAB_2) + (b_1 \text{Ln } PWR_1 - b_2 \text{ Ln } PWR_2 + b_1 \text{Ln } PWR_2 - b_1 \text{ Ln } PWR_2) + (C_1 \text{Ln } FER_1 - C_2 \text{ Ln } FER_2$$

$$+ C_1 \text{Ln } FER_2 - C_1 \text{ Ln } FER_2) + (d_1 \text{ Ln } SED_1 - d_2 \text{ Ln } SED_2$$

$$+ d_1 \text{Ln } SED_2 - d_1 \text{ Ln } SED_2) + (U_1 - U_2) \quad \ldots\ldots(4)$$

Rearranging the terms in (4).

$$\text{Ln}\frac{TR_1}{TR_2} = \text{Ln}\left[\frac{A_1}{A_2}\right] + \left[(a_1 - a_2) \text{ Ln } LAB_2 (b_1 - b_2 \text{ Ln } PWR_2 + (C_1 - C_2) \text{ Ln } FER_2 + (d_1 - d_2) \text{ Ln } SED_2\right] + \left[a_1 \text{ Ln } \frac{LAB_1}{LAB_2} + b_1 \text{Ln} \frac{PWR_1}{PWR_2} + C_1 \text{Ln} \frac{FER_1}{FER_2} + d_1 \text{ Ln } \frac{SED_1}{SED_2}\right]$$

$$U_1 - U_2 \quad \ldots\ldots(5)$$

The decomposition model (5) involves ratios of natural logarithims of quantities in inputs and total return for private and collective farms. The left side of the expression above measures the total percentage change in total return under private farms in relation to collectives.

The first bracketed expression on the right hand side measures the percentage change in total return due to shift in the scale parameter of the production function; the second bracketed expression is a measure of change in total return due to shifts in the slope parameters; if we add the values of both the first and second bracketed expressions on the right hand side, we get a measure of organizattional effect. The third bracket expresses the sum of logarithms of the ratios of each input - private to collective - each weighted by the total return elasticity of that input. This expression is a measure of change in total return

elasticity of that input. This expression is a measure of change in total return due to the changes in the per hectare quantities of labour, fertilizer, power and seed used given the total return elasticities of these inputs under private farms.

To assess the derived objective of estimating the input saving effected and "extra" output (total return) produced due to superior productivity performance of private farms over collectives, the methodology suggested by Bisaliah [1] is used. The following definitions and expressions are used for estimating the value of input saved:

TR_{PVT} : Per hectare total return under private farms.

TR_{PC} : Per hectare total return under collective management.

I_{PVT} : Value of labour, power, fertilizer and seed inputs used in producing TR_{PVT}.

I_{PC} : Value of labour, power, fetilizer and seed inputs required to produce TR_{PVT} under collective management.

r : Percentage increase in total return per hectare under private farming with collective management levels of inputs of labour, power, fertilizer and seed.

S_I : Value of per hectare labour, power, fertilizer and seed inputs saved due to the production of TR_{PVT} under private management.

Therefore:

$$I_{PC} = \left[1 + \frac{r}{100}\right] I_{PVT}$$

$$S_I = \left[\frac{r}{100}\right] I_{PVT}$$

Further, the extra output approach permits us to estimate the quantity (Value) of extra output (return) obtainable under private farms, using the volume of inputs used under collective management:

Let:

Δ TR = $TR_{PVT} - TR_{PC}$: Change in total return per hectare in Birr.

r : As defined earlier,

(Δ TR) x (r) : Quantity of extra return due to organization effect alone.

3. EMPIRICAL RESULTS

It is recalled that constant returns to scale characterise the input - output relations under both types of farm organization and the test of equality of parameters governing the per hectare production function relationship between private and collective farms has suggested that the respective regression equation are different with respect to both slope and intercept parameters. These results therefore, have warranted the decomposition of total return differential into organizational and input effects.

The per hectare production functions for both private and collective farms, and the geometric mean levels of inputs required for the decomposition analysis are as in Tables 1 and 2 respectively.

Using decomposition equation (5) and the value of production parameters (Table 1) and mean values of inputs and returns (Table 2), the total productivity increase of 25.90 per cent under private farms over collective is partitioned into organization and input level effects. The empirical results on decomposition are presented in Table 3.

TABLE 1

Per Hectare Production Function estimates - Private and Collective Farms

Factors	Return Elasticities	
	Private (n = 90)	Collective (n = 23)
Intercept	44.7146**	12.7585**
	(6.118)	(2.884)
Labour	0.1871	0.1531
	(1.247)	(0.341)
Power	0.3428*	0.1405
	(1.832)	(0.581)
Fertilizer	0.2149**	0.0579*
	(4.139)	(1.697)
Seed	0.1271	0.4840**
	(1.249)	(2.811)
R^{-2}	0.4523**	0.4984**
F	14.3030	6.4657

**Significant at 1 per cent level.
*Significant at 5 per cent level.
( ) t - values.

TABLE 2

Per Hectare Geometric Mean Levels of Inputs and Total Return - Private and Collective Farms

Input	Private	Collective
Labour (Man-days)	82.27	87.01
Power (Birrs)	79.99	137.14
Fertilizer (Qls)	0.40	0.44
Seed[13] (Birrs)	128.51	61.75
Total return (Birrs)	698.55	539.15

TABLE 3

Partitioning of per Hectare Differential Total Return Into Components of Organizational and Input Level Effects

Particulars	Percentage attributable
Total observed change in gross return	25.90
Source of Change:	
a. Organizational Effects	38.07
b. Input Level Effects:	-12.26
(i) Labour	- 1.05
(ii) Power	-18.48
(iii) Fertilizer	- 2.05
(iv) Seed	9.32
c. Total due to all sources (a + b)	25.81

It is observed from Table 3 that there is a total productivity differential of 25.90 per cent under private farms over collectives. This total productivity differential is accounted in terms of two broad effects - organization and input levels. (1) The net contribution of organizational effect to productivity differential is estimated to be about 38 per cent. This is to mean that with the same levels of per hectare inputs of labour, power, fertilizer and seed as under collective management, about 38 per cent more output (return) could be obtained under private farms. This is a measure of efficiency gain under private farms in comparison with collective farms. (2) As against this substantial positive organizational effect, there is a negative input level effects to the extent of 12.26 per cent. To this dampening effect, labour has contributed 1.05 per cent, power 18.48 per cent and fertilizer 2.05 per cent. The positive seed input effect of 9.32 per cent has been more than offset by negative effects of the other three inputs, giving rise to a negative input level effect of 12.26 per cent. The negative contribution of these three key inputs are directly related to the low levels of use of these inputs by private farms (Table 2). As a result of dampening input level effect, the estimated productivity change under private farms due to all sources is found to be about 26 per cent which is quite close to observed change in productivity. In brief, small holder farmers have obtained a higher productivity per unit area cultivated even though they have used less amount of the three major inputs. Conversely, productivity performance of small holder farms is suggestive of the inference that with the same level of inputs these farm can obtain higher returns than the collectives.

The results on the value of inputs saved are presented in Table 4. It could be seen from Table-4 that the value of inputs saved per hectare under private farming comes to about Birr 153 per annum. In other words, the value of additional resource required to produce per hectare private farm level output under collective management is estimated to be about Birr 153 per annum.

TABLE 4

Values of Input Saved Under Private Farming Over Collectives

Item	Value (Birrs)
I_{PVT}	401.54
I_{PC}	554.41
r	38.07
Value of inputs saved (S_I) per hectare under private farming in Hetosa	152.87
Total value of inputs saved in Hetosa*, if collective managemnet is replaced by private management	677,672.70

*The total area cultivated under collective management in Hetosa comes to 4433 hectares.

This magnitude of resource saving has been due to an upward shift in production function or downward shifts in unit cost functions under private farms compared to collectives. If the entire area of 4433 hectares of cultivated land managed by collectives at present in Hetosa are brought under private management, the total number of resource saving is estimated to be about Birr 677,673 per annum.

As indicated earlier, we also estimate quantitatively the value of extra output obtained under private farming due to organizational effect alone. Table 5 provides empirical results on this aspect.

TABLE 5

Value of Additional Output Per Hectare Under Private Farming with Collective Management Level of Inputs

Particulars	Value (Birr)
TR_{PVT}	762.10
TR_{PC}	575.57
Δ TR	186.53
r	38.07
(Δ TR) x (r)	70.88
Value of additional output for Hetosa	314,211.04

It could be seen from Table 5 that organizational effect alone could generate value of output worth about Birr 71 per hectare under private farming, with no additional resources. Any policy move to bring 4433 hectares of land cultivated by collectives at present under private farming would generate an additional output worth about Birr 314,211 per annum in Hetosa. This is obviously a measure of gain from superior productivity performance[14] under private farming. However, these estimated gains are not meant to discount other tangible and intangible gains which are likely to accrue to the society at large under collective management.

NOTES

1. This study is based on the M.Sc. thesis submitted to the Univer sity of Agricultural Sciences, Bangalore (India) by the principal investigator.

2. In the country as a whole, there are 2323 collectives (1987) with a membership of about 4 per cent of total peasant popula tion.

3. See [4] details.

4. For instance see Cohen and Issackson [2].

5. Organizational effects in this study are defined to have emerged from the type of farm business (Private vs Collective), Production technology adopted by these two distinct farm organizations, and from the differential development policy (e.g. input price subsidy, administered and nonadministered produce prices etc.) accessible to them.

6. See Yeshitila [7] for details.

7. Ibid.

8. Ibid.

9. Ibid.

10. Official Exchange Rate: US$1 = Birr 2.07.

11. For details see Yeshitila (1988).

12. Open market price valuation of seed input used by private farms, as compared to the subsidied rate at which collectives obtain seed from the Government, partly accounts for low seed rate used by collectives.

13. The present study does not pretend to have assessed the effects of input price subsidy accrued to collectives and output price advantage (due to local market output pricing) accrued to private farms on productivity performance. However, it is estimated that private farms stand to gain to the extent of Birr 98.74 hectare due to produce sale in open local market, and these farms stand to lose to the tune of Birr 72.94 per hectare due to the fact that they cannot get fertilizer and seeds at the subsidised prices.

REFERENCES

[1] Bisaliah, S., "Decomposition Analysis of Output Change Under New Production Technology in Wheat Farming: Some Implications to Returns to Research Investment", **Indian Journal of Agricultural of Economics,** Vol. 32, No. 4, 1977.

[2] Cohen, J.M. and Issackson, N.I., Villagization in the Arssi Region of Ethiopia, Uppsala, 1987.

[3] Kmenta, T., "On Estimation of the CES Production Function", **International Economic Rev.** Vol. VIII, 1967.

[4] NRDC-CPSC (National Revolutionary Development Campaign Central Planning Supreme Council), Ten Year Development Plan, (Amharic), Addis Ababa, 1984.

[5] PMAC (Provisional Military Administrative Council), Cooperative Societies Proclamation, ProclamationNo.138, Addis Ababa, 1978.

[6] Saith, A., "The Distributional Dimensions of Revolutionary Transition in Ethiopia" **Journal of Development Studies,** Vol. 22, No. 1, 1985.

[7] Yeshitila Teferra, "Economic Performance of Private, Collective and State Farms in Ethiopia: A Study in Arssi Region" M.Sc. (Agricultural Economics) Thesis (unpublished), Submitted to the University of Agricultural Sciences, Bangalore 1988.