EFFICIENCY DIFFERENTIALS IN THE PRODUCTION OF COCOA IN WEST MALAYSIA

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ABSTRACT

This paper examines the efficiency differences among the individual cocoa producers in West Malaysia.

Cross-sectional data collected from 260 cocoa smallholders were used for the study. Both the average production function estimated by the Ordinary Least Squares techniques and the frontier production function estimated by the Linear Programming methodology were employed in the analysis.

The results indicated that technical inefficiencies were present in the study area. The study revealed that a large proportion of the farmers have output levels below their potential. For the least efficient farmers, the level of output could be increased by 34 per cent if they were to improve their management expertise or to improve the efficiency in the use of the available input factors.

1. INTRODUCTION

In spite of the dominant role agriculture plays in the overall economic development of the country mainly through its contribution to the Gross Domestic Product, employment and foreign exchange earnings, this sector is still beset with the problem of low agricultural productivity in the production of major export crops (rubber, oil palm and cocoa) at the smallholder's level (Information Malaysia Yearbook, 1989). As for cocoa although this crop is the third major export crop in the country, at the farm level production per hectare from the smallholders is relatively low when compared to the potential yields which can be obtained if the farmers were to follow the recommended practices both in terms of the management of the holdings and the utilisation of the farm inputs.

It has been observed that in spite of all the various efforts undertaken by the government in recent years such as the provision of extension and credit facilities, there seems to have been not much change in the productivity status of this group of producers.

It is strongly felt that if agriculture was to play a more important role in the development programmes in Malaysia, increasing attention should also be given to the strategy of increasing cocoa productivity. Otherwise, its contribution to such key development objectives such as employment, poverty alleviation and the balance of payments will be jeopardised.

In this study, the efficiency differentials of the individual cocoa producers are estimated. It is hoped that the new information generated could be utilised to improve the productive capacity of the existing farms as well as the new cocoa areas.

2. FUNCTIONAL FORM AND THE DATA

There are three frontier production models that have been widely used in empirical studies, namely, (i) a deterministic production frontier estimated by means of a linear programming technique; (ii) a statistical production frontier which is estimated either by using the corrected ordinary least squares or the maximum-likelihood technique and; (iii) a stochastic production frontier with a composed error structure which is also estimated by using the maximum-likelihood technique.[1]

In this study the deterministic production frontier developed by Timmer (1970)[2] is employed in the analysis that follows. The main reason for choosing this approach is that it can be applied for the measurement of technical inefficiency for each observation in the sample. In addition this method also provides the ease of camparing the frontier estimates with that of the 'average' production estimates computed.

The production function specified was the familiar Cobb-Douglas function[3] which in its logarithmic form in the present study is written as follows:

$$\text{Log } Y = \log a_0 + a_1 \log X_1 + \ldots + a_6 \log X_6 + \mu$$

Where :

Y = expected income from cocoa and coconut (measured in Malaysian Ringgit)

X_1 = land size (acres)

X_2 = services from farm implements (measured in Malaysian Ringgit)

X_3 = chemicals comprising weedicides and pesticides (measured in Malaysian Ringgit)

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[1] For a detailed explanation, see Forsund et al (1980), ' A Survey of Frontier Production Functions and On Their Relationship to Efficiency Measurement', *Journal of Econometrics, 13, pp. 5-25.*

[2] See Timmer (1970), 'On Measuring Technical Efficiency', *Food Research Institute Studies, Vol. 9(2), pp. 99-171, for details.*

[3] The Cobb-Douglas function form was used because of its well known advantages (see, Dawson, P.J. and Lingard,J. (1982). *Management Bias and Return to Scale in a Cobb-Douglas Production Function for Agriculture, European Review of Agricultural Economics, 9, pp. 7-24.*

X_4 = fertiliser (measured in Malaysian Ringgit)

X_5 = labour (measured in man-days)

X_6 = living capital comprising cocoa and coconut (measured in Malaysian Ringgit)

Cross-sectional data collected from 260 cocoa smallholders from the district of Hilir Perak which is considered as one of the largest cocoa growing areas in the country were used for the study. The data gathered were confined to the calendar year 1988.

3. EMPIRICAL RESULTS

Table 1.1 reports the results of using both the 'average' and the frontier approaches. The columns labelled LP (100) are the results from fitting the deterministic function; while the label LP (98) are the results obtained after removing two per cent of the extreme observations from the sample.

The estimated average production function coefficients for the conventional inputs are presented in the first column in order to provide the statistical tests of significance in hand when looking at the estimates of the frontier.

From the results computed it was found that the coefficient for labour was greater for the frontier function. When a closer examination of the magnitude of the frontier intercept was made it was revealed that its value was actually within the 95 per cent confidence interval of the average production function estimate. This therefore, implied that there was no significant difference in its value between the two methods used.

With two per cent of the observations removed the estimated coefficients looked remarkably like those estimated with ordinary least squares. All the coefficients were very similar to those of the analogous average function. The intercept as well as the magnitude of the labour coefficient were also within the 95 per cent confidence interval of the average estimates. The rest of the inpts have similar output elasticities since the amounts used increased proportionately, approximately so, with output.

TABLE 1.1 REGRESSION COEFFICIENTS USING AVERAGE AND FRONTIER PRODUCTION FUNCTIONS

VARIABLES	AVERAGE PRODUCTION FUNCTION n = 260	LP(100) n = 260	LP(98) n = 255
Intercept	4.4684*** (0.4443)	4.6224	4.8628
Land	0.5702*** (0.0756)	0.5679	0.5691
Farm Implements	0.0091** (0.0047)	0.0082	0.0087
Chemicals	0.0070** (0.0031)	0.0040	0.0057
Fertilisers	0.0181*** (0.0029)	0.0298	0.0168
Labour	0.1197** (0.0520)	0.2429	0.1324
Living Capital	0.2310*** (0.0571)	0.2385	0.2296
R^2	0.8624		
F - Statistic	271.49***		

Figures in parentheses are the standard errors

Level of Significance: *** 1 per cent

** 5 per cent

* 10 per cent

4. EFFICIENCY DIFFERENTIALS

In order to examine the efficiency differentials Timmer's Technical Efficiency Index was computed for the individual farms. This is obtained by dividing the farm's actual output by its potential output. The latter is derived by using the formula:

$$\sum_{i=0}^{m} \hat{a}_i \; X_{ij} = \hat{Y}_j$$

where:

$\hat{a}_i$ = (i = 1....m) = estimated coefficients

X_{ij} = logarithm of the amount of inputs

$\hat{Y}_j$ = potential output of farm j

and TEI (Technical Efficiency Index) = $Y_j/\hat{Y}_j$

where:

Y_j = actual output of farm j

The index computed will indicate how each farm employs the inputs available relative to the best practice in the sample.

The frequency distribution indices are presented in Table 1.2. It was observed that the least efficient operator had an index of 0.66. The average technical efficiency indices were 0.820. These indicate average technical efficiency levels of 82 per cent for the sample.

It was noted that in the sample, all the farmers relied on similar inputs and technologies. In other words they employed identical inputs in the production process, except for quality differences which were reasonably reflected in the values of these factors. Thus it was assumed that the technical efficiency differentials among the farmers did not reflect differences in the types of inputs, but rather differences in how these inputs were used and managed.

TABLE 1.2 FREQUENCY DISTRIBUTION OF TECHNICAL EFFICIENCY (TE) INDICES

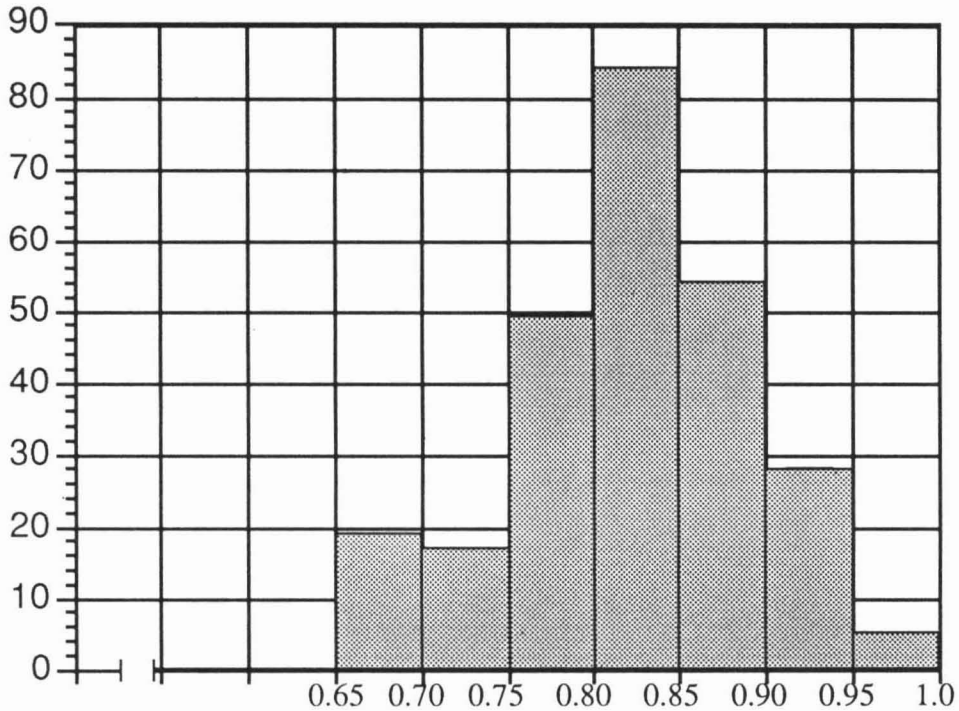
TE INDICES	POOLED DATA n = 255
>= 0.50 < 0.55	-
>= 0.55 < 0.60	-
>= 0.60 < 0.65	-
>= 0.65 < 0.70	19 (7.45)
>= 0.70 < 0.75	17 (6.67)
>= 0.75 < 0.80	49 (19.22)
>= 0.80 < 0.85	84 (32.94)
>= 0.85 < 0.90	53 (20.78)
>= 0.90 < 0.95	28 (10.98)
>= 0.95 = < 1.00	5 (1.96)
Mean	0.820
Std. Dev.	0.072
Minimum	0.660
Maximum	1.000

Figures in parentheses are percentages

The average technical efficiency levels of 82 per cent recorded implies that, if the average farmer were to improve his management expertise, or improve the efficiency in the use of available input factors, so as to operate on the production frontier, he would obtain 18 per cent more output. With respect to the least efficient farmer, it is evident that the level of output would be increased by 34 per cent if these actions were taken.

The frequency distributions as illustrated in the table clearly indicates that the range of efficiency in all the sample groups was quite large. For the whole survey area the range was 0.66 to 1.00, with approximately 86 per cent of all farmers having an index of 0.75 or more.

FIGURE 1: HISTOGRAM OF THE DISTRIBUTION OF THE TECHNICAL EFFICIENCY INDICES



5. CONCLUSIONS

The result of this study clearly demonstrates the presence of technical inefficiencies in this study area. From the calculations of the individual efficiencies indicies it was revealed that only a small proportion of the farmers were on the efficient frontier while the majority of them have output levels below their potential.

Based on this outcome, it is deemed necessary that a further investigation should be undertaken to isolate those factors which led to their relatively poor performance. The design of an appropriate policy measures will certainly help the least efficient group to attain the level of output now achieved by the most efficient farmers in the area.

REFERENCES

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