

# AN ANALYSIS OF SUGAR PRODUCTION IN A CHANGING POLITICAL ENVIRONMENT

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## INTRODUCTION

**W**ITHIN THE past few years there have been very dramatic price changes in primary products from developing countries. These price changes have in many cases resulted from an increasing desire by developing economies to maximize the benefits derived from their resource-based export industries. Such a desire has manifested itself in increasing government participation in many natural-resource-based ventures, and indeed to outright nationalization in some cases. The benefits the less developed economies have sought to maximize include increased foreign exchange earnings, as well as increased employment.

Sugar is a product which has been subject to substantial price fluctuations, and in addition, is vulnerable to national, political pressures, largely because of its association with the colonial heritage. We thought it useful, therefore, to discuss the effects of the policies of one sugar-producing country, Guyana, in its attempt to influence the economic performance of that industry. The purpose of this paper will be to analyze the economic implications of a major shift in government policy on sugar production with the termination of colonial status. Specifically, our concern is with the increased emphasis of sugarcane production on small cane farms at the expense of large corporate estates. The examination of comparative production performance on estate and small cane farms before and after the change in government policy will hopefully serve as a useful example to other developing economies considering an increased role for small-scale farming.

## I. THE ECONOMIC AND POLITICAL BACKGROUND

Guyana is located on the northeast coast of South America with a fairly large land mass but with most of its population concentrated along a very narrow coastal strip, much of which has been reclaimed from the sea. The initial

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The data and discussion in this paper are based upon the authors' experiences as economic advisers in Guyana, for the Canadian International Development Agency, during 1970 and 1971. The data upon which this study is based comes from a report that we prepared for the Guyanese government.

development of Guyana was largely a result of the growth of sugar production. From as early as the sixteenth century, Guyana was recognized as an important potential sugar producer and first the Dutch, then the British attempted to develop the industry. Seawalls were built to protect the low lying sugarcane acreage from flooding. Labor was imported, first slaves from Africa, then indentured labor from India, to work in the highly labor-intensive sugar industry.

From the origin of sugar production until Guyana achieved independence from Britain in 1966, the Guyanese economy has undergone many dramatic changes. Sugar has become less important with the development of other major industries such as forestry, rice, and bauxite. Nevertheless, the sugar industry remains one of the most important industries in Guyana, whether measured in terms of employment, export earnings, or contribution to gross domestic product. Over the years, the character of both world sugar production and the Guyanese sugar industry have changed dramatically. Historically, sugar was produced in Guyana on a large number of independent sugar estates and sold in what appeared to be a virtually unlimited U. K. market. Through time, amalgamations occurred until there are now only two sugar companies which mill all Guyanese sugarcane, and between them operate a handful of large estates which control most of the sugar acreage in Guyana. Aside from the large estates there are a number of peasant or small cane farms operating under agreements with the sugar companies.

Until the shortages and steep price increases of the past few years, the sugar market was often characterized by chronic over-supply, such that "the market in many periods could not be cleared at a price that would cover the costs of most of the producers" [7, p. 14]. This chronic over-supply had two results. First, a number of sugar agreements were concluded, which established producer quotas at agreed prices with several countries. Any excess beyond the quotas was sold on the free market at (normally) much lower prices. Secondly, low prices led to "a drive to reduce costs and raise efficiency. . . in the sugar industry in most parts of the world" [7, p. 15], including Guyana. Efforts in this regard began in Guyana with the recommendations of a special commission (the Venn Commission) set up in 1948 to study its sugar industry.

The Venn Commission concluded that the Guyanese sugar industry had to mechanize in order to remain competitive. It was realized that mechanization would improve labor productivity (and thus wages) but would also result in a substitution of capital for labor. In the commission's own words, "it is obvious that every opportunity will in the future have to be taken to relieve human muscles from performing tasks that can be more cheaply and efficiently performed by machines" [4, p. 78].

In the absence of a sufficiently rapid increase in output, the substitution of capital for labor can be expected to result in labor displacement which is a serious problem for an economy such as Guyana, already suffering from a sizeable unemployment problem. This fact was recognized by the Venn Commission which recommended an expanded role for small cane farming, apparently regarded as more labor-intensive than estate production. At the same time,

however, it was recognized that large-scale production was essential for an efficient and competitive sugar industry:

...the salvation of the industry has been to adopt large scale farming and indeed, only then can maximum efficiency of cultivation and production be assured. [4, p. 104]

The Venn Commission, established by the British government, can be regarded as an indicator of the economic and political framework within which the Guyanese sugar industry operated until the early 1960s.

Under such a framework the estates apparently made every effort to increase output and efficiency through mechanization. However, increases in output were constrained, at least in part, by the availability of profitable export markets. As a result, increased efficiency basically involved the substitution of capital for labor. For example, between 1956 and 1963, the capital stock on estates increased by 60 per cent while the labor force on estates decreased by 20 per cent. During this period, some expansion occurred in small cane farms, which served to absorb part, but not all, of the estate labor displaced.

The early 1960s was a period of political transition as Guyana moved from a colony to an independent nation in 1966. This transitional period was a very difficult one, with substantial political upheaval as the various political parties began vying for political power in anticipation of independence. As a result, there was a greater awareness of such issues as unemployment and foreign ownership. As far as the sugar industry was concerned, this political awareness culminated in a meeting between the chairmen of the two large sugar companies, Bookers and Demerara, and the premier of Guyana. At that meeting, a four point "decolonization" program for the Guyanese sugar industry was set out.<sup>1</sup> A result of this "decolonization" program was that the estates and government engaged in the active encouragement and the relative expansion of small cane farms after 1963.<sup>2</sup> In addition, the estates made sustained efforts to stabilize their labor force in order to prevent labor displacement, recognizing that:

...in an industry which is still largely labour intensive...mechanization must proceed cautiously in the context of widespread unemployment and underemployment.... [5, pp. 13-14]

The industry's own development plan for 1971-80 [6, pp. 7-17] indicates a continuation of the patterns established in 1963. Virtually all of a projected 3 per cent per annum industry expansion is expected to come from small cane farms. Further, in a discussion with management of the largest sugar producers, it was stressed that moral obligations, as well as the peculiar nature of the industry impeded the substitution of capital for labor.

<sup>1</sup> The four points in this decolonization program were: Guyanization of management; expansion of small cane farms; replacement of estate-run by local government-run social services; and government share participation in the sugar industry. [2, pp. 14, 17, 18].

<sup>2</sup> Since the estates provide the marketing, milling, and other facilities (including, to some extent, land) their support is essential, as is the government's, in the form of loans and social services.

It was pointed out that the swamp-like conditions of the fields hindered mechanization. At the same time, there had been increasing underutilization of capital in recent years, which had the effect of lessening the full impact of mechanization on labor displacement.

The developments beginning in 1963 thus appear to herald a reversal of the approach taken by the sugar industry prior to 1963. First, in contrast to the pre-1963 period, estate growth was slower and small cane farm growth much more rapid. Second, and perhaps more importantly, increased employment appears to have been emphasized at the expense of improved efficiency and productivity. In this latter regard, since estate productivity exceeds that of small cane farms, this action reduced the efficiency of the industry as a whole. At the same time, estate hesitancy to substitute capital for labor has slowed the growth of estate productivity. As a result, total employment in cane production increased by 1,486 workers from 1963 to 1969, in contrast to a decrease of 4,767 workers from 1956 to 1963. In addition, labor productivity in cane production diminished from an annual increase of 8 per cent a year prior to 1963 to 1.5 per cent a year after 1963.

## II. ECONOMIC PERFORMANCE BEFORE AND AFTER DECOLONIZATION

The previous section of this paper outlined the main political changes that occurred circa 1963, and which had a dramatic effect on the Guyanese sugar industry. The purpose of this section will be to assess the comparative economic performance of the Guyanese sugar industry before and after 1963, in the light of the changing roles played by the estates and small cane farms. In assessing performance, the factors that will be considered in this section are: acreage used, employment, output, labor productivity, and land yields. Particular emphasis will be placed on the efficiency of land use and performance stability in the following sections.

Total acreage planted, both before and after 1963, increased at approximately the same annual rate (4 per cent yearly growth pre-1963, 4.8 per cent post-1963). Prior to 1963, the yearly acreage planted by small cane farms had remained almost unchanged. After 1963, however, the acreage planted by small cane farms increased by 50 per cent a year. During the latter period the estates made more land available to small cane farms, at the expense of their own future expansion. By 1969, small cane farm acreage, which in 1956 and in 1963 had been 2 per cent of estate acreage planted, was 6.6 per cent of estate acreage.

Between 1956 and 1963, employment in estate cane production had declined from 19,958 to 14,240 workers, while employment on small cane farms had increased from 938 to 1,889. The resulting net displacement of 4,767 workers from the sugar industry as a whole, was largely due to the substitution of capital for labor, as noted above. After 1963, however, and despite the fact that capital stock in the Guyanese sugar industry continued to increase at the same rate as

## SUGAR PRODUCTION

89

TABLE I

Year	Labor Productivity (Cane Output/Field Worker)		Land Yields (Cane Output/Acre)		Land-Labor Ratio (Acre/Field Worker)		Ton Cane/Ton Sugar	
	Estates	Small Cane Farms	Estates	Small Cane Farms	Estates	Small Cane Farms	Estates	Small Cane Farms
	1956	137.7	52.5	37.7	27.2	3.7	1.9	10.8
1957	148.7	41.1	35.7	29.5	4.2	1.4	10.4	12.9
1958	185.6	44.9	40.2	31.9	4.2	1.4	11.3	11.8
1959	186.5	35.2	36.1	34.3	5.2	1.0	11.3	11.7
1960	227.8	35.2	38.2	32.7	6.0	1.1	11.2	11.2
1961	231.4	32.8	33.1	26.9	7.0	1.2	11.0	11.3
1962	243.3	35.9	34.3	33.2	7.1	1.1	10.6	11.1
1963	235.4	34.2	35.3	33.3	6.7	1.0	10.8	11.6
1964	235.8	34.6	31.5	31.7	7.5	1.1	11.6	13.8
1965	234.1	49.7	32.0	25.9	7.3	1.9	11.0	11.2
1966	240.1	51.3	32.2	28.5	7.5	1.8	11.5	12.4
1967	261.2	66.7	32.9	29.3	7.9	2.3	11.0	11.3
1968	231.3	74.0	32.7	31.1	7.1	2.4	11.0	11.3
1969	264.5	84.3	33.0	32.1	8.0	2.6	11.3	11.5

Source: Calculated from data provided by Guyana Sugar Producers Association and Guyana Ministry of Economic Development.

Note: All quantity measurements are in long tons.

prior to 1963, employment in sugar cane production increased by 343 workers on estates and by 1,143 workers on small cane farms.

As a result of the above developments, cane output in Guyana increased at approximately the same annual rate after 1963 (3.3 per cent per year) as before (2.9 per cent per year). However, the growth rate of output on estates declined slightly (from 3 per cent a year to 2.5 per cent a year) after 1963, while small cane farm cane output increased dramatically (from a 4.7 per cent growth rate to a 49 per cent growth rate) after 1963. Nevertheless, total estate cane output far exceeded that on small cane farms. In 1956 and 1963 small cane farm output was less than 2 per cent of that on estates, but by 1969 this had increased to over 6 per cent.

As an examination of Table I will reveal, labor productivity, which had been increasing by 10 per cent a year on estates prior to 1963, grew only 2 per cent a year after that date. On the other hand, small cane farm labor productivity, which had actually declined by 5 per cent a year prior to 1963, rose by 24 per cent a year after that date. These dramatic changes in comparative performance seem to be associated with changes in the land/labor ratio shown in Table I. Note that between 1956 and 1963 the land/labor ratio on estates increased substantially, while on small cane farms it declined. After 1963, the land/labor ratio on estates increased slightly while that on small cane farms increased very substantially (160 per cent). Although labor productivity on small cane farms increased much more rapidly than that on estates after 1963, labor productivity on the latter remained far above that of the former, as can be seen from Table I. Undoubtedly this was a result of the much higher land/labor ratio on estates. In the Guyanese sugar industry as a whole, the economic consequences of the political changes in 1963 appear to have slowed the growth rate of labor productivity (from 8 per cent prior to 1963 to 1.7 per cent after that date).

In considering land yields, it is interesting to note, as shown in Table I, that prior to 1963 land yields actually declined slightly on estates while they increased on small cane farms. In all likelihood these trends are related to the changes in land/labor ratios observed above. After 1963 land yields on both estates and small cane farms levelled out.

The above discussion leads to some interesting questions concerning the efficiency of increasing the number and size of small cane farms. The post-1963 emphasis on small cane farming has been accompanied by increased labor productivity on those farms but they are still more labor-intensive than the estates. In Guyana, the unemployment level is very high so that the expansion of small-scale farming would help to relieve the excess labor situation. One wonders whether the further increased expansion of small cane farming, with its accompanied increase in labor usage, is most efficiently utilizing the scarce land resource of that country. In order to answer that question we will consider the relative efficiency of land utilization on both the estates and the small cane farms in the next section.

### III. MEASURING THE RELATIVE EFFICIENCY OF LAND USE ON ESTATES AND SMALL FARMS

In this section our purpose is to establish a framework for the measurement of the impact of land utilization on cane production in both the estates and the small cane farms. In tackling the problem of measuring the efficiency of land utilization in cane production we decided to use an expanded version of a Cobb-Douglas "type" production function. Such a framework should enable us to arrive at conclusions and policy recommendations on the economic feasibility of expanding small farm size. The production function can be written as follows:

$$Q = \gamma e^{\lambda r} (L^\alpha \cdot K^\beta) \bar{A}^\epsilon, \quad (1)$$

where  $Q$  is output year,  $L$  and  $K$  are the labor and capital inputs, and  $\bar{A}$  is average farm size. In the empirical tests:  $Q$  was cane output in long tons,  $L$  was the number of field workers,  $K$  the utilized capital on estates,  $\bar{A}$  the average farm size in acres. The data was used in index form for the years 1956 to 1969. The subscripts  $E$  and  $S$  will refer to data for estates and small cane farms respectively.

The production function will be fitted empirically using an iterative procedure with the information available for estates. We will then build a similar production function for the small cane farms, and compare the results of our estimates.

We assume that the above production function has a constant elasticity of substitution, ( $\theta$ ), between  $K$  and  $L$ ; and when we measured the magnitude of  $\theta$  we found it not to be significantly different from unity.<sup>3</sup> Under the usual Cobb-Douglas specifications, the sum of the shares going to  $L$  and  $K$  equals one. From the data available for estates we were able to estimate the average value of  $\alpha$ ; where  $\alpha = L \cdot W / P \cdot Q = 0.536$  and  $\beta = 0.464$ .

Although it is obvious that land is an input in the production process we do not enter it as such, since data are not available which would enable us to assign an "a priori" return to land. We have taken the step of dividing the value of output between labor and capital. Therefore, it must be understood that when we are referring to  $L$  and  $K$  we are intrinsically including land as a part of each variable. For example, our capital variable is in effect, capitalized-land. This step allows us to introduce a separate land utilization variable, and to isolate its impact on output.<sup>4</sup>

<sup>3</sup>  $\theta$  was estimated from the formula:

$$Q_E / L_E = d(W/P)^\theta \cdot (CU)^\nu,$$

where the introduction of  $(CU)$  is a correction for possible changes in capacity utilization,  $W$  is the average estate wage rate, and  $P$  the average price of sugar sold,  $\theta$  was 0.92 with a standard error of 0.14, and  $\nu$  was not significantly different from zero. This technique is well known in the literature, see especially, [1] [3].

<sup>4</sup> An alternative theoretical approach would have been to consider  $K$  and total acreage ( $A$ ), as a joint input. We would then have  $L^\alpha \cdot (A+K)^{1-\alpha}$  but this would not have enabled us to isolate the impact of land utilization on production. Our empirical results would have been biased if  $A$  were treated both as an input and as a measure of utilization—i.e., there is probably a high degree of multicollinearity between the independent variables  $A$  and  $\bar{A}$ .

$\bar{A}$  is an index of land utilization defined in terms of average estate size, and  $\varepsilon$  is the efficiency of increased land usage by the estates, i.e.,  $\varepsilon$  is the elasticity of output with respect to average farm size. We are simply assuming that there is an optimal farm size where land is most efficiently utilized given the inputs  $K$  and  $L$ . We arrived at a measure of  $\varepsilon$  by regressing, in log form, the ratio of actual production to "simple" Cobb-Douglas estimates of estate output, on our land utilization variable.<sup>5</sup> Our estimate of  $\varepsilon$  was 0.276.

A central hypothesis of this study has been that behavioral and production activities were quite different before and after the political disturbances which took place in 1962–64. For quantitative purposes we have centered on 1963 as a pivotal year in our analysis and have described the pre-1963 and post-1963 output, employment, and productivity trends in estates and small cane farms. These variables indicate a shifting of the emphasis of production from the large estates to the small cane farms after the political disturbances.

In the pre-1963 period it seems that the owners of the estates were attempting to increase the efficiency of production at the expense of the labor input. The post-1963 trends indicate less of an emphasis on labor displacement, as well as less of an emphasis on technical efficiency. For political reasons, as well as the maximization of long-run profits, the estate owners saw fit to curb the reduction of their labor force.

Quantifying such behavior involved the use of a dummy variable combining technological and political conditions; and the estimation of the average change in the pattern of these conditions. Let  $r$  be this structural change variable and  $r=tp$  where:  $t$  is a time trend of technological change from 1956–69 ( $t=1, 2, \dots, 14$ ) and  $p$  is an index of the political-economic climate ( $p=1$  for 1956–63 and  $p=0$  for 1964–69). Thus,  $r=1, 2, \dots, 8$  for the years 1956 to 1963 and  $r=0$  for the years 1964 to 1969.

The logic behind this pattern is as follows: From 1956 to 1963 the estate owners were attempting to increase the efficiency of their production processes so that each year's observation represents a higher level of efficiency than the year before. After 1963 economic efficiency was not a short-run goal of the producers, because the post-1963 political conditions associated with decolonization were of dominant consideration. As a consequence,  $r$  falls to zero.

The impact of the average change of  $r$  on the production process was found by regressing the ratio of the unexplained production residuals on  $r$ .  $\lambda$  is the coefficient in that regression and gives the impact of the structural change variable ( $r$ ) on output ( $Q$ ),  $\lambda$  was found to be 0.014.

<sup>5</sup> When using an iterative procedure which involves the introduction of more than one variable to explain the initial residual variance it is necessary to justify which variable to introduce first; the reason being that the order of the introduction of the independent variables can alter the measurement of their impact on the dependent variable. We chose to introduce land utilization before the political change variable because the former is important in the long-run production function for both estates and small cane farms, whereas the latter is introduced as dummy variable important only for the estates and only for part of the period studied.



Introducing all of the known parameters into equation (1) we arrive at our estimate of the production function for the large sugar estates.

$$Q_E = -0.7 + 1.02e^{0.014r}(L_E^{0.536} \cdot K^{0.464})\bar{A}_E^{0.276} . \quad (2)$$

The  $R^2=0.88$  and all coefficients, except the intercept, were significant at least at the 95 per cent level.<sup>6</sup>

We have now isolated the variables which explain 88 per cent of the variance of sugar cane output on the estates in Guyana. Our next step is to fit a similar production function for the small cane farms, so that we may compare the land utilization parameter to that given in the estate production function.

Since there is an absence of capital data for the small cane farms we decided to estimate (1) by combining the labor input of the small cane farms with the index of  $K$  given for the estates, i.e., we must assume relatively similar capital usage in the small cane farms and the estates. This assumption seems reasonable since the estates often purchase equipment for the small cane farms. In addition, small cane farms tend to be located within estate boundaries, so that the production techniques used would tend to be similar.

An alternative to using the same index of  $K$  on both the estates and the small cane farms would have been to use the absolute acreage on small cane farms as an indicator of capital used. The assumption being that greater amounts of total acreage, ( $A_s$ ), means greater amounts of capital employed.

Such an assumption yielded the production function:

$$Q_s = -13.0 + 1.25(L_s^{0.536} \cdot A_s^{0.464})\bar{A}_s^{0.430} . \\ R^2 = 0.98 .$$

The results are quite similar to the estimates given by (3) except that  $\epsilon'$  falls from 0.99 to 0.430. This is probably due to a degree of multicollinearity between  $A_s$  and  $\bar{A}_s$ . In any case, the alternative formulation would not seem to significantly alter the results of our analysis, which is constrained by the restricted amount of available data.

It is estimated that labor's share is approximately the same in small cane farms as it is on the estates so that  $\alpha$  is still given as 0.536.<sup>7</sup> Since the small cane farms were not subjected to the same type of technological-political pressures as were the large estates, it is argued that  $e^{2r}$  is not a necessary explanatory part of the production function for small cane farms.

Leaving out the technical-political variable, we estimated the coefficients for (1) using the data for small cane farms. The iterative procedure employed was

<sup>6</sup> It should be noted that the estimated forms of our production functions include an intercept. Rather than force the production function through the origin we decided to include an intercept term in our empirical tests. If the production function as ultimately formulated is correct, the intercept will not be significantly different than zero and therefore there is no necessity to arbitrarily constrain the initial formulation.

<sup>7</sup> Although there is a lack of adequate data, this seems to be a reasonable estimate since small cane farmers receive about 66 per cent of the value of their crop (the milling fee being approximately 33 per cent), and other nonwage costs are approximately 20 per cent of this amount. See [5, p. 10] [7, p. 83].

similar to that used in estimating the production function for estates. The empirical results for the production function for small cane farms were as follows:

$$Q_s = 19.0 + 1.37(L_s^{0.536} \cdot K^{0.464})\bar{A}_s^{0.99} . \quad (3)$$

The  $R^2=0.98$  and all coefficients (except the intercept) were highly significant.

A comparison of equations (2) and (3) reveals that the slope of (2) is not significantly different than unity, whereas that of (3) is significantly different than unity, 1.02 vs. 1.37. If, as is usually assumed, this parameter is an indicator of technology, then small cane farms have undergone some improvement in the state of their technology in the time period discussed. This change probably represents the adoption by small cane farms of techniques pioneered on estates. The emphasis on small cane farming after 1963 undoubtedly contributed to this transfer of technology.

Comparing  $\epsilon$  for large and small farms, we find that the efficiency of increased land usage is approximately three and a half times larger on the small farms (0.990 vs. 0.276). In other words, the elasticity of cane output with respect to land utilization on small cane farms was substantially larger than on estates. Although this would seem to provide economic support for increasing the average size of small cane farms, we must bear in mind that the absolute level of efficiency on small cane farms remains much lower than on estates. We refer particularly to the fact that labor productivity is still substantially below the estate levels, although land yields are becoming comparable.

Nevertheless, in view of the fact that additions to average farm size appear to be more output efficient on small cane farms, a policy of expanding small cane farming by increasing the average size of those farms is not inconsistent with improved economic efficiency. However, considering the overall greater efficiency of the estates, any expansion of small cane farming at the expense of the estates (i.e., by reducing the number and size of estates) would almost certainly reduce the absolute efficiency of the Guyana sugar industry.

We should also make note that in equation (2), the structural change variable played an important role in the production function for the estates. This would appear to support the hypothesis developed earlier, that the pre- and post-1963 estate economic behavior differed because of changes in the economic and political climate associated with the decolonization of the sugar industry.

#### IV. PERFORMANCE STABILITY

In the previous sections of this paper, changes in the relative performance of estates vs. small cane farms, as measured in terms of land/labor ratios, labor productivity, land yields, and land utilization were discussed. However, two further measures of comparative performance should also be considered. First, the relative ability to maximize sugar output given cane production, and second, the relative stability of the land/labor ratio, labor productivity, and land yields.

An examination of Table I shows that, with the exception of one year, the

TABLE II  
COEFFICIENTS OF VARIATION

	Estates		Small Cane Farms	
	Adjusted	Unadjusted	Adjusted	Unadjusted
Land/labor ratio	10.33	22.31	24.85	33.80
Labor productivity (cane)	9.01	17.02	20.01	32.21
Land yields (cane)	6.43	7.35	6.63	7.83
Ton cane/ton sugar	2.94	3.07	5.69	6.26
Output (cane)/quota sales	11.50	15.49	15.33	45.98

Note: The writers recognized that significant time trends in the variables could influence the C.V.'s, i.e., a strong time trend would automatically mean a large C.V. Since such an occurrence might bias our comparison of relative stability we adjusted the original C.V.'s given in this table for the percentage change in the variables over time.

estates were able to produce a greater amount of sugar from each ton of cane reaped. Aside from year to year variations this difference was trendless over the period studied. At the same time, the degree of variability of sugar produced from cane reaped is much less in the estates, as measured by the coefficient of variation shown in Table II. This of course indicates that over the period studied the estates have been more consistent in maximizing the sugar content of cane and apparently better able to adapt to changing climatic conditions.

On a similar vein it is interesting to compare the relative stability of previously discussed indicators of performance. Table II gives a comparison of the coefficients of variation (C.V.) for estates and small cane farms, for land/labor ratios, labor productivity, and land yields. With the exception of land yields, the C.V.'s for estates is substantially less than those for small cane farms. Stability in the variables is of course essential for production planning purposes.

Given the nature of the international sugar market, stability in output with respect to quota sales is also crucial. For the Guyanese producers, in order to meet their quotas for the higher priced markets, and to avoid selling in the "free" market at usually much lower prices, stable and reliable production is a necessity. The impact of changes in market demand on output performance can be approximated by a comparison of the C.V.'s of cane output/quota sales. Given identical market conditions the C.V. of this ratio should be similar for estates and small cane farms. Since the C.V. for small cane farms is larger than that of the estates, we can speculate that the small cane farms have been less successful in adjusting to changes in market conditions.

## V. SOME POLICY RECOMMENDATIONS

To summarize the above, it is clear that in an absolute sense, and by various measures of comparative performance, the estates are more efficient than small cane farms. However, since additions to average farm (or estate) size appear to be more output efficient on the small cane farms, a continuation of the post-1963 emphasis on small cane farms seems warranted. It has also been shown

that year to year variations in small cane farm output are greater and correspond less closely to quota sales than do output variations on the estates. In view of the nature of the international sugar market, such instability in output could be a serious problem as noted earlier. This handicap must be overcome if small cane farms are to provide an increasing proportion of industry output.

The "decolonization" program established in 1963 had an obvious and direct effect on the economic performance of both estates and small cane farms. These effects were illustrated by a simple examination of the data, as well as by the use of a political-structural change variable in our production function analysis.

Our analysis would appear to suggest the following. First, if it is the policy makers' objective to solely increase employment, it can be accomplished by expanding small cane farming at the expense of the estates, because of the lower land/labor and output/labor ratios on small cane farms. Such a policy however, would sizeably decrease the efficiency of the industry in view of the absolutely lower labor productivity and land yields on small cane farms. Second, if it is the policy makers' objective to increase land yields and labor productivity, this can be done by expanding estates at the expense of small cane farms. Such a policy would of course decrease employment in the sugar industry. Third, a compromise policy would be to expand the size and number of small cane farms, while not reducing the size and number of estates. Such a policy would increase employment, and improve the relative productivity of land and labor on small cane farms, without substantially reducing the efficiency of the industry as a whole.

#### REFERENCES

1. ARROW, K.; CHENERY, H. B.; MINHAS, B.; and SOLOW, R. M. "Capital-Labour Substitution and Economic Efficiency," *Review of Economics and Statistics*, Vol. 43, No. 3 (August 1961).
2. The Booker Group. *Review of the Year 1964* (London: Bucklersbury House, 1965).
3. BROWN, M. *On the Theory and Measurement of Technological Change* (Cambridge, Mass.: Harvard University Press, 1966).
4. Great Britain, Colonial Office. *Report of a Commission of Inquiry into the Sugar Industry of British Guiana* (H.M.S.O., 1949).
5. Guyana Sugar Producers Association. *Sugar in Guyana* (Georgetown, 1967).
6. ————. *Industry's Indicative Development Plan, 1971-80* (Georgetown, 1970).
7. REUBENS, E. P., and REUBENS, B. G. *Labour Displacement in Labour Surplus Economy: The Sugar Industry of British Guiana* (Jamaica: Institute of Social and Economic Research, University of the West Indies, 1962).