CHAPTER VIII

REGIONAL EFFICIENCY RANKING IN INDIAN SUGAR INDUSTRY

Location of a firm or an industry has some bearing on its performance, measured either in terms of productivity or profitability or any other criterion. Sugar industry is subject to substantial regional variations with regard to installed capacity, sugarcane production, cane crushed, duration of crushing season, average recovery, sugar production, sugarcane yield per hectare and productivity. The heterogeneity of the regions with respect to natural endowments, nature of the product and factor markets, transportation, etc. are some of the reasons which cause inter-regional variations in the performance of an industry. A study about the nature and extent of such variations are considered essential for efficient allocation of resources among the regions and to explain, to some extent, inter-regional economic disparities.

The aim of the study in this chapter is to analyse the regional efficiency of the industry by making use of the Cobb-Douglas production function with state dummy variables. The concept of efficiency, according to prof. Vashistha has three interpretations which can be classified as technical, price or allocative and economic. \(^1\) "The technical efficiency of a firm
indicates the potential gain from tuning up the management; while the price or allocative efficiency indicates the potential gain from varying the factor proportions and improving market information. The economic efficiency gives an 'over all' view of the efficiency of firms and helps in ranking them in order of their potential for raising output from additional investment at given prices". The concept of the efficiency employed here is a familiar form of residual, where efficiency is defined and measured as variation in output unexplained by labour and capital. The problem is one of providing the estimates of state effects by dummy variables in the Cobb-Douglas Production function. States are regarded as regions in this study for the purpose of economic policy. The number of persons employed in sugar industry in India and selected regions had increased from 1973-74 to 1981-82 but it had decreased during the period from 1982-83 to 1990-91. The real capital stock of this industry had increased at a faster rate during 1982-83 to 1990-91 than the period from 1973-74 to 1981-82. Therefore, the stability of the region with regard to efficiency between two periods of time (1973-74 to 1981-82 and 1982-83 to 1990-91) has been examined through F-test.

Cobb-Douglas Production Function with State Dummy Variables

In order to determine the efficiency of the regions over time, the model used here is Cobb-Douglas Production function with
state dummy variables. This may be specified as

\[
\text{Log } V_{it} = a_1 + b_1 D_1 + b_2 D_2 + b_3 D_3 + b_4 D_4 + b_5 D_5 + C_1 \log L_{it} + C_2 \log K_{it} + u
\]  

(1)

Where \( D_1, D_2, D_3, D_4 \) and \( D_5 \) are dummy variables. The subscript ‘\( i \)’ refers to the region and ‘\( t \)’ refers to time.

\[
\begin{align*}
D_1 &= 1 \text{ for the region Andhra Pradesh; 0 for others} \\
D_2 &= 1 \text{ for the region Bihar; 0 for the others} \\
D_3 &= 1 \text{ for the region Karnataka; 0 for the others} \\
D_4 &= 1 \text{ for the region Maharashtra; 0 for the others} \\
D_5 &= 1 \text{ for the region Tamil Nadu; 0 for the others}
\end{align*}
\]

\( D_1 = D_2 = D_3 = D_4 = D_5 = 0 \) for the region Uttar Pradesh.

The terms \( a_1, (a_1 + b_1), (a_1 + b_2), (a_1 + b_3), (a_1 + b_4) \) and \( (a_1 + b_5) \) are state intercepts corresponding to the regions Uttar Pradesh, Andhra Pradesh, Bihar, Karnataka, Maharashtra and Tamil Nadu. These intercepts may be considered as efficiency indices.

In fact, the introduction of state dummies for the respective regions in this analysis seems warranted as this industry is subject to substantial regional variations with regard to installed capacity, sugarcane production, cane crushed, duration of factories, average recovery, sugar production and sugarcane yield per hectare (see Tables A.1 to A.7). State dummies should lead us nearer reality because of substantial regional variations in this industry with regard to sugarcane yield per hectare,
sucrose content of the sugarcane used and nature of the equipment, etc. 3.

In this analysis, the equation (1) above has been estimated on the basis of ordinary least squares method for the period 1973-74 to 1990-91 and its time segment 1973-74 to 1981-82 and 1982-83 to 1990-91. The regression coefficients, state intercepts and the order of ranking are given in Tables 8.1 and 8.2.

Table 8.1 shows that most of the coefficients are significant at 5 per cent level and coefficient of determination ($R^2$) is 0.82 for the period of 18 years from 1973-74 to 1990-91. This means that 82 per cent of variation of the dependent variables is explained by the explanatory variables. The coefficient of determination ($R^2$) is 0.80 and 0.85 for the time period 1973-74 to 1981-82 and 1982-83 to 1990-91 respectively. The value of Durbin-Watson statistic indicates that there is no auto correlation. The coefficients are not statistically significant for the time periods 1973-74 to 1981-82 and 1982-83 to 1990-91 except labour coefficient in 1973-74 to 1981-82 and capital coefficient in 1982-83 to 1990-91.

Further, as efficiency is defined in terms of state intercepts, the study shows that Tamil Nadu is the most efficient region and Uttar Pradesh is the least efficient region during
study period 1973-74 to 1990-91 as their ranks with regard to efficiency are 1 and 6 respectively. (See first row of Table 8.2). With regard to efficiency, ranks are 2, 3, 4 and 5 for Karnataka, Andhra Pradesh, Bihar and Maharashtra respectively for the same period. This shows that Tamil Nadu, Karnataka and Andhra Pradesh are relatively more efficient than Bihar, Maharashtra and Uttar Pradesh. The study indicates that Uttar Pradesh is the most efficient region and Karnataka is the least efficient region compared to all the other regions for the period 1973-74 to 1981-82. For the period 1982-83 to 1990-91, the study shows that Tamil Nadu stands first and Bihar is the last region.

When comparison is made for the two periods 1973-74 to 1981-82 and 1982-83 to 1990-91 with regard to efficiency ranks, we don’t arrive at the same ranks for the regions except Maharashtra. This shows that efficiency of the regions had varied over the time period. It might be due to substantial regional variations with regard to the sugarcane yield, cane crushed, duration of the factories, average recovery, sugar production, etc. When the ranks of the different regions for the time period 1973-74 to 1981-82 and 1982-83 to 1990-91 are compared with the pooled sample. The study arrive at the conclusion that Tamil Nadu is the most efficient region and Uttar Pradesh is the least efficient region during the study period. Further it will be seen from Table 8.2 that Tamil Nadu, Karnataka, Andhra Pradesh and
Maharashtra are relatively efficient region than Uttar Pradesh and Bihar. Thus the tropical regions (Tamil Nadu, Andhra Pradesh, Karnataka and Maharashtra) are relatively more efficient than subtropical regions (Uttar Pradesh and Bihar). This is also confirmed by the fact that the performance of the tropical region is much better than that of sub-tropical region with regard to production of sugarcane, cane crushed, duration of factories, average recovery, yield per hectare and Production of sugar (see Table A.8). In the tropical region the yield per hectare varies from 70 to 100 tonnes whereas in the sub-tropical regions which varies from 35 to 47 tonnes per hectare. Such comparatively high yields in the tropical regions are due to, among other things, excellent hot and humid climate, which is a natural habitat for cane cultivation. Sugarcane being essentially a tropical plant thrives best in this region.

The results of this study are comparable with those of earlier studies. Asit Banerjee has stated that productivity is low in Bihar as compared to Madras and Bombay for the period 1946 to 1962. Sastry (1965) has stated that Bombay has relative production advantage over Uttar Pradesh. Subramaniyan (1982) has stated the tropical regions (Maharashtra, Tamil Nadu and Andhra Pradesh) are relatively more efficient than subtropical region (Uttar Pradesh and Bihar).
Stability of Regional Efficiency

In this study it is interested in examining whether the relative position of the region with regard to efficiency remains unaltered or not between the two periods of time (1973-74 to 1981-82 and 1982-83 to 1990-91). Chow has suggested the following F-test that can be used to investigate the stability of the regional efficiency pattern. The test is

\[ F^* = \frac{\sum e^2 - (\sum e_1^2 + \sum e_2^2)/K}{(\sum e_1^2 + \sum e_2^2)/n_1 + n_2 - 2K} \]

Where

\[ \sum e^2 \] = unexplained variation of the pooled sample corresponding to the period 1973-74 to 1990-91

\[ \sum e_1^2 \] = Unexplained variation of the sample corresponding to the period 1973-74 to 1981-82,

\[ \sum e_2^2 \] = Unexplained variation of the sample corresponding to the period 1982-83 to 1990-91.

\[ n = n_1 + n_2 \] = Number of samples.

\[ K \] = Number of coefficients including the intercept \( a_1 \).

If \( F^* < F_{0.05} \) with \( K \) and \( (n_1 + n_2 - 2K) \) degrees of freedom, one can accept the null hypothesis that there is no difference in the coefficients obtained from the two samples corresponding to the period 1973-74 to 1981-82 and 1982-83 to 1990-91. In our case

\[ n = 9 + 9 = 18 \]
\[ K = 8 \]
\[ \Sigma e_{2p}^2 = 0.02901 \]
\[ \Sigma e_{1}^2 = 0.02068 \]
\[ \Sigma e_{2}^2 = 0.02386 \]
and \[ F^* = -0.087 \]

Therefore, \[ F^* < F_{0.05} \] with \( v_1 = 8 \) and \( v_2 = 2 \) degrees of freedom ( Since the values of \( F^* \) and \( F_{0.05} \) are -0.087 and 19.4 respectively). Hence we can accept the null hypothesis that there is no difference in the coefficients obtained from the two samples. Therefore, we can infer that the stability of the regional efficiency pattern remains unaltered between the two periods 1973-74 to 1981-82 and 1982-83 to 1990-91.

Results of this chapter can be summarised as follows. It could be observed from the above analysis that Tamil Nadu is the most efficient region considering the two time periods 1973-74 to 1990-91 and its later part 1982-83 to 1990-91. It is evident that efficiency had varied among the regions over the time period. It is also confirmed that the performance of the tropical regions is much better than the sub-tropical regions which was made possible by favourable climatic conditions prevail in tropical regions. The stability of the regional efficiency pattern remains unaltered between two samples.
### TABLE 8.1

Production function

\[ \log V_{it} = a_1 + \sum b_i D_i + c_1 \log L_{it} + c_2 \log K_{it} \]

<table>
<thead>
<tr>
<th>Period</th>
<th>Regression Co-Efficients and t values</th>
<th>$R^2$</th>
<th>F</th>
<th>D.W.</th>
</tr>
</thead>
<tbody>
<tr>
<td>period</td>
<td>a1</td>
<td>b1</td>
<td>b2</td>
<td>b3</td>
</tr>
<tr>
<td>1973-74 to 1990-91</td>
<td>-0.25</td>
<td>0.26*</td>
<td>0.22*</td>
<td>0.31*</td>
</tr>
<tr>
<td></td>
<td>(2.16)</td>
<td>(2.09)</td>
<td>(2.34)</td>
<td>(1.33)</td>
</tr>
<tr>
<td>1973-74 to 1981-82</td>
<td>0.47</td>
<td>-0.12</td>
<td>-0.05</td>
<td>-0.13</td>
</tr>
<tr>
<td></td>
<td>(0.66)</td>
<td>(0.29)</td>
<td>(0.04)</td>
<td>(0.13)</td>
</tr>
<tr>
<td>1982-83 to 1990-91</td>
<td>0.54</td>
<td>0.02</td>
<td>-0.02</td>
<td>0.12</td>
</tr>
<tr>
<td></td>
<td>(0.12)</td>
<td>(1.27)</td>
<td>(0.67)</td>
<td>(1.73)</td>
</tr>
</tbody>
</table>

Note: * indicates that the coefficients are significant at 5% level

Figures in brackets are t values

D.W. indicates that there is no auto correlation at 1% level
<table>
<thead>
<tr>
<th>Sample Period</th>
<th>Uttar Pradesh $a_1$</th>
<th>Andhra Pradesh $a_1+b_1$</th>
<th>Bihar $a_1+b_2$</th>
<th>Karnataka $a_1+b_3$</th>
<th>Maharashtra $a_1+b_4$</th>
<th>Tamil Nadu $a_1+b_5$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1973-74 to 1990-91</td>
<td>-0.25 (6)</td>
<td>0.01 (3)</td>
<td>-0.03 (4)</td>
<td>0.06 (2)</td>
<td>-0.14 (5)</td>
<td>0.09 (1)</td>
</tr>
<tr>
<td>1973-74 to 1981-82</td>
<td>0.47 (1)</td>
<td>0.35 (5)</td>
<td>0.42 (3)</td>
<td>0.34 (6)</td>
<td>0.46 (2)</td>
<td>0.40 (4)</td>
</tr>
<tr>
<td>1982-83 to 1990-91</td>
<td>0.54 (5)</td>
<td>0.56 (4)</td>
<td>0.52 (6)</td>
<td>0.66 (3)</td>
<td>0.71 (2)</td>
<td>0.76 (1)</td>
</tr>
</tbody>
</table>

Note: Figures in brackets are order of ranking.
FOOTNOTES


