CHAPTER VII

ANALYSIS OF TOTAL FACTOR PRODUCTIVITY
The performance of public sector undertakings can be viewed from several angles by adopting alternative criteria for evaluating efficiency. The choice of an appropriate criterion for assessing the performance of PUs would obviously depend on the approach that is adopted. Accordingly several studies assessing the performance of public sector undertakings and evaluating their efficiency have appeared in the recent years.¹ Most of these studies have, however, judged the relative efficiency of public sector undertakings mainly against the backdrop of financial results using the criterion of net profitability or the rate of return on the total capital employed, to indicate overall efficiency of public sector undertakings.² It is evident, that the profit criterion is not the only criterion but is there any a prior ground on which it may qualify even as the most important criterion for assessing the performance of public sector undertakings.³

The performance of public sector undertakings is viewed from either of the two angles – commercial or social. The appropriate criterion for the former being the net profits earned by the PUs, while the one for the latter being the contribution made by the enterprise to the country’s net national


product. The broader considerations of total output and income generation, represent the distinction between the relative productivity and the relative change in the productivity over a period of time.⁴

Productivity refers to a comparison between the quantity of goods or services produced and the quantity of resources employed.⁵ The relative importance of the resources differs from one industry to another depending upon its nature, availability and the cost of each input, product pattern, technology employed etc. The efficiency by which the input is transformed into output reflects the performance level. The productivity is defined as the optimum utilisation of resources to achieve the output. An analysis of trends in productivity and the resource utilisation helps one in correctly assessing the performance and aids in forecasting the various productivity parameters for future.⁶ Thus it is the index of total factor productivity that represents the most appropriate criterion for evaluating the overall performance of public sector undertakings.

Productivity indices are increasingly used as objectives


⁶ Bakul H. Dholakia, p. 10.
and scientific indicators to assess the performance of the PUs. A common method used to measure productivity is through partial productivity ratios. When there is an increase in any of the partial productivity ratios, then there is saving in the use of that particular factor. If these productivity ratios indicate conflicting trends, then it is difficult to judge the overall productivity. The analysis of trends of total factor productivity indices actually assesses the performance of that organization.

The researcher has calculated the total factor productivity by using Divisia Index Method, as it treats time as continuous and the index as an integral over time.7 The results can be correctly assessed and compared with that of other enterprise for long time periods. Secondly, the data help to enumerate the rates of growth of real output and input in the past. Each of the annual percentage rate of change of factor inputs was weighted by its share in the real value of production. The weighted percentage rate of change of factor inputs is added to find out the total weighted percentage rate of change of composite input. The difference between the percentage rate of change of real output and weighted percentage rate of change of composite input represents the output change explained in terms of increased productivity.8 The output is the total output, but in real


terms the actual values of total cost are added to profits while the loss is subtracted from it. Thirdly, this method enables one to take more number of inputs to assess the rate of change of factor inputs and output.

Basically, the index of the total factor productivity, is referred to the index of output per unit of total factor input and is derived as a ratio of the index of net output to the index of total factor inputs. This can be summarised as:

\[ A = \frac{Y}{X} \]  \hspace{1cm} (i)

where \( A = \text{Total Factor Productivity} \)

\( Y = \text{Total Output} \)

\( X = \text{Total Input} \)

If there is a marginal increase, it can be denoted by:

\[ \frac{dA}{A} = \frac{dY}{Y} - \frac{dX}{X} \]  \hspace{1cm} (ii)

\[ = w_i \frac{dY_i}{Y_i} - v_j \frac{dX_j}{X_j} \]  \hspace{1cm} (iii)

The weights \( w_i \) and \( v_j \) represent shares 'i' and 'j' in the value of total output 'Y' and total input 'X' respectively.

The total factor productivity index can be expressed as:

\[ TP = O_{RI} - I_{Rj} \]

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where $TP$ = Rate of change of total factor productivity.

$Q_{R1}$ = Rate of change of composite output.

$I_{Rj}$ = Rate of change of composite input.

The rate of change of composite input is the total of factor inputs as given below:

$$I_{Rj} = (I_{R1}S_1) + (I_{R2}S_2) + (I_{R3}S_3) + \ldots + (I_{Rj}S_j).$$

Where,

$I_{R1}$ = Rate of change of input 1.

$I_{R2}$ = Rate of change of input 2.

$S_1$ = Share of input 1 in real value of production.

$S_2$ = Share of input 2 in real value of production.

As both HPF and HTL are manufacturing units, the inputs considered for the analysis of rate of change of composite input are employment ($x_1$), raw materials ($x_2$), capital stock ($x_3$), power and fuel ($x_4$), stores and spares ($x_5$), transport and handling ($x_6$) and miscellaneous ($x_7$). The money values of the above inputs are taken from the literature available and from the annual reports from 1968 to 1982 for HPF and from 1962 to 1982 for HTL.

**ESTIMATION OF REAL VALUE OF PRODUCTION IN HPF AND HTL**

According to the Divisia Index Method, the total value of production is the total output in that year. This is indicated by the total value of sales achieved in the year by a particular
organization. The real value of production is derived by subtracting loss or adding profit from/to the total cost in that year. The total cost includes the total costs incurred on the seven factor inputs chosen for the present study, and has been discussed earlier.

Table 7.1 shows the computation of real value of production and analysis of percentage of rate of change in HPF. It shows that the real value of production was less than the total cost incurred from 1968 to 1975, owing to the losses incurred in these years. As HPF started its production in 1967-68, the real value of production increased 236.99 percent in 1969 and further 138.12 percent in 1970. It indicates that the costs incurred on various factor inputs was higher owing to the initiation of production. The total cost increased five times in 1968 and doubled in the following year due to the increase in the employment and raw materials costs. The raw materials for the initial production programme were imported from the collaborators and the high rate of rejection level aided in the utilisation of higher percentage of raw materials. Thus it led to an increase of the expenses on raw materials. The efforts made by HPF to procure the raw materials indigenously, led to the decrease of the expenses but posed serious problems in the production because the raw materials were far below the standard quality of the raw materials acquired from the other countries. The quality control and the adoption of other
countries. The quality control and the adoption of other principles to control the misappropriations in the production process reduced the percentage rate of change of raw materials cost. As a result it lowered the rate of increase of total cost. The growth rate of total cost virtually doubled in 1975, with the start of the conversion of cine colour film. The cost incurred on various factor inputs varied marginally which caused a marginal change in the total cost.

The value of real production was affected by the growth rate of profit/loss in HTF from 1966 to 1982. The growth rate decreased to 2.14 percent in 1972, because the loss decreased considerably and on the other hand the total cost also decreased. The percentage rate of change was 152.45 percent in 1975, but it decreased gradually to 10.57 percent in 1978 and varied marginally thereafter.

The real value of production has also been calculated in HTL to reveal its percentage rate of change. Table 7.2. shows that with the initiation of the production, the costs on the factor inputs increased. The total cost increased gradually from Rs.98.11 lakhs in 1966 to Rs.668.17 lakhs in 1982. The profit and loss account reveals that except in the years 1964, 1965 and 1967, HTL was able to achieve marginal profits despite the reduction of the prices of unit teleprinters. The total cost increased considerably in 1966 due to the effect of the devaluation of the rupee in 1964 which inflated the amount to
Rs. 38.11 lakhs in 1966.

The percentage rate of change of real value of production reveals that it increased from 55.80 percent in 1963 to 155.74 percent in 1965 and 297.79 percent in 1966. The real value of production decreased 21.26 percent and 8.87 percent in 1967 and 1969 respectively. This shows that HTL enforced changes in the profit and the cost centres to even out the expenses incurred and decrease the wastages by adopting procedures for effective maintenance and quality control of raw materials. The percentage rate of change in the real value of production was marginal from 1970 to 1977. This is because of the indigenisation of raw material and the process applied which led to a decrease in the growth rate of the factor inputs, and the regular supply of teleprinters in the monopolistic environment helped HTL to gain profits which showed a steady trend from 1968 to 1982.

The analysis shows that the total cost in HPF and HTL mainly depended more upon the raw materials cost than on any of the other factor inputs.

The weighted percentage rate of the employment, raw materials, capital stock, power and fuel, stores and spares, transport and handling expenses has been calculated in the corresponding chapters. The analysis of the weighted percentage rate of change in the miscellaneous expenses is the only remaining thing that needs to be studied. The weighted percentage of each of the inputs
mentioned above has been calculated by weighting the percentage rate of change in that particular input by its share in the real value of production.

ANALYSIS OF WEIGHTED PERCENTAGE RATE OF CHANGE OF THE MISCELLANEOUS EXPENSES IN HPF AND ETL

The miscellaneous expenses is the total money spent on repairs, advertisement, publicity, and all other expenses which has not been computed in the inputs from \( X_1 \) to \( X_6 \). Tables 7.3 and 7.4 analyse the weighted percentage rate of change in HPF and ETL respectively.

Table 7.3 depicts that the miscellaneous expenses increased 52.77 percent in 1968 which gradually decreased to 30.62 percent in 1969.\(^{10}\) The efforts made by HPF to effect indigerisation of production process and the procurement of raw materials, following of the strategies for building up of the market for the photosensitized products, decreased the expenses on the repairs, and advertisement and publicity. From 1975 to 1982 the growth rate slackened from 8.11 percent to 1.30 percent in 1981. Its share in the real value of production was 0.4111 in 1968, decreased to 0.1593 in 1969. In 1974 its share decreased from 0.1422 to 0.0697, which further reduced to 0.0392 in 1977. The weighted percentage rate of change was highest 16.27 percent in 1971, which decreased gradually to 0.04 percent in 1981.

The miscellaneous expenses increased 379.48 percent as highest in 1964 as indicated by the table 7.4. The expenses decreased 6.20 percent, 10.91 percent and 3.80 percent in 1970,

\(^{10}\) Annual Report (Octacamind : HPF, 1969-70).
1973 and 1979 respectively. The growth rate gradually declined from 73.64 percent in 1968 to 47.30 percent in 1971, further to 11.96 percent in 1972 and 3.09 percent in 1978. The market which was stable for supplying the teleprinters led to the decrease in the expenses on advertisement and publicity after 1964. HTL made efforts to circulate its new product i.e., electric type-writer in the market. It adopted advertisement and publicity channels in 1980 thus increasing the expenses by 46.50 percent. Its share in the real value of production which was 0.109 in 1964 decreased to 0.022 in 1966. It increased to 0.055 in 1972, and decreased marginally in the following years. It can be pointed out that the share of the miscellaneous expenses was comparatively less in HTL than that of HPF. The weighted percentage rate of change in the first half of the total period (1962 to 1982), first decreased from 28.08 percent in 1964 to 1.11 percent and minus 0.25 percent in 1967 and 1970 respectively, then increased to 15.08 percent in 1971. It showed marginal variation from 1972 to 1982.

ANALYSIS OF THE TOTAL WEIGHTED PERCENTAGE RATE OF CHANGE OF INPUTS

The weighted percentage rates of change of $X_1$, $X_2$, $X_3$, $X_4$, $X_5$, $X_6$, and $X_7$ (factor inputs) in each year are added to compute the total weighted percentage rate of change of composite input as explained in Tables 7.5 and 7.6 for HPF and HTL respectively.

Table 7.5 indicates that the total weighted percentage rate of change of input was 213.81 percent in 1968, decreased marginally to 99.41 in 1970. It increased again to 127.07 in
1975. It shows that the weighted percentage rate of change of employment expenses was 85.71 percent, which affected the weighted percentage rate of change of composite inputs. The undertaking of the conversion of the cine colour increased the raw material expenses, which affected higher weighted percentage rate of change in composite input in 1975. It reveals that the weighted percentage rate of change in composite input was affected by the change in the raw materials expenses. The weighted percentage rate of change of all inputs decreased to minimum from 1976 to 1981, as HEF was able to regulate the costs on various inputs evenly. The least weighted percentage rate of change was of $X_3$ (capital stock) 0.0003 in 1981.

The total weighted percentage change in composite input in HTL revived from minus 28.65 percent in 1963 to 88.98 percent in 1964. It increased considerably to 279.05 percent in 1966, declined thereafter to 0.46 in 1972 as indicated in Table 7.6. It increased again to 13.41 percent in 1973 and maintained the same with minimum margin thereafter. Out of the total weighted percentage rate of change of composite input, the major share was of raw materials initially along with employment and capital stock. The analysis reveals that adoption of new techniques of inventory control, cost and value analysis, quality control of the raw materials procured indigenously and the formulation of the effective production scheduling programme led to a decrease in the percentage rate of change of factor inputs, but mainly because of raw materials. The labour unrest and the
manpower absorption has increased the rate of employment expenses, which led to an increase of its share in the real value of production.

TOTAL FACTOR PRODUCTIVITY (TFP) INDEX IN HPF AND HTL

Having derived the total weighted percentage rate of change of input from 1968 to 1982 in HPF and from 1962 to 1982 in HTL, and the percentage rate of change in the real value of production, it is now possible to compute the change in the total factor productivity for HPF and HTL respectively, by subtracting the weighted percentage rate of change of composite input from the percentage rate of change of output.

Table 7.7 shows that the change in TFP index (1968 = 100.00 base year) increased to 171.17 in 1970. It decreased considerably to 3.46 in 1971. This was affected by the minimal difference between the percentage rate of change in output which increased marginally due to low generation of profits in 1976 and input. Before that it incurred heavy loss from 1968 to 1975. The total weighted percentage rate of change of composite input increased due to the uneven increase in the expenses of factor inputs taken for the study. From 1974, the TFP index showed an increasing trend, but varied between 2.91 to 4.36 only.

The trend of the TFP index has been calculated in the table 7.8 for HTL (1962 = 100.00 base year). It indicates that the TFP index decreased to 72.85 in 1963 and further to 45.85 in 1965. It reduced to 8.45 in 1967, revived in the following year.
and achieved 18.73 thereafter it showed a gradual decrease to 7.43 in 1978. The gradual decrease of TFP index in HTL is because of the low generation of finance with the adoption of pricing policies for achieving the marginal profits. There was an uneven distribution of finance on various factor inputs as discussed earlier, thus increasing the total weighted percentage rate of change of composite input.

The study reveals that both PUs, showed a similar trend of TFP in the previous years. It also shows that the trend has changed to adopt growth pattern rather than accumulation of the profits. The study proves that the TFP index is the most relevant method to assess the performance of both the PUs. The study further points out that according to TFP index, HTL is considered to be more efficient than BPF.