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EFFECTIVENESS OF PRODUCTIVITY RATIO AS DETERMINANT OF FINANCIAL PERFORMANCE OF PSEs

by

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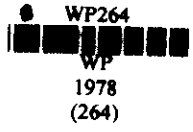

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EFFECTIVENESS OF PRODUCTIVITY RATIO AS DETERMINANT OF FINANCIAL PERFORMANCE

Of considerable importance in productivity studies is the extent of effectiveness of productivity ratio as determinant of overall performance of the enterprise. It has long been recognized that no single criterion is really adequate to evaluate the performance of Public Sector Enterprises. Consequently, Bureau of Public Enterprises in their comprehensive annual evaluation of performance of Public Sector Enterprises, examine several aspects of performance, which broadly cover i. financial performance, ii. physical performance, with respect to production, sales, exports, capacity utilisation, inventories, employment, generation of internal resources, townships and social overhead.

Financial performance of individual enterprises is assessed having recourse to the following main performance ratios:

1. Net profit (or loss) to paid up capital
2. Gross profit to capital employed
3. Net profit to net worth
4. Gross sales to capital employed
5. Value added to capital employed.

In addition BPE also analyses the expense ratio and the extent to which asset formation in a PSE is financed by internally generated resources. Financial performance is undoubtedly dependent upon physical performance of various activities such as production, sales, capacity utilisation, inventories, employment, etc. Clearly, factors governing physical performance must inevitably influence overall financial performance.

Two concommittant questions arise in this context, namely -

1. What, if any, are effective determinants of financial performance of Public Sector Enterprise

2. What are the major factors that influence financial performance As noted earlier these factors would have to be naturally related to physical aspects of performance.

A pertinent question of obvious interest, is whether the productivity ratio (which is, in essense inverse of the expense ratio computed by BPE), is really an effective determinant of financial performance. If this were indeed it would in practical terms mean that a financially good enterprise is in fact a productive enterprise, and efforts to increase productivity of the enterprise must necessarily result in improved overall financial performance. Productivi could thus be the vital missing link that reconciles requirements of higher financial performance on one hand and higher physical performance, on the other. Complementary problem is to assess the effectiveness of performance ratios currently used by BPE, for performance evaluation of the PSEs.

In our attempt to resolve the issues raised above, we resorted to the multivariate statistical technique of discriminant analysis , developed apparently independently by Fisher, Mahalanobis and Hotelling, respectively. The three principal uses to which the technique has been put can be outlined as follows:

1. Classification and diagnosis of diseases.

2. Study of the relations between populations. For example, do aptitudes and attitudes of a competent architect differ from those of a competent engineer?

3. As a multivariate generalisation of the t-test. Given a number of related measurements of multiple variables made on each of two groups, it provides a single test of null hypothesis that two populations have the same means with respect to all measurements.

Applications of the technique have been reported to a number of problems in management science such as quality rating, personnel classification and selection, pattern of

employment across industries, error detection in mail order surveys, study of audience characteristics, sampling inspection, etc. Literature is replete with numerous reported applications of discriminant functions in diverse fields of study such as anthropometry, psychometry, medical diagnosis, psychology, biology and biomedicine, animal husbandry, astronomy, etc. More recently, Bhattacharya and Raghavachari (1) have reported application to a problem in financial management. This problem concerns identifying effective determinants of working capital management.

Major difficulty in using the technique is the initial availability of groups or populations which are distinct, so that a given member can be classified as belonging to one of the groups. The corresponding discriminant function also highlights effectiveness of the multiple variables for discriminating between the groups. In studies such as anthropometry, behavioural sciences, medical diagnosis, etc., existence of distinct groups is often assured. However, in management science applications of the type reported by Bhattacharya and Raghavachari, element of subjectivity is involved in the formation of initial groups. Discriminant function will therefore be only as effective as the original classification of groups, and possibility of a circular argument cannot altogether be ruled out. Neverthless, once distinct groups are available, discriminant analysis will lead to the multivariate test of hypothesis concerning equality of means and help ascertain whether the group parameters are significantly different. If they are, resulting discriminant function would be used to discriminate between the two groups. In many studies, this itself could be of major advantage.

In order to apply this multivariate statistical technique to the problem under consideration, various financial performance ratios used in the past by BPE and other reported studies were accumulated. These are listed below:

1. Net profit to sales (NPS)
2. Gross profit to sales (GPS)
3. Gross sales to gross block (GSGB)
4. Sales to inventory turnover (SIT)
5. Gross profit to gross block (GPGB)
6. Net profit to paid up capital (NPPC)
7. Gross profit to capital employed (GPCE)
8. Net profit to net worth (NPNW)
9. Gross sales to capital employed (GSCE)
10. Value added to capital employed (VACE)

In addition, we also took into account productivity ratio (PR) defined in this study. All other ratios reflecting physical performance were deliberately omitted, since these were viewed in the nature of factors influencing financial performance.

It may be noted that some of the performance variables listed above are of composite nature. For instance, GPS can be expressed as

$$GPS = NPS + (I + T)S$$

where (I + T)S is the ratio of (Interest + Taxes) to sales. Similarly,

$$GPCE = GPS \times GSCE$$

Since both GPS and GSCE are included as performance variables, GPCE may be dropped. Also in the case of PSEs, net worth is defined as

Net worth = Paid up capital + Reserves - Deficit

In a number of enterprises, even though the profitability is good, because of substantial accumulated deficits, net worth is often negative. The ratio NPNW, in such instances, is abnormally large. In addition, in case of enterprises making net loss and with negative net worth, the ratio NPNW would appear to be meaningless. Moreover, restricting to enterprises with positive net worth, if an enterprise has a relatively low net worth, even a modest net profit could make its NPNW substancially higher than an enterprise with a correspondingly higher net worth. For these reasons, NPNW was deleted from the list of performance variables. For discriminant analysis, the list of variables was pruned to the following:

1. Net profit to sales (NPS)
2. (Interest + Taxes) to sales (I+T)S
3. Gross sales to gross block (GSGB)
4. Sales to inventory turnover (SIT)
5. Net profit to paid up capital (NPPC)
6. Gross Sales to capital employed (GSCE)
7. Value added to capital employed (VACE)
8. Productivity ratio (PR)

Values of these ratios were computed for 72 running enterprises manufacturing and selling goods, using most recent annual reports available at the time of study.

To start with, out of 72 enterprises for which computations were made, we picked 5 enterprises in the first group and 13 enterprises in the second group. The 5 enterprises were characterised by highest recorded productivity ranging from 1.54 to 2.561, and had shown highest NPS ratios. The 13 enterprises in the second group were marked with lowest recorded ranging from 0.0175 to 0.875 and high negative NPS ratios. Thus, at least in terms of productivity the two groups could be considered distinct. Objective of discriminant analysis with the groups so formed, was to ascertain if, with respect to the multiple performance variables selected above, the groups were significantly different and to examine discriminating power of various performance variables.

The output of discriminant analysis is given in Appendix 3. The classification ability of discriminant function is shown in Exhibit 1 below:

Exhibit 1

Classificatory Ability of Discriminant Function

(Original Groupings)

Actual	Predicted		Total
	Group I	Group II	
Group I	5	0	5
Group II	0	13	13
Total	5	13	18

It is clear from the exhibit that discriminant function correctly classified all the enterprises. F-ratio was significant at 0.01 level, implying that the groups were significantly different and the probability of misclassification was practically nil. Reviewing the relative importance

values, it is noticeable that only two variables namely, Productivi ty Ratio and Sales to Inventory Turnover ratio accounted for a total of 88% relative importance (RI). Remarkably, Productivity Ratio alone accounted for 70 % of RI Value. Since NPPC could be expressed as NPS x GSPC, and VACE as VAGS x GSCE, NPPC and VACE were replaced by the ratios of Gross Sales to Paid up Capital (GSPC) and Value Added to Gross Sales (VAGS). The output of new discriminant analysis with the original 18 enterprises is given in Appendix 3. Exhibit 2 displays the classificatory ability of new discriminant function.

Exhibit 2

Classificactory Ability of Discriminant Function (Original Grouping, with New Variables)

Actual	Predicted		Total
	Group I	Group II	
Group I	5	0	5
Group II	0	13	13
Total	5	13	18

The F-ratio was significant at 0.01 level of significance and the probability of misclassification was 0.0030. Again the new discriminant function correctly classified all the enterprises. Reviewing the relative importance values, only 5 variables i.e. PR, GSGB, SIT, VAGS and NPS accounted for 96% of RI. It is interesting to note that, here again, productivity ratio had an overwhelming RI of 71%.

Discriminant analysis established that at least in so far as original groups were concerned, they were significantly different The corresponding discriminant function had very low probability of misclassification and productivity ratio was a very effective discriminant between groups, in the multivariate set up reflected by MDA.

New Scheme of Classification:

As we have said before, the BPE in its own analysis of performance of PSEs, takes into account primarily the following performance variables: NPPC, NPNW, GSCE, VACE, GPCE. Because of the composite nature of some of these variables, the same may be replaced by ratios NPS, GSCE, VAGS, (I+T)S, GSPC. Due to reasons already discussed, NPNW is again ignored. In addition, GSGB, PR and SIT were retained. Based on the above performance variables, out of 72 enterprises, we selected 16 enterprises which performed uniformly 'good' and another 18 enterprises which performed uniformly 'bad'. The 16 enterprises in the first group, had apart from generation of internal resources, declared dividends as well quite an event in PSEs. To cross check the classification, we adopted a five point scale, taking cognizance of five ratios: NPS, PR, GSGB, GSCE and GSPC. One point was assigned to each ratio and the enterprise adjudged as performing well on a particular ratio, was assigned a score of one. If not, it was assigned a score of zero. Using this scoring system, each enterprise in the first group of 16, had a cumulative score of 3 or more, average score being 4. Each enterprise in the second group of 18 organizations, had a cumulative score of 0 to 2, average score being 0.6.

With the new classification, discriminant analysis was repeated. MDA output is shown in Exhibit 3 of Appendix 3. The classsificatory ability of the corresponding discriminant function is shown in Exhibit 3 below:

Exhibit 3

Classificatory Ability of Discriminant Function

(New Classification, 34 Enterprises)

Actual	Predicted		Total
	Group I	Group II	
Group I	16	0	16
Group II	0	18	18
Total	16	18	34

The new discriminant function again correctly classified all the enterprises. F-ratio was significant at 0.01 level of significance and the probability of misclassification was 0.12. Reviewing the relative importance values, only 3 variables namely PR, GSGB and GSPC were found to account for nearly 91% of RI. The analysis helped to bring into focus, discriminatory ability of Productivity Ratio when classification was based on judgement about overall financial performance and cross checked with the scoring system. This conclusion in a way reinforced our belief that apart from its undisputed importance to physical performance, productivity ratio could be a major determinant of financial performance.

In our next scheme of classification, we used the discriminant function obtained during our previous classification, and the corresponding cutoff point, for classifying the enterprises in the two groups. Eight enterprises whose discriminant function scores were too close to the cut off point were eliminated. Out of the remaining enterprises, 34 were classified in the first group and 30 were classified in the second group. The new output with MDA is shown in Exhibit 4 of Appendix 3. As noted from that output, there was now a sharp drop in the squared distance between the two groups, and probability of misclassification increased to nearly 0.28. The classificatory ability of discriminant function is shown in Exhibit 4, below. The new discriminant function correctly classified nearly 91% of enterprises. It is interesting to note, however, that even in the new discriminant function, Productivity Ratio had the highest relative importance value. Further analysis was not considered worthwhile. While the analysis did establish that PR, GSGB and SPC are good determinants of financial performance, this in a way strengthens our submission that productivity ratio is a major determinant of financial performance.

Exhibit 4

Classificatory Ability of Discriminant Function

(New Classification GR I = 34, GR II = 30)

Actual	Predicted		Total
	Group I	Group II	
Group I	34	0	34
Group II	6	24	30
Total	40	24	64

Reference

[1] S.K. Bhattacharyya and M. Raghavachari, 'Effective Determinants of Working Capital Management,' Working Paper No. 1, 1976.

Appendix 3

Exhibit 1: Discriminant Analysis Using Original Classification

Size: GR I = 5
GR II = 13

Variable	Mean of Group I	Mean of Group II	Differences of Means	Discriminant function coefficient	Percentage relative importance	Rank
Productivity ratio	1.8332	0.5989	1.2343	88.0944	71.12	1
Net profit to sales	0.236	-4.5957	4.8317	0.4316	1.36	6
Gross sales to gross block	1.1074	0.5245	0.5829	6.9827	2.66	4
Sales to inventory turnover	5.8428	1.4983	4.3445	-5.9712	16.97	2
Net profit to paid up capital	0.1706	-0.1821	0.3527	11.0045	2.54	5
Gross sales to capital employed	0.8962	0.7760	0.1202	7.4596	0.59	7
Value added to capital employed	0.6872	0.4462	0.2410	-3.5124	0.55	8
(Interest+Taxes) to sales	0.2354	0.4860	-0.2506	25.6624	4.21	3

$D_1 = 146.639 \quad D_2 = 60.1829$

$D = \frac{D_1 + D_2}{2} = 103.411$

D^2 - Statistic = 86.4566

If value of DISC.FN is > D it belongs to Group I
If value of DISC.FN is ≤ D it belongs to Group II

F-ratio = 21.9519 with D.F. 8 and 9, significant at 0.01 level.

Prob. of misclassification is negligible.

Exhibit 2: Discriminant Analysis with Original Classification: (Size: Group I = 5
Group II= 13)

(Revised Variables)

Variable	Mean Group I	Mean Group II	Difference Group I- Group II	Coefficient of discriminant function	Relative importance	Rank
Productivity ratio	1.8332	0.6038	1.2244	26.9750	70.93	1
Net profit to sales	0.2360	-4.6676	4.9036	-0.4138	4.34	5
Gross sales to gross block	1.1074	0.5795	0.5279	7.7426	8.74	2
Gross sales to capital employed	0.0762	0.8818	-0.0056	-4.0086	0.05	8
(Interest+Taxes) to sales	0.2322	0.3891	-0.1569	-2.2969	0.77	7
Gross sales to paid up capital	0.949	1.1320	-0.1830	-2.5030	0.98	6
Value added to gross sales	0.7870	0.4191	0.3679	7.7024	6.06	4
Sales to inventory turnover	5.8423	1.6832	4.1597	-0.9129	8.12	3

$D_1 = 52.2331$, $D_2 = 17.1350$

$D = \frac{D_1 + D_2}{2} = 34.684$

D^2 - Statistic = 35.0981

F ratio = 8.9116 with D.F. = 8 and 9, significant at 0.01 level of significance.
Probability of misclassification = 0.0030
If value of DISC FN is > D it belongs to Group I
If value of DISC FN is ≤ D it belongs to Group II

Exhibit 3: Discriminant Analysis with New Classification (Size: Group I = 16, Group II = 18

Variable	Mean Gr. I	Mean Gr.II	Difference Gr.I-Gr.II	Coefficient of discriminant function.	Relative importance	Rank
Productivity ratio	1.6393	0.7854	0.8539	7.3471	29.64	2
Net Profit to sales	0.1208	-0.2895	0.4102	0.5142	0.99	7
Gross sales to gross block	1.8926	0.5930	1.2996	6.0453	37.11	1
Sales to inventory turnover	6.4588	1.6522	4.8066	0.1339	3.04	4
Gross sales to capital employed	1.1933	0.7735	0.4198	-1.2815	2.54	5
Gross Sales to paid up capital	5.5750	1.0222	4.5528	-1.1498	24.73	3
(Interest+Taxes) to sales	0.1362	0.1439	-0.0077	-11.8857	0.43	8
Value added to gross sales	0.6044	0.5178	0.0866	3.6857	1.52	6

$D_1 = 17.0809$, $D_2 = 7.4589$

D^2 - Statistic = 9.6221

$$D = \frac{D_1 + D_2}{2} = 12.2699$$

F Ratio = 7.9594 with D.F = 8 and 25, significant at 0.01 level.

Probability of misclassification = 0.12

If value of DISC FN is > 12.2699, it belongs to Group II.

If value of DISC FN is $\leq$ 12.2699 it belongs to Group II.

Exhibit 4: Discriminant Analysis with New Classification (Size Group I = 34, Group II =

Variable	Mean Gr. I	Mean Gr.II	Difference Gr.I-Gr.II	Coefficient of discriminant function	Relative importance	Rank
Productivity ratio	1.3205	0.8817	0.4388	2.9486	27.12	1
Net profit to sales	0.0713	-0.1955	0.2668	4.6809	26.18	2
Gross sales to gross block	2.0391	1.6925	0.3466	1.5959	11.59	5
Sales to inventory turnover	4.4883	2.4059	2.0824	0.0468	20.39	3
Net profit to paid up capital	1.1348	1.6223	-0.4875	-0.3755	3.84	7
Gross sales to capital employed	0.1071	0.1750	-0.0679	-4.7547	5.77	6
Value added to capital employed	4.4062	6.8677	-2.4615	-0.3644	18.80	4
(Interest+Taxes) to sales	0.5485	0.4670	0.0815	2.1403	3.66	8

$D_1 = 6.3248, \quad D_2 = 1.5535$

D^2 - Statistic = 4.7712

$D = \frac{D_1 + D_2}{2} = 3.9392$

F. ratio = 8.4320 with D.F. = 8 and 55, significant at 0.01 level.

Probability of misclassification = 0.28

If value of DISC FN is > D, it belongs to Group I

If value of DISC FN is ≤ D, it belongs to Group II