Introduction

A sector's performance can be seen in different ways depending upon the objectives in mind. Profitability has been recognised as the main indicator of financial performance in the case of private sector.[1] On the other hand, economic performance can be studied in terms of productivity, efficiency, technology and technical progress.[2] There can be other measures of performance from the national economic and socio-political view points. For instance, even while a company makes handsome profits if it is achieved by neglecting the interests of labour, consumer and the environment at large, the costs to the society can be enormous.[3] From a specific region's point of view, location of a project in an area with

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1. Sales maximisation as suggested by Baumol and growth maximisation suggested by Marris and the behavioural theory of Cyert and March take a view that managerial behaviour is growth oriented as modern corporations are not owned by single individual and are run by management teams. See: W.J. Baumol, Business Behaviour, Value and Growth, 2nd Edition, Macmillan, New York, 1967; Robin Marris, The Economic Theory of Managerial Capitalism, Macmillan, London, 1964; and R. Cyert and J.G. March, A Behavioural Theory of the Firm, Prentice-Hall, Englewood Cliffs, NJ, 1963. While profit maximisation cannot be an exact description of corporate behaviour it is regarded as workable approximation; managements that stray too far from profit maximisation in the pursuit of other goals, may expose the firm for takeovers and consequential loss of their own jobs. See the comments attributed to Solow in: W.J. Baumol and Alan S. Blinder, Economics: Principles and Policy, Harcourt Brace Jovanovich (International Edition), San Diego, Third Edition, 1985, p. 868. A similar view was expressed by Scherer & Ross when they stated :

   > (T)he last word has by no means been uttered on how assiduously modern industrial corporations strive to maximise their profits. From the voluminous and often inconsistent evidence, it appears that the profit maximization assumption at least provides a good first approximation in describing business behaviour. Deviations, both intended and inadvertent, undoubtedly exist in abundance, but they are kept within more or less narrow bounds by competitive pressures, the self-interest of stock-owning managers, and the threat of managerial displacement by important outside shareholders or takeovers.

   See: F.M. Scherer and David Ross, Industrial Market Structure and Economic Performance, Houghton Mifflin Co., Boston, 19..., p. 52.

2. It this context one may refer to the observations of the Arjun Sengupta Committee on public enterprises. The Committee noted that while public enterprises pursue a number of objectives simultaneously and a single measure of performance is difficult to specify there are certain objectives which are common and these should form the basis for general performance criteria. The criteria may fall into four groups: 1. financial performance, 2. productivity and cost reduction, 3. technical dynamism and 4. effectiveness of project implementation. In respect of financial performance the Committee suggested three ratios namely, (i) gross margin on assets (for all enterprises), (ii) net profit on net worth (for core sector and profit making enterprises), and (iii) gross margin on sales (for service enterprises). See: Government of India, Ministry of Finance, Report of the Committee to Review Policy for Public Enterprises, December 1984. (Chairman: Arjun Sengupta). For a good discussion on efficiency measures categorised as economists' approach and managerial approach, one may refer to Geeta Gouri, "Economic Liberalisation in India and Efficiency in Public Enterprises -- Some Issues", in T.L. Sankar and Y. Venugopal Reddy, op. cit.

3. It is said that criteria such as environmental awareness, ethnic conduct, citizenship and employee relations are beginning to be taken into consideration besides profitability in measuring corporate performance. See: William L. Jacobs and Brian H. Kleiner, "New Developments in Measuring Corporate Performance", Management Research News, Vol. 18, Nos. 3-5, pp. 70-77.

poor infrastructure and providing employment to local population can be considered an achievement by itself. Similarly, contributing to a country's exports and net earning of foreign exchange can be an important consideration for an economy suffering from huge external debt.

Just as there is no single criteria for judging performance, performance in turn, in whatever manner it is measured, can be influenced by a number of factors. For instance, studies on profitability have used size, market share, capital-output ratios, foreign ownership, technology imports, age, advertisement intensity, other entry barriers, etc. as explanatory variables. In turn, profitability ratios were used as explanatory variables along with some of the above, to understand the differences in growth, investment, pattern of financing, etc., implying simultaneity in their relationship.[4]

In the case of joint sector, the subject of our study, there can be multiple objectives from the ownership category point of view. The objectives of the three groups of owners, public sector promoter, private promoter and the general public can be different though not mutually exclusive in which case the joint venture could not have come into being in the first instance. In a joint venture with two partners, both the partners may not be interested in maximising the financial performance of the venture. Each one may be seeking diverse or the same objective other than profit maximisation of the joint venture.[5] If, for example, it is an R&D project, the partners may have only pooled their resources and also tried to reduce the risk to share the resulting new applications, processes and product innovations.

While these could be valid reasons, there is the issue of sustainability of the venture in the long run. Neither of the partners may support the venture endlessly. Which means that the venture has to reach some level of financial stability.[6] If, however, in a JSE, the private promoter also is the main beneficiary in terms of marketing the output or using the JSE's output as a raw material/component in its own production, financial performance of the JSE may not be at the top of his priorities. Moreover, if it is known that at a future date he can take the unit into his full control the private promoter may not hesitate to starve the JSE so that in the event of the public promoter disinvesting he need not have to pay a heavy price based on market quotations. These possibilities underline the importance of the role

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4. See: N.S. Siddharthan, B.L. Pandit and R.N. Agarwal, "Growth and Profit Behaviour of Large-Scale Indian Firms", The Developing Economies, Vol. XXXII, No.2, June 1994, pp. 188-209, and Nagesh Kumar, Multinational Enterprises and Industrial Organisation: The Case of India, Sage Publications, Delhi, 1984.

5. A view was that joint ventures are different from wholly owned divisions because the interests of the joint venture and the parent company are often in conflict. However, joint ventures should be evaluated primarily as standalone entities seeking to maximize their own performance, not the parent company's performance. See: Erin Anderson, "Two Firms, One Frontier: On Assessing Joint Venture Performance", Sloan Management Review, Vol. 31, No. 2, Winter 1990, pp. 19-30.

6. It is relevant to note that a study of U.S.-China joint ventures noted that the performance criteria used by joint venture participants was converging with profitability as the dominant element. See: Gregory E. Osland, "Successful Operating Strategies in the Performance of U.S.-China Joint Ventures", Journal of International Marketing, Vol. 2, No. 4, 1994, pp. 53-78.

of the nominee directors. It should be noted in this context that the policy of disinvestment only specifies that the public sector promoter can disinvest after the unit goes into commercial production.[7] Disinvestment is in no way related to the stability of the venture financially or otherwise. The timing of disinvestment could be an act of mutual understanding and the public sector promoter's need for funds. The performance could also be related to the venture's place in the overall structure of the private promoters' industrial establishments. For instance, if the JSE is crucial for the private promoter -- being the sole or a major entity in his House -- he is more likely to be interested in its success. One can similarly argue in a situation where there are no other firms in the house dealing in the same product either as consumers or competitors.

We have noted in the foregoing that the main objective of the public sector promoter was industrialisation of the respective state. The justification provided by the ILPIC while recommending joint sector was that (a) whenever the state contributes substantially to a project in the form of loans, it should have the option to benefit from the success of the venture in the form of dividends and capital appreciation and (b) the enterprises should work in public interest rather than merely for private profit. Incidentally, the first type of justification coincides with the objective of the general public. Thus the objective of the public sector promoter can have some commonality with those of the general public.

Location in a backward area, providing employment, protecting the environment, maintaining harmonious industrial relations, exporting and earning net foreign exchange, optimum utilisation of resources, conservation of scarce natural and other resources, building local technological capability (R&D), producing quality goods, responsiveness to customer needs by providing quality goods and prompt service, non-exploitation of monopoly position, prompt payment of statutory dues such as corporate tax, sales tax, customs and excise duties, electricity and water charges to public authorities, information disclosure, non-siphoning of funds for personal gains, implementing projects in time without cost overruns[8], lower project costs for comparable projects in the private and public sectors, growth in terms of sales, assets, return on investment for the shareholder, internal resource generation, etc. can all be viewed as constituting public interest in the Indian case. It follows from this that the second objective of serving public interest is more relevant from the public sector promoter's point of view.

The objectives of the joint sector are : (i) acceleration of industrialisation and balanced regional development; (ii) resource mobilization; (iii) broadbasing of entrepreneurship; and (iv) social control over industry.[9] The first objective seems to have

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7. Ministry of Industrial Development, Circular 10(12)LIC. Pol/69, op. cit.

8. IDBI, Guidelines for nominee directors, op. cit., p. 2-3.

9. M.R. Murthy, "Joint Sector: The Purpose, Rationale and Objectives", Working Paper, Institute for Studies in Industrial Development, April, 1995.

received preference in terms of location of JSEs in backward areas.[10] It was noted that the objective of containing concentration of economic power did not receive much attention.[11] New and relatively smaller entrepreneurs and technocrats did get involved in JSE promotion in a significant manner. While it may not be possible to study all the other elements of the objectives and expectations from the sector within the framework of the present study, we shall deal with a some of them at the individual sector level and in comparison with the private corporate sector.

2 Selection of Companies for Performance Study

To analyse the performance of a sector whose composition does not remain stable, which experienced a high degree of operational difficulties, whose constituents are limited in number and further most of which are relatively of recent origin, it becomes necessary to make certain assumptions with regard to the choice of companies for study as also to find a suitable set of other companies for comparative analysis. While the JSEs have been promoted over a period of time, we have noticed that a number of them have run into serious financial difficulties and have either been non-operational/went into liquidation, untraceable or were already amalgamated with other companies. A large majority of such JSEs were indeed referred to the Board for Industrial and Financial Reconstruction (BIFR). A few others ceased to be JSEs as the public sector promoter had divested its stake in the venture. Table - 1 gives a distribution of companies according to their status of operations. Out of the 301 JSEs identified by us which offered their shares to the public, as many as 83 can be termed as having experienced serious financial difficulties and hence their operations were affected adversely. Seventeen companies ceased to be JSEs as either these were amalgamated with other companies or the public sector promoter divested its stake. The very fact that such large number of JSEs turned out to be sick reflects poorly on the sector. Indeed, such failures work out to be 28 per cent in terms of numbers and nearly one-fifth in terms of total assets.[12]

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10. M.R. Murthy, "Joint Sector: An Approach to Regional Industrial Development", Working Paper, Institute for Studies in Industrial Development, June, 1995.

11. M.R. Murthy, "Joint Sector and Regulation of Concentration of Economic Power", Working Paper, Institute for Studies in Industrial Development, October, 1995.

12. It was not possible to have consistent set of data on paid-up capital and total assets either due to the status of the company (sickness, liquidation and amalgamation) or non-availability of data. In cases where data for 1990-91 was not available, we have taken the latest available figures. Research & Statistics Division of the Department of Company Affairs also follows a similar practice in their compilations of company finances (Factsheets on Non-government Big-sized companies, Government Companies and Indian Subsidiaries of Foreign Companies, etc.). See: Government of India, Ministry of Law, Justice & Company Affairs, Department of Company Affairs, Registration and Liquidation of Joint Stock Companies in India : 1992-93, 1993.

Table - 1

Distribution of Joint Sector Companies which went to the Public according to their Status of Operations

(Figures in Rs. crores)

Status		No. of Compa-nies	Paid-up Capital		Total Assets	
			Amount	%Share in Total	Amount	%Share in Total
(1)		(2)	(3)	(4)	(5)	(6)
1.	Commercial Prodn. before March 1987	101	506.14	21.39	3494.05	32.52
2.	Commercial Prodn. after March 1987	39	467.02	19.74	947.24	8.82
3.	Public Issue/Inc. after March 1987	46	570.74	24.12	1881.01	17.51
	Sub-total (2+3)	**85**	**1037.76**	**43.87**	**2828.25**	**26.33**
4.	Sick Companies	83	547.59	23.15	1989.38	18.52
5.	Amalgamated	11	68.84	2.91	286.79	2.67
6.	Disinvested	6	47.85	2.02	309.26	2.88
	Sub-total (4-6)	**100**	**664.28**	**28.08**	**2585.43**	**24.07**
7.	Government Cos.	12	76.45	3.23	357.69	3.33
8.	No Identifiable Private Promoter	3	81.15	3.43	1477.32	13.75
	All Companies	301	2365.79	100.0	10742.74	100.0

Note: Data on Paid-up capital and total assets refer to 1990-91 or the latest year prior to 199-91 for which information is available.

Source: Based on the data generated from the prospectuses of JSEs which went to public for issue of capital. To this additional information like classification of private promoters, location, etc. was added wherever relevant.

The magnitude of failure becomes more significant if the amalgamated/divested cases which at the time of amalgamation/ divestment were performing very poorly are also taken into account.[13] In view of the considerable extent of sickness in the joint sector it would be useful to study the factors responsible for the same and whether these differ from private sector companies. Such an analysis is necessary more so because of the expected close supervision of financial institutions and their support in acquiring necessary approvals, financial accommodation, etc. which are crucial for timely start-up of a project's operations.

It can also be seen from the Table that twelve of the JSEs continued to figure in the list of Government Companies as on March 31, 1990. In three companies there never was any identifiable private promoter.[14] Out of the remaining 180 JSEs, 37 started commercial production after March 1987 and a further 46 were either incorporated or came to the public after March 1987. Since it was felt necessary to allow certain time period for the company to stabilize its operations before its physical and financial performance could be studied we had to leave these companies from further analysis. Thus we could identify 101 JSEs which started their commercial operations before March 1987 and which have participation of all the three ownership groups: public sector, private promoter and the general public. Since we intend to cover the period up to 1990-91, such of the companies which started commercial production during 1986-87 would have been in operation at least for four years by 1990-91.[15]

Out of these 101 companies detailed financial data could be collected from company annual reports for 77 companies. It has been observed that the 77 companies accounted for 85.32 per cent of the paid-up capital and 90.12 per cent of the total assets of the JSEs selected for study. These 77 companies for which data on financial parameters could be collected, constitute a representative set of JSEs identified for study of financial and other performance.

For studying financial performance, we have chosen the three years 1988-89, 1989-90 and 1990-91. In view of the small number of JSEs covered in the detailed study and their wide industrial distribution, it was decided not to attempt industry level analysis. For analysing trends in productivity growth we have taken the seven year period 1983-84 to 1989-90. The number of JSEs for which we could get data for seven consecutive years

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13. It may, however, be noted that a few of the joint sector companies were indeed formed to takeover sick industrial undertakings. Magadh Spun Pipes Ltd and Kumardhubi Metalcastings Ltd are cases in point.

14. Gujarat State Fertilizers Co. Ltd is a case in point.

15. In sum, the criteria for selection of JSEs for detailed study is: (i) it should already not have been declared as sick or is in the process of rehabilitation or it was not put under liquidation; (ii) it should not have been amalgamated with other companies; (iii) the public sector promoter has not divested its stake or the unit did not cease to be a joint sector one; (iv) there is an identifiable private promoter; and (v) it should have started commercial production at least four years prior to 1990-91.

was relatively few at 24. While it would have been desirable to study productivity changes over a longer time period, the possibility of making to do with fewer number of companies restricted us to cover only a seven year period. 1990-91 was not considered for productivity analysis as it was an abnormal year with the economy and political scene in turmoil and (ii) subsequent to 1990-91 the economic policies have undergone substantial changes.[16]

In order to have a comparative picture we relied on a data base generated from data tapes on large and medium sized non-government public limited companies obtained from the Reserve Bank of India and available with the Institute for Studies in Industrial Development. This data set does not identify the companies by name but offers a vide variety of data on the status and performance of each of the companies covered. To make the companies selected from this database as closely comparable as possible with the set of JSEs to be studied, we have taken only such manufacturing companies which were incorporated during or after 1970. To improve the homogeneity of the set, we have restricted the selection to those having a paid-up capital of at least Rs. 50.00 lakhs in 1988-89. When similar restrictions were applied, the number of joint sector companies came down from 77 to 69.

Depending upon the time period under study, the number of companies selected from the RBI data set differed. For the analysis of financial and other performance indicators we could identify 614 companies. For productivity analysis the companies identified were 203. It may be mentioned that since the names of companies covered in the RBI data set are not known it was not possible to control for the year of commercial production and the composition of the set in terms of joint and non-joint sectors.[17] For the sake of convenience this set would be referred to as private sector. This may be justifiable because in the two broad divisions of government and non-government companies, joint sector companies are treated as non-governmental companies i.e., JSEs they form part of the private sector.

3 Financial Performance of Selected JSEs

While we have observed in the above that the sector suffered from serious financial difficulties it cannot be said that the sector failed uniformly. To examine this aspect, we have calculated the financial ratios (i) Return on Assets (ROA), (ii) Gross Margin on Sales (GMS) and (iii) Sales to Assets Ratio (SAR).[18] The results are presented in Table - 2. It can be seen from the Table that the joint sector performed consistently

16. The inclusion of 1990-91 for financial performance is, however, justified on the basis that the respective ratios were calculated for each of the years 1988-89, 1989-90 and 1990-91.

17. The limitation of commercial production may not prove to be a significant limitation because none of the companies selected from the RBI database were incorporated after 1987.

18. The concept and calculation of these ratios and measurement of the component variables has been discussed in detail in Chapter III under the Data and Methodology section.

Table - 2

Relative Financial Performance of Joint Sector Companies in comparison with Private Sector Companies

	1989-89		1989-90		1990-91	
	Joint Sector	Private Sector	Joint Sector	Private Sector	Joint Sector	Private Sector
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Return on Assets (%)	11.73	9.72	11.66	10.06	12.73	10.83
Gross Margin on Sales (%)	17.38	13.49	16.27	13.54	17.36	14.80
Sales to Assets Ratio	0.67	0.72	0.72	0.74	0.73	0.73

Note: The number of JSEs covered were 69 and private sector companies were 614. All these were manufacturing companies with paid-up capital of at least Rs. 50.00 lakhs and were incorporated in 1970 or thereafter.

Source: Database generated from RBI data tapes for the private sector and data collected from company annual reports for the joint sector.

better in terms of the first two ratios i.e., ROA and GMS and somewhat poorer in terms of sales to assets ratio.[19] Even in this case the difference between the sectors narrowed over the three year period.

ROA represents a measure of business performance which is not affected by accounting and financing modes. ROA takes the total firm concept and looks at how effectively a company has utilised its resources irrespective of the source of finance i.e., internal or external. Our results have thus shown that the joint sector was better at using its resources compared to the general private sector. The second measure namely GMS is an

19. ICICI also noted that JSEs' performance was quite comparable with public and private sectors. See: ICICI, op. cit. It may also be relevant to note that P.N. Mishra observed that the financial performance of JSEs was better than that of the private sector in terms of profitability and asset utilisation and growth in net assets and net worth. See: P.N. Mishra, op. cit. Raju Sinha, op. cit. also noted that the performance of joint and private sectors was comparable.

indirect measure of cost competitiveness. It is important to note that joint sector performed better in all the three years of study. We have mentioned in the foregoing that the selection of private sector companies suffered from certain limitations like inability to control for commencement of commercial production, joint sector companies and stock exchange listing. Given the consistently better performance displayed by the joint sector even if such factors are taken into account it can be said that the performance of the sector was at least equal to private sector if not better.

3.1 Dividend Payment

A measure of company's performance is also provided by the ability to pay dividends. This not only helps in sustaining investor interest but also reflects the company's financial health as it was not only able to show profits but also distribute them. If we keep the question of rate of dividend aside, it can be seen that a greater proportion of JSEs declared dividends in all the three years (See Table - 3)

Table - 3

Number of Companies Declaring Equity Dividend in Joint and Private Sectors

Year	No. of Companies		% Share in Total	
	Joint Sector	Private Sector	Joint Sector	Private Sector
(1) (2)	(3)	(4)	(5)	
1988-89	25	192	36.23	31.27
1989-90	29	220	42.03	35.83
1990-91	30	242	43.48	39.41

Note: Percentage shares in columns (4) and (5) are calculated with respect to the total number of companies in each category i.e., 69 and 614 respectively.

Source: Same as Table - 2.

3.2 Dependence on Imported Technology

Import of technology is expected to give an edge to companies over those relying on indigenous technologies. This is particularly so in an environment where not much efforts are made to develop technology, introduce product improvements and innovations through

in-house R&D.[20] Dependence on imported technology has been used in studies of Indian industry as an explanatory variable on profitability and export-orientation, R&D, etc. The results of our exercise presented in Table - 4 bring out that JSEs were comparatively less dependent on imported technology as payments for technology in the form of royalties and know-how fee formed smaller percentages of net sales in 1988-89 and 1989-90. The marginally higher share in 1990-91 was not because joint sector went in for large scale import of technology but because there was a steep decline in the corresponding ratio for the private sector. It may be mentioned that the Indian policy framework was in favour of lesser dependence on technology imports.[21] The behaviour of joint sector, in this context, may be seen to be in line with the official policy.

Table - 4

Technology Import Intensity* in Joint Sector and Private Sector Companies

(Percentages)

Year	Joint Sector Sector	Private
(1)	(2)	(3)
1988-89	0.43	0.64
1989-90	0.24	0.50
1990-91	0.33	0.32

* Calculated on percentage of payments for technology in net sales.

Source: Same as Table - 2.

20. R&D worked out to only about 0.07 per cent of net sales for 1989-90 according to an RBI study on company finances. See: "Finance of Public Limited Companies:1989-90", Reserve Bank of India Bulletin, Vol. XLVI, No. 11, November 1992, pp. 1709-1815.

21. The Government followed a selective policy towards technology imports and foreign investment. Besides limiting the technology imports to certain industries and products there has been a general ceiling on duration of agreements and rates of royalty payments. The "Statement of Industrial Policy, 1977" categorically stated that "(F)uture development of industries in India must be based on indigenous technology as far as possible". See: Government of India, Ministry of Industry, Department of Industrial Development, Guidelines for Industries -- Part I : Policy and Procedures, 1979. Also see: Nagesh Kumar, Multinational Enterprises and Industrial Organisation: The Case of India, Sage, Delhi, 1990.

3.3 Dependence on Imported Inputs

Another measure of import intensity is provided by the share of imported raw materials, stores and spares in net sales. It is observed that technology imports are accompanied by imported capital goods and also necessitate dependence on imported raw materials and spares over longer periods. We have seen in the above that joint sector enterprises were less dependent on technology imports compared to the private sector. The results of our analysis of expenditure on imported raw materials and spares as a proportion of net sales presented in Table - 5 suggest that JSEs were dependent on imported materials to a lesser extent compared to the private sector. Even if we take total imports i.e., inclusive of capital goods imports, the corresponding ratios for JSEs were less than those for private sector in all the three years.[22] In this respect too, the sector may be seen to be more in line with the official policy of regulating imports.

Table - 5

Import Intensity* of Joint and Private Sector Companies

(Percentages)

Year -	Intermediate Imports		Total Imports	
	Joint Sector	Private Sector	Joint Sector	Private Sector
(1)	(2)	(3)	(4)	(5)
1988-89	9.16	11.87	10.83	13.22
1989-90	8.90	11.85	10.94	12.94
1990-91	7.87	10.27	8.94	11.29

* Calculated as percentage of imports in net sales.

Note: Intermediate imports include imported raw materials, stores and spares. Total imports include capital goods imports also.

Source: Same as Table - 2.

22. It is relevant to note that P.N. Mishra found that selection of the product was usually done by SIDCs depending upon the availability of local resources. See: P.N. Mishra, op. cit.

3.4 Export-Orientation

Corporate performance is also seen in terms of its ability to penetrate export markets. Unlike selling in the protected domestic market, exporting means meeting the competition of international companies in terms of price and quality. Indian corporate sector is not known for its export orientation. Exports constitute only a small portion of sales.[23] Following the neo-technology theories of international trade which emphasizes the role of technology gap in determining a country's international trade pattern, it is generally postulated that export performance depends upon foreign ownership, import of technology and technology embodied in capital goods.[24] We have seen in the above that joint sector companies were less dependent on technology, material and machinery imports. Probably due to such characteristics of theirs, JSEs exhibited a lower level of export orientation compared to the private sector (see Table - 6). JSEs' position did not improve even when looked at their capacity to replenish the expenditure in foreign currency.

Table - 6
Exports to Sales Ratio of Joint and Private Sector Companies

Year	Exports to Sales Ratio (%)		Earnings to Expenditure Ratio (%)	
	Joint Sector	Private Joint Sector	Private Sector	Sector
(1)	(2)	(3)	(4)	(5)
1988-89	1.69	4.73	0.14	0.32
1989-90	2.35	5.70	0.20	0.41
1990-91	3.02	5.31	0.31	0.43

Note: Earnings calculated as exports and all other earnings and expenditure includes all types of imports and all other expenses.

Source: Same as Table - 2.

4 Analysis of Technological Change and Productivity Trends

23. Exports accounted for about 6 per cent of net sales in 1989-90 according to the RBI study on "Finances of Public Limited Companies, 1989-90", op. cit., p. 1715.

24. For instance, a study of export behaviour of Indian large manufacturing firms observed a positive relationship between technology transfer via both foreign direct investment and licensing and global competitiveness. See : Aradhna Jain, "International Technology Transfer and Export Performance in a Deregulated Developing Economy: The Case of Indian Manufacturing Firms", presented in the seminar Technology and Globalisation, held at Institute of Economic Growth, Delhi, on April 3, 1995. Also see: Nagesh Kumar and N.S. Siddharthan, "Technology, Firm Size and Export Behaviour in Developing Countries: The Case of Indian Enterprises", Journal of Development Studies, Vol. 31, No. 2, December 1994, pp. 289-309.

The economic development of a country is generally measured by the level of real Gross Domestic Product (GDP) per capita. Higher levels of real GDP per capita can be achieved through higher labour or capital productivity or higher level of utilization of the existing resources. The concept of productivity is based on the relationship between the quantity of goods and services produced and quantity of inputs utilised in turning out these goods and services.[25] Productivity is an indicator of the economic and technical efficiency with which given inputs are converted into output.[26] Increase in productivity, especially at the aggregate level, indicates a saving of real resources and a reduction in costs. If a competitive environment prevails it would result in increased supply and is likely to bring down prices.

4.1 Measurement of Productivity

There are two measures of productivity namely, (1) single factor productivity and (2) total factor productivity (TFP). Methodology for measuring the productivity can be classified into two broad categories, viz. (a) non-parametric approach and (b) production function approach.

(i) Non-parametric Approach: This method is based on determining the ratio of the total quantity of output to the quantity of an input.

(ii) Production Function Approach: In this method different parameters of productivity can be measured directly. It shows the relationship between the maximum output obtainable from a given set of inputs, and the relationship among the inputs themselves in the existing state of technological knowledge. The efficiency of factors, the degree of economies of scale, the degree of capital intensity of a technology and how the factors can be substituted for each other, can be measured by estimating the parameters of the underlying production function. Four well established production functions are: (a) Cobb-Douglas (C-D); (b) Constant Elasticity of Substitution (CES); (c) Variable Elasticity of Substitution (VES); and (d) Transcendental Logarithmic.

4.2 Single Factor Productivity (SFP)

The simplest indicators of productivity are SFP measures derived by dividing the output by the relevant input. SFP ratios give output per unit of input of a particular kind, namely, labour, capital or raw materials. So there can be as many SFP ratios as there are inputs. Labour productivity ratio (AP_l) can be represented by

$AP_l = V/L$ = Output/(Labour Input)

where V is value added and L labour. This ratio yields average product of labour. Similarly, capital productivity ratio (AP_k) can be represented by

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25. S. Fabricant, A Premier on Productivity, Prentice Hall of India, New Delhi, 1973.

26. P. Dalbir-Alai, "Trends in Productivity Growth across Large Scale Manufacturing Industries of India", Indian Economic Review, 22, 1987, pp. 151-175.

$AP_k = V/K = Output/(Capital\ Input)$

Where V is same as before and K is capital. This yields the average product of capital. A rise in these ratios suggests an increase in the productivity of that particular factor. Although, it is usual to take the input in physical terms, in this study the input has been measured in value terms the reason being that data on number of units of labour was not available for either of the sectors. For the sake of comparability, measure in value terms is taken. Under the assumption of perfect competition prevailing in both the factor and product markets, the two measures in physical and value terms coincide.

Labour productivity and capital productivity are only partial indices and can thus give misleading indicators of the average productivity level. For instance, labour productivity can be augmented by simply raising the level of capital input -- in other words, at the expense of capital productivity and vice versa. Further, different partial productivity indices may display opposite trends in which case no judgement is possible about overall efficiency. If all the partial productivity indices have similar trends, then it might still be possible to draw inferences about the overall efficiency.[27]

4.3 Empirical Studies on Productivity

Many of the studies on productivity in Indian manufacturing are based on the data provided by Census of Indian Manufacturers and Annual Survey of Industries (ASI).[28] Company level data is also used to study trends in productivity and related issues. Company level data offers some additional advantages as one can use certain firm-specific characteristics in explaining the trends. For instance, Goldar examined the relationship between technology acquisition and productivity growth in large manufacturing firms.[29] Similarly, Bhat studied the effects of technology transfer on the automobile industry of

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27. W.E. Salter, Productivity and Technical Change, Cambridge University Press (2nd edition), Cambridge, 1966.

28. Mention can be made in this regard of S.S. Mehta, "Returns to Scale and Sources of Growth of Output in Large-Scale Indian Industries", Indian Journal of Industrial Relations, January, 1976, pp. 339-350; Raj Krishna and S.S. Mehta, "Productivity Trends in Large Scale Industries", Economic & Political Weekly, Vol. 3 No. 43, 1968, pp. 1655-1660; Asit Banerji, Capital Intensity and Productivity in Indian Industry, Macmillan, Delhi, 1975; S.R. Hashim and M.M. Dadi, Capital-Output Relations in Indian Manufacturing (1946-64), M.S. University Baroda, Baroda, 1973; B.N. Goldar, Productivity Growth in Indian Industry, Allied Publishers, Delhi, 1986, Isher J. Ahluwalia, Productivity and Growth in Indian Manufacturing, Oxford University Press, Delhi, 1991; Deepak Mohanty, "Growth and Productivity in Indian Economy", Reserve Bank of India Occasional Papers, Vol. 13, No. 2, June 1992, pp. 55-80.

29. B.N. Goldar, "Technology Acquisition and Productivity Growth: A Study of Industrial Firms in India", paper presented in the seminar on Technology Transfer, Trade and Industrial Performance, held at Institute of Economic Growth, Delhi on September 30, 1994.

India by examining the productivity trends in each of the major automobile manufacturers.[30] ICICI brought out a study on productivity changes in the companies assisted by them by using aggregate data for the assisted companies.[31] In view of the uncertainty surrounding the categorisation of joint sector factories under the ASI, it was felt desirable to use the company-level data analysed in the first part of this paper. The number of joint sector companies for which we could get seven year time series data was 24 and the corresponding set of private sector companies consisted 203 companies.

4.4 Production Function Approach

A production function measures the relationship between input and output. It specifies the manner in which input is transformed into output and the contribution of different factors of production in producing the output. The Cobb-Douglas function (C-D function) is based on the following assumptions. (i) The factor shares of the two factors of production namely, capital and labour are positive and the ratio of their output elasticities measures the ratio of the factor shares going to labour and capital. (ii) It is usual to assume that perfect competition prevails in the factor market so that factors are paid according to their productivity. (iii) Normally, the C-D function is assumed to possess a degree of homogeneity equal to unity i.e., constant returns to scale prevail. (iv) The elasticity of substitution between capital and labour is unity. (v) Finally, neutral technical progress prevails.

The choice was between choosing the C-D production function which has often been used for an aggregate production function and a more elaborate but less restrictive function like the Trans-log production function. Ideally, such a function would yield both partial productivity and total factor productivity measures along with accommodating biased technical progress. We chose the C-D production function on the basis that it is more often used for an aggregate production function. Furthermore, the data requirements of a Translog function are much more exacting. Hence, the results of technological progress (in the following section) have to be viewed in the light of the choice of the function which is based on the assumption of neutral technical progress. To overcome the shortcomings of the C-D function in so far as it does not measure biased technological progress, an independent exercise is presented in the section on embodied technological progress by means of a set of regression equations.

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30. Shripad Bhat, "Effects of Technology Transfer on Indian Automobile Industry", unpublished Ph.D. thesis submitted to the Indian Institute of Technology, 1992. P. Rameshan, "Organisational efficiency and Indian Industry: A Firm-level Analysis", Anvesak, Vol. 25, No. 1, Jan-June 1995, pp. 53-72 and R.C. Sharma and Narain Sinha, "Frontier System and Estimation of Productive Efficiency in Intra-industrial Private and Public Enterprises", The Journal of Institute of Public Enterprise, Vol. 18, Nos. 1&2, 1995, pp. 27-35 also analyse firm-level data for measurement of productivity.

31. ICICI, Productivity in Indian Manufacturing: Private Corporate Sector 1972-73 to 1991-92, ICICI, Bombay, 1994.

4.5 Single Factor Productivity Trends

Empirical results relating to SFP indices for joint and private sectors are presented in Table - 7. It can be seen from the Table that productivity of capital showed substantial increase compared to labour productivity in both the sectors. It also appears that there is not much of a difference between the two sectors particularly in terms of capital productivity growth. Labour productivity grew comparatively at a faster rate in the joint sector compared to the private sector.[32] Since both the SFP ratios have shown an increasing trend, though at different rates, it can be concluded that the overall productivity of the two sectors was increasing.

Table - 7

Index Numbers of Labour Productivity and Capital Productivity of Joint and Private Sectors (1983-84 to 1989-90)

(Base: 1983-84=100)

Year	Private Sector (203)		Joint Sector (24)	
	V/L	V/K	V/L	V/K
(1)	(2)	(3)	(4)	(5)
1983-84	100.00	100.00	100.00	100.00
1984-85	111.81	127.78	108.48	113.64
1985-86	124.89	166.67	129.91	150.00
1986-87	127.43	177.78	153.13	177.27
1987-88	104.22	155.56	112.95	131.82
1988-89	117.72	194.44	116.52	177.27
1989-90	115.61	205.56	115.18	204.55
Annual Average Rate of Growth	1.28	11.04	1.54	10.94

Note : 1. Calculated from the price adjusted net value added (V), net fixed capital (K) and wages and salaries (L). Growth rates are compound growth rates.

2. Figures in brackets are the number of companies covered.

Source: Same as Table - 2.

32. It may be relevant to refer to the conclusion of Pakki Reddy that value added per employee in joint sector was lower than that in the public sector but higher than that in the private sector. See: Pakki Reddy, in J. Mahender Reddy, et. al., op. cit.

4.6 Cobb-Douglas Production Function (C-D)

The production function that has been most frequently employed in empirical work is the C-D production function. The output V is assumed to be related with labour (L) and capital (K) in the form,

$$V = A L^{\alpha} K^{\beta} \quad (1)$$

where A may be regarded as an efficiency parameter and coefficients α and β measure the elasticities of output with respect to labour and with respect to capital respectively. Further, the sum of α and β gives the information about returns to scale, that is, response of output to proportionate change in the inputs.

If $\alpha + \beta = 1$, then there are constant returns to scale. If the sum is less than one it represents decreasing returns to scale and if it is greater than one, then it is a case of increasing returns to scale. α and β also represent the factor shares of the respective inputs.

Taking logarithms on both sides, and adding a stochastic term (1) gets transformed to:

$$\ln V = \ln A + \alpha \ln L + \beta \ln K + u_t \quad (2)$$

Using the seven year (1983-84 to 1989-90) pooled cross-section data for 24 joint sector companies and 203 private sector companies equation (2) was estimated. The literature on production functions is replete with discussion on the measurement of variables which go into the production functions. Keeping the theoretical requirements and the scope of the study and availability of data at firm level in view we have taken net value added as the measure of output, net fixed capital to represent capital input and wages and salaries paid to the employees as labour input.[33] These were respectively deflated using the index numbers of wholesale prices for all commodities, index numbers for machinery and machine tools, and consumer price index numbers for industrial workers to eliminate the affect of price changes.

The estimated equations (3) and (4) are for joint and private sectors respectively.

Joint Sector:

ln V =	-0.1356 +	0.8478 ln L +	0.2240 ln K	(3)
	(-0.2730)	(12.9750)	(4.1080) t-values	
	(0.4968)	(0.0653)	(0.0545) SEs	

33. For a good discussion on the measurement of output and the inputs -- labour and capital -- see chapter III of B.N. Goldar, Productivity Growth in Indian Industry, op. cit.

$\bar{R}^2$=0.7216

Private Sector:

ln V =	0.2517 +	0.8260 ln L +	0.1986 ln K	(4)
	(1.5310)	(32.9620)	(9.5920) t-values	
	(0.1644)	(0.0251)	(0.0207) SEs	

$\bar{R}^2$=0.7067

It can be seen that the equations have turned out to be good fits as coefficients of both K and L are highly significant and the adjusted R^2 came out to be more than 0.7. Labour elasticity of output α turned out to be far higher than the capital elasticity β in both the equations. α turned out to be almost four times β. Thus the estimated function shows that value added was more responsive to labour than capital. Interestingly enough, in both the cases the sum of factor elasticities worked out to be only marginally higher than 1.00 indicating constant returns to scale (CRS). An examination of the residual sum of squares in the restricted and unrestricted models revealed that CRS prevailed in both the sectors.[34]

4.7 Efficiency, Technology and Technical Progress

The three related aspects of efficiency, technology and technical progress are discussed below in the theoretical perspective with relevant empirical findings:

(i) Efficiency: Two types of efficiency have been highlighted and measured in economic literature. Allocative efficiency involves effective factor use in relation to factor prices which ensures that there is an optimal allocation of resources. The producer under such circumstances reaps maximum profits. The Cobb-Douglas production function has a built-in structure that ensures allocative efficiency provided that a sufficient condition is met. The requirement is that the factor shares of the two inputs are positive. Assumptions (i) and (ii), stated earlier, in the context of the C-D function, along with an empirical finding of positive factor shares ensures allocative efficiency. As stated in the earlier section the results of the C-D function clearly establish that the sufficient condition for allocative efficiency is found in both the private and joint sectors since the αs and βs are both positive.

Another concept of efficiency is called technical efficiency. There are two dimensions to this concept. In a static sense, the level of technical efficiency measures the amount of output that is not directly due to the existing level of inputs.[35] It can be

34. This is done by using the ratio $\{(SSE_r-SSE_u)/d\}/\{SSU_u/(n-k-1)\}$ where SSE stands for residual sum of squares, subscript u for unrestricted, r for restricted, n for number of observations, d for the difference in the number of parameters in the unrestricted as compared to the restricted and k for number of regressors in the unrestricted model. For details, see: Julia Hebden, Applications of Econometrics, Heritage, Delhi, 1983, pp. 138-139.

35. Though there is a view that all output can be measured if inputs are further specified, the present study adheres to the view point that primary factors are only to be included in the production

measured through a C-D function in terms of the intercept. The intercepts of both the production functions were found to be statistically insignificant at the 5 per cent level. This implies that technical efficiency levels in both the sectors must be treated as zero although the intercept of joint sector equation shows a negative sign.

(ii) Technology: Technology is defined as the capital-labour ratio. At a given point of time, this ratio of factor use is governed by the prevailing factor price ratio. Under equilibrium the factor price ratio is equal to the ratio of the marginal productivities which in turn depends upon the factor use. It has been found that allocative efficiency prevails and hence it may be expected that over time this parity between factor price ratio and the ratio of factor use namely, capital-labour ratio is adhered to (see Table - 8 for the indices of capital-labour ratios in the two sectors). In respect of the given average technology of the two sectors, the antilog of intercepts of the following equations (5) and (6) show that the ratio for the private sector was 13.81 and that of joint sector was 11.75. This clearly shows that the technology employed by private sector was relatively more capital intensive.

Table - 8

Index Numbers of Capital-Labour Ratio in Private and Joint Sectors

(Base: 1983-84=100)

Year	Private Sector	Joint Sector
1983-84	100.00	100.00
1984-85	89.02	92.44
1985-86	77.04	84.88
1986-87	71.66	86.05
1987-88	66.74	84.50
1988-89	60.37	64.15
1989-90	57.30	55.52

Source: Same as Table - 2.

whether differences exist between the two sectors with respect to the nature of technological progress. We present a simple measure of technology and technological progress by means of two regression equations one each for the joint and private sectors.

(..continued)

function. Another reason that is often quoted for increase in the residual growth is a wrong specification of CRS. This is not true in the present case since it has been tested for and was found to be true. The third reason that is quoted to be responsible for increasing the residual growth is unaccounted quality differentials. This problem does not exist in the present method of estimation because the study measures inputs in value terms. Differences in quality of labour or skills are subsumed in the value measure since the composite measure of labour inputs in value terms is arrived at by multiplying different wage rates by the respective quantities of labour employed. These different wages represent the quality differentials in the labour input. That is skilled workers are paid more according to their productivity (assumption (ii) of C-D). The same holds good for differences in the capital input which is arrived at by multiplying the various prices of capital use by their respective quantities. Quality differentials are once again subsumed in the rental price differentials. There is no bias of estimation either because the values have not been constructed but merely taken as they exist. Actual differentials are automatically incorporated in the values of variables.

$$\ln\tau_j = A_j + \delta_j t + u_{jt} \quad (5)$$

$$\ln\tau_p = A_p + \delta_p t + u_{pt} \quad (6)$$

where $\tau = \Sigma(K)/\Sigma(L)$
over the total number of firms in each year.
The subscripts j and p respectively indicate joint and private sectors.

A stands for initial average level of technology. δ stands for degree of bias in technological progress. u stands for error term. $\delta > 0$ implies labour saving technological progress and $\delta=0$ means neutral technological progress and if $\delta < 0$ the situation is capital saving.

The estimated equations corresponding to (5) and (6) respectively are:

Joint Sector:

$$\ln\tau_j = 2.4636 - 0.0893t \quad (7)$$
(32.106) (-5.203) t-values
(0.7676) (0.1716) standard errors

$\bar{R}^2=0.8129$

Private Sector:

$$\ln\tau_p = 2.6257 - 0.09253t \quad (8)$$
(102.631) (-16.1773) t-values
(0.2559) (0.00572) standard errors

$\bar{R}^2=0.9775$

It can be seen from the above that both the equations represent good fits. Since δs turned out to be negative and highly significant it can be concluded that in both the sectors technological progress is capital saving in nature. The results of SFP are corroborated by the findings of capital saving technological progress. It means that lesser capital is being employed since use has become more efficient. On the other hand, employing more of labour leads to fall in its productivity. This is economically viable embodied technological progress since in a labour surplus economy it is indicative of allocative efficiency. This implies that the optimal

resource allocation is being ensured.

4.9 Disembodied Technical Change

Disembodied technological progress has been measured as TFP growth and is attributed to growth in output other than that due to growth in inputs. It is often referred to as managerial or efficiency factor.

4.10 Total Factor Productivity Growth (TFPG)

The inherent limitation of partial productivity analysis is that the ratios of output/labour and the output/capital can be misleading, as improvement in productivity cannot be attributed to any single factor. It has to be understood as a product of a number of interacting economic relationships. Therefore, TFP measures which take into account both capital and labour are used. TFP measure is supposed to reflect the 'residual' or 'technical progress' that cannot be attributed to either of the two factors under the given assumptions of the model.[36] At the aggregate level, the concept of total productivity is more relevant than the single factor productivities (i.e., labour or capital productivity). In a labour-surplus economy, with a relatively low wage structure, the prime emphasis would be on increasing the productivity of capital without hampering employment opportunities. On the other hand, in the developed countries, where there is a shortage of labour and a fast rising wage structure, the prime concern would be to increase labour productivity. This would help them economize on the use of labour input in the production process.

Total Factor Productivity is defined as the ratio of output to weighted combination of inputs. The changes in TFP may take place due to a number of factors, such as improvements in the labour quality or greater utilization of capacity or advances in technical knowledge. All these factors contribute to the overall efficiency of factor use.

Estimates of TFP growth are expected to provide an indication of change in output per unit of input. If output were homogenous and if there was a single homogenous input, the estimation of TFP would have been straightforward. But, in reality, what we observe is the multi-product, multi-input scenario, where serious conceptual and empirical problems arise in the estimation of TFP.

4.11 Parametric Estimation of Total Factor Productivity Growth

Equation (1) does not measure the technical progress over a period of time i.e., increases in output which occur because of shifts in the production function resulting from technical progress. To introduce the aspect of technical progress, we assume,

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36. See: R.M. Solow, "Technical Change and Aggregate Production Function", Review of Economics and Statistics, Vol. 39, 1957, pp. 312-330; E.D. Domar, "On Total Productivity and All That", Journal of Political Economy, Vol. 70, 1962, pp. 597-609; J. Kendrick, Productivity Trends in the United States, Princeton University Press, NBER, Princeton, 1961.

$$A(t) = A\, e^{g.t} \qquad (9)$$

where A and g are constant. Combining (1) and (9) we can write,

$$V_t = Ae^{g.t} L_t^{\alpha} K_t^{\beta} \qquad (10)$$

A is simply the value of A(t) at time t=0. Partially differentiating (10) with respect to 't' yields,

$$\frac{\partial V_t}{\partial t} = g.\, V_t$$

or,
$$\frac{\partial V_t}{\partial t} / V_t = g$$

Thus g measures the proportionate change in output per time period when input levels are held constant. It is therefore the proportionate change in output that occurs because of technical progress.

Transformation may be obtained by taking log of equation (10) which becomes,

$$\ln V_t = \ln A + gt + \alpha \ln L_t + \beta \ln K_t \qquad (11)$$

The estimated equations reveal a positive compound growth rate of 2.1 per cent per annum which is significant at 5 per cent level for the private sector and rate of growth of 2.6 per cent for the joint sector which, however, turns out to be statistically insignificant.[37] The respective factor shares in the above equation are not significantly different from those obtained from the earlier C-D function estimates given in (3) and (4) which do not include the time variable. The intercepts also display similar behaviour as the previous estimates. The difference between the two significance levels of production function estimates of TFP growth could be due to the standard errors. For instance, the parametric estimates level of significance for joint sector may be low because the trend of TFG growth is not consistent. At the industry level various tendencies are combined which might be otherwise heterogeneous.

4.12 Semi-parametric Estimate of TFP Growth

Using the estimated coefficients α and β from equations (3) and (4) total factor

37. Significant only at 33% level.

productivity growth (TFPG)[38] for both the sectors are computed using the relationship:

$$TFPG = G_V - \alpha G_L - \beta G_K \qquad (12)$$

where G_V, G_L and G_K are the growth rates of output, labour and capital inputs respectively.

The resultant TFP growth rates are as follows:

Joint Sector 4.075

Private Sector 5.143

In terms of TFP growth rate private sector exhibited a better performance compared to the joint sector. However, the difference is somewhat narrow. We have seen in the above that JSEs were less dependent on imported technologies, materials and capital goods. It may also be noted that out of the 24 JSEs as many as 14 were located in identified backward areas. These two factors could be among the possible explanatory variables for the relatively lower performance of the sector. Non-parametric estimates are higher because unlike parametric estimates, they do not eliminate the error factors. Parametric estimates on the other hand, are deterministic and eliminate the error term. So it may be concluded that on the basis of parametric and non-parametric estimates both sectors show positive TFP growth but TFP growth in joint sector is less consistent.

The results of the empirical estimates relating to production function, single factor productivities, total factor productivity and technical progress revolve around the C-D function. Of the five assumptions on which C-D function is based, three were testable assumptions. Out of the three two were tested in our exercises. Constant returns to scale assumption was found to be true while neutral technical progress was not found to be true. The second result, however, is to be treated with caution since it is an independent estimate and does not arise as a built-in parameter of the production function. The elasticity of substitution could have been tested but for the non-availability of data on number of units of labour employed.

38. For an elaboration of the measure of TFP growth through non-parametric methods see: Isher Judge Ahluwalia, Industrial Growth in India: Stagnation since the Mid-sixties, Oxford University Press, Delhi, 1985, p. 128.