CHAPTER - IV

PARTIAL PRODUCTIVITY AND TOTAL FACTOR PRODUCTIVITY IN INDIAN MANUFACTURING

4.1 Introduction :

Economic efficiency of an economy can be measured in terms of productivity of its factor inputs. Economic policy followed by India over the years contributed little in terms of productivity growth. India introduced a series of instruments such as industrial licensing for the purpose of investment allocations, which were thought to be sensible on economic grounds. These instruments, in the form of Industrial Policies and Industrial regulations were modified several times for the faster industrial development of this country. These measures have not bought production efficiency and competition in the manufacturing sector. Bhagwati and Desai (1970)[1], Bhagwati and Srinivasan (1975)[2] and Bhagwati (1987)[3], (1988)[4] pointed out that economic efficiency has not been maintained by the instruments chosen for development of India Ahluwalia (1985)[5] showed that the high marginal capital output ratio in the Indian economy is an offshoot of the inefficient factor use, unavoidable in the presence of the faulty industrial and trade policy regimes. Ahluwalia's study also concluded that the cause of slow industrial growth lie in, "the cumulative impact of the growing inefficiencies in factor use overtime".

In Economic literature, the productivity growth is treated as complementary to economic efficiency and is treated as a source of high levels of output growth. Of late, improvements in productivity, as the major contributor for growth in developing countries, have been given due importance. The economic efficiency depends upon the productivity of factor inputs used in manufacturing sector. However, in most of developing countries production and productivity are often not distinguished properly. Production is the absolute amount of flow of output during a given period. Productivity is the indicator of efficiency of factors of production.

Generally productivity is considered as the measure of efficiency of factors of production or inputs. The productivity is measured by expressing output as a ratio to the amount of input required to produce it or by expressing the change in output as a ratio to the change in amount of input required to bring it about. If the productivity performance is improving in an economy, it means that its factors of production are manifesting into the incremental output efficiency. Therefore, along with increases in volume of factor inputs, productivity improvements will also be contributing to the growth. For example, for any given output a higher rate of productivity improvement, if obtained means, the economy is able to save some factor inputs. Such released factors can be efficiently utilised for increase in production in the same sector or can be used in some other sector. In the absence of productivity growth, the economy has to depend largely upon higher intakes of capital accumulation and savings It requires, continuously higher and higher proportions of saving to income. In a developing country like India, such continuous increases in the ratio of saving to income imply enormous hardships to the people In such cases productivity improvements can reduce the overall burden on the people.

The productivity studies have been given due importance during the past three to four decades. Most of recent the research works in various economies show that 40 to 70 per cent of their economic growth over a long period is the result of productivity growth. Even in developing countries, next to capital accumulation, productivity growth is given importance as a source of growth (Khatkhate, 1993)[6]. It is, therefore, necessary to find out exactly the extent by which productivity improvements are occurring at the aggregate level and in various sectors of the Indian economy.

Further, the growth in industrial productivity is an essential element for the development and the structural change of developing economy, i.e. from Agriculture dominance to industrial dominance. In a growing economy, the income elasticity of demand for industrial goods is higher than that of agricultural produce and therefore the demand side factors favour the growth process in industry. The productivity improvements and factor efficiency in the industrial sector can lead to a fall in the relative price of industrial goods to that of agriculture because of more competitive pricing policy in the industrial sector. Besides this, the high price elasticity of demand for industrial goods has also accelerated the demand for industrial goods and led to market expansion for such goods. Therefore it is necessary to explore the possible sources of productivity growth in the manufacturing sector.

In this context, an attempt is made in this chapter to analyse the productivity growth and trends there in, in the Indian manufacturing sector. Productivity analysis is done using both the partial productivity and total factor productivity approaches This chapter is divided into five sections. Second section deals with approaches to measurement of productivity, third section analyses partial factor productivity and its growth (PFP), fourth section analysis total factor productivity and its growth (TFP), the last section presents observations.

4.2 <u>Approaches to the measurement of Productivity</u> :

The measures of productivity are of two types (i) Partial factor productivity and (ii) Total Factor Productivity. The partial productivity growth measure is the conventional method and had been used by various economists to measure the productivity growth. It is a simple ratio of output generated per unit of factor input. By this method to estimate productivity of any individual factor input, the output i.e. value added is expressed as a ratio of a particular factor input.

$$PFP_f = V.A / Q_f$$

where:

PFP_f = Partial productivity of a factor input (f)

V. A = Value added

Q_f = Quantity of factor input

Where f is either capital (K) or labour (L).

By using this ratio one can get partial productivity of either labour or capital.

Though partial productivities are widely used in economic literature, their limitations have been noted by the economists The major disadvantage of this measure is that if the inputs labour and capital do not vary in the same proportions, i.e., if the relative proportions of the factors alter, then the partial measure will show bias for one particular factor because the ratios will give simple average productivity of that single factor, its weightage in production is neglected.

The PFP measure seems to be satisfactory if the relationship among the factors is one of fixed coefficients, if all the factor quantities change at the same rate and that there are no alterations in relative shares. In the process of faster industrial growth, one observes that as a result of application of more capital, there is capital substitution which leads to increased use of capital in the manufacturing sector. In such a changing situation, if we measure labour productivity using partial approach, the results may show an increase in labour productivity. This sort of increase is more a reflection of rising capital - labour ratios rather than pure growth in the labour productivity. A more appropriate measure of productivity is termed as the total factor productivity (TFP) or total factor productivity growth (TFPG). Under this measure of productivity, productivity growth is estimated by adjusting for growth in various factor inputs weighted by their shares. The TFP is discussed in the next section.

The partial factor productivity measured by the ratio of output to a single input is the simplest measure of productivity. The PFP in terms of labour productivity is the most commonly used measure for the simple reason that it is handy to compute and easy for interpretation. However economists consider capital productivity as a better measure.

4.3 Studies on Partial Factor Productivity :

In this section major studies on PFP and productivity growth are discussed. A number of studies have been conducted to estimate productivity in the Indian manufacturing sector. These studies make use of both partial and total factor productivity analysis.

According to Singh (1966)[7] labour productivity in the manufacturing sector rose significantly and that there was fall in capital productivity. This study concludes that the increase in labour productivity was due to increasing capital intensity. Shivamaggi, Rajagopalan and Venkatachalam (1968)[8] examined labour productivity for the period 1951 to 1961 for seven important industrial categories. They observed an increase in labour productivity and attributed the same to capital deepening. Raj Krishna and Mehta (1968)[9] also arrived at the same conclusion for the period 1946 to 1964.

Benerji (1971)[10] estimated partial productivity for both labour and capital for the years 1946 to 1964. He found an increase in labour productivity, while the capital productivity showed a decrease for the period. He also came to the conclusion that increase in labour productivity was achieved mostly through capital deepening.

Mehta (1980)[11] studied partial productivity for the period 1953 to 1965 and compared partial productivity of capital and labour. The movements in labour productivity and capital productivity showed a divergent trend. According to his study, labour productivity increased significantly in industries like Vegetable oil, Chemicals, Tanning, Glass and insignificantly in Matches, Iron and Steel and Cement industries. However, capital productivity did not increase but decreased in many industries. In the study of Mehta, capital intensity was the reason to explain the growth in labour productivity in industries such as Sugar, Tanning, Ceramics, Cotton Textiles, Confectionery and Sewing machines while in case of other industries, despite a rise in capital per worker it had not led to increase in labour productivity. Mehta concludes that capital intensity need not increase labour productivity in all industries.

Goldar (1985)[12] have analysed productivity trends in Indian manufacturing for the period 1951-1979 covering roughly the first three decades of the post-independence period. He has found a significant rising trend in labour productivity and capital intensity and a significant falling trend in capital productivity.

Ahluwalia (1991)[13] study for the period 1959-60 to 1985-86 indicates a very strong rising trend in capital intensity, a weaker rising trend in labour productivity and a secular decline in capital productivity. The rate of growth of labour productivity in manufacturing was 2.2 per cent per annum. While capital per unit of labour increased at the rate of 4.9 per cent per annum and capital productivity declined at the rate of 2.5 per cent per annum.

4.3.1 Partial Factor Productivity : Labour and Capital Productivities :

The simplest indicators of productivity are the partial productivity measures derived by dividing the output (Gross value added) by the relevant input. There can be as many measures of partial productivities as there are inputs. But generally economists take into consideration of labour and capital in partial analysis, while labour

Table 4.1 : Industry wise Partial Labour Productivity

Year	20-21	22	23	24	25	26	27	28	29	30	31	32	33	34	35-36	37	All. Mfg
1973-74	42 37	40.79	42.71	57.07	26.36	43.92	40.51	66.67	56.12	166.57	136.29	50.15	75.53	67.07	96.42	77 61	65.15
74-75	49.22	77.24	41 41	63.18	21.35	39.45	38.21	66.98	71.22	158.81	165.53	45.59	98.65	62.67	102.38	76 18	68.44
75-76	41.14	40.19	32.62	55.43	28.81	42.77	29 30	56.41	48.41	104.67	112.84	37.69	60.73	50.31	69.67	59 37	52.83
76-77	46.88	43.31	33.53	47.83	29.61	38 26	34 45	53.67	55.75	111.13	151.36	43.11	72.84	55.49	73.96	72.05	58.40
77-78	51.86	25 67	33.29	51.91	28.52	37.90	34 64	54.22	53.48	116.47	143.36	50.25	64.06	53.05	78.17	71.64	57.27
78-79	58.04	32.70	41.41	59.51	28.10	46.80	34.96	54.47	50.52	137.83	126.63	43.87	71.59	56.73	79.99	72.09	63.32
79-80	47.73	28.65	44.07	51 31	30.57	38.50	33.37	52.39	46.17	120.11	114.48	41.28	63.43	54.57	74.69	60.12	58.25
80-81	33.52	21.59	41 76	55 36	35.45	41.41	29.76	51.40	41.01	99.99	109.16	41.24	65.93	59.47	80.71	58.48	55.36
81-82	43.92	24.38	40.16	56.11	33.17	48.32	30.43	54 83	43.59	111.52	107.68	42.70	79.68	55.39	82.85	65 43	56.97
82-83	57.83	22.98	33.25	63.10	29.56	52.23	29.12	46.73	49.92	122.08	122.67	39.75	69.96	54.74	89.66	73.62	61.71
83-84	69.39	39.90	39.33	63.05	25.27	48.88	37 70	47.92	60.42	137 65	86.84	50.40	69 69	62.40	91 86	76 55	67.19
84-85	64.50	42.81	37.28	61.31	20.12	64.07	35.40	58.44	62.55	130.62	131.02	55.71	51.82	57.16	107.67	77 71	68.22
85-86	64 94	32.54	42.14	73.06	22.93	52.28	32.57	50.81	47.99	134.90	208.91	61.84	65.70	65.02	98.45	73.04	72.81
86-87	64.40	32.42	46.43	78.18	39.44	65.24	37.11	61.17	48.83	133.59	201.27	54.06	55.90	71.39	101.78	85.19	74.05
87-88	61 26	32.51	42.89	61 83	35.23	63.89	39 79	59.86	58.52	143.87	210.84	57.31	63 09	75.08	108.45	79.35	75 74
88-89	78.35	41.87	48.15	65.73	33.85	77.81	40.33	68.38	50.81	159.31	226.48	62.78	87.02	83.29	113.95	81.12	86.3
89-90	82.86	31.77	55.19	98.89	47.98	84.19	37.03	52.32	56.63	190.36	209.73	69 44	94.44	66.23	132.73	98.16	93.74
90-91	73.35	41.94	61.53	109.42	29.56	95.45	56.77	73.28	66.79	216.88	247.52	90.53	109.66	62.73	136.92	120.13	101.41
91-92	75.12	46.99	51.63	91.71	34.34	108.99	58.33	71.11	75.10	210.67	211.68	106.93	79.40	72.07	138.30	105.06	99.57
92-93	68.22	45.50	50.16	95.78	35.84	104.62	51 37	65.47	84.56	416.86	282.08	78.69	99.37	64.11	144.64	106.69	121.57

Table: Industry wise Partial Capital Productivity

Table 4.2 : Industry wise Partial Capital Productivity

Year	20-21	22	23	24	25	26	27	28	29	30	31	32	33	34	35-36	37	All. Mfg
1973-74	0.4224	0.9974	0.6492	0.5559	0.7415	0.7965	1.0873	0.5374	1.4329	0.4020	0.4034	0.4118	0.1787	0.7125	0.5314	0.6881	0.4341
74-75	0.5172	1.4692	0.6154	0.5633	0.7750	0.7724	0.9749	0.5566	1.6166	0.3645	0.4734	0.3846	0.1938	0.6582	0.5499	0.6669	0.4349
75-76	0.5509	0.9269	0.5610	0.6607	1.0328	0.9463	0.8791	0.5111	0.9253	0.3283	0.4152	0.4044	0.1894	0.5999	0.5215	0.6097	0.4125
76-77	0.5953	1.4344	0.5648	0.6375	0.9823	0.9425	0.9415	0.4979	1.1629	0.3751	0.4471	0.4440	0.1998	0.6685	0.5883	0.6827	0.4491
77-78	0.6636	1.0596	0.5827	0.6609	0.9916	0.8950	0.9791	0.5276	0.9929	0.3970	0.4734	0.5341	0.1741	0.7078	0.6143	0.5917	0.4566
78-79	0.7071	1.3881	0.7229	0.6981	0.9357	0.9634	0.9708	0.5094	0.8917	0.4639	0.3406	0.4564	0.2059	0.7205	0.6363	0.4411	0.4753
79-80	0.5695	1.2238	0.7405	0.6435	1.2367	0.8063	0.9801	0.4861	0.8423	0.4021	0.3574	0.4320	0.1772	0.7391	0.6313	0.4412	0.4462
80-81	0.3965	1.0577	0.6589	0.5994	1.3744	0.8709	0.7883	0.4284	0.6991	0.3330	0.3336	0.4112	0.1842	0.7177	0.6566	0.4481	0.4092
81-82	0.5287	1.0809	0.5575	0.5520	1.1510	0.9944	0.7759	0.4359	0.7437	0.3570	0.2850	0.3846	0.2021	0.6520	0.6360	0.4932	0.4094
82-83	0.7371	1.0538	0.4976	0.5470	1.0771	1.0285	0.6815	0.3260	0.8002	0.3943	0.3757	0.4343	0.1732	0.6146	0.6925	0.5401	0.4288
83-84	0.8378	1.6987	0.5922	0.5110	0.7961	0.9885	0.6245	0.2819	0.9616	0.4342	0.2059	0.3927	0.1735	0.6500	0.6881	0.5443	0.4352
84-85	0.7488	1.3521	0.5059	0.4716	0.8488	1.2869	0.5786	0.3036	1.0447	0.4013	0.2959	0.3870	0.1328	0.6181	0.7609	0.5265	0.4158
85-86	0.7241	1.0715	0.5163	0.5420	0.8179	1.0307	0.5239	0.2364	0.7880	0.4014	0.4599	0.3586	0.1399	0.6593	0.6525	0.4911	0.4074
86-87	0.6244	1.0125	0.5578	0.5025	1.5389	1.0998	0.5223	0.2261	0.7726	0.3468	0.4228	0.2441	0.1301	0.6371	0.6474	0.5166	0.3845
87-88	0.5616	0.8633	0.4717	0.3522	1.0015	0.6986	0.4921	0.2282	0.8420	0.3565	0.4158	0.2183	0.1288	0.6054	0.6182	0.3784	0.3559
88-89	0.6393	0.8048	0.4504	0.3379	0.6098	0.8915	0.4539	0.2244	0.6440	0.3463	0.3623	0.1997	0.1648	0.5429	0.5445	0.3773	0.3551
89-90	0.5814	0.8094	0.5152	0.3958	0.9561	0.9579	0.3844	0.1927	0.6977	0.3234	0.3722	0.2126	0.1641	0.4669	0.5918	0.4063	0.3650
90-91	0.4610	0.8217	0.4970	0.3775	0.5136	0.9989	0.5124	0.2334	0.5768	0.3005	0.3799	0.2517	0.1381	0.3448	0.5510	0.4789	0.3231
91-92	0.4425	0.9336	0.3465	0.2692	0.5347	1.0173	0.5323	0.2223	0.7049	0.0297	0.3204	0.2736	0.0868	0.3876	0.5268	0.3982	0.2989
92-93	0.3843	0.7756	0.2975	0.2521	0.6756	0.9899	0.4725	0.1976	0.6475	0.5631	0.4107	0.1898	0.1078	0.3099	0.4830	0.3685	0.3379

productivity shows the efficiency with which labour is being utilised and capital productivity indicate capital efficiency in simple ratio analysis. Against this background, an attempt is made in this section to measure partial productivity measures and their growth in the Indian manufacturing sector for the period of study for the major industrial categories and 'all manufacturing'.

In this analysis output in terms of value added is taken and is measured at constant prices (1980-81). Labour is measured in terms of mandays, and capital represents Net Fixed Capital Stock (NFCS) at 1980-81 prices.

The partial productivity estimates presented in the Table 4.1 and 4.2 gives detailed picture of labour productivity and capital productivity. If one looks at these tables, for most of the industries, one observe a rise in labour productivity for the sample period in the analysis. In contrast, a fall in capital productivity is observed for most of the industries at two digit level for the same period.

For 'all manufacturing' sector it is noticed that the labour productivity has increased over the years, i.e. from Rs.65.14 to Rs.121.56 from 1973-74 to 1992-93. However with the individual industry differences in trend are observed. The rate of increase in the labour productivity is different for different industries.

The trend growth rates of labour productivity ranged from 0.06 per cent in case of Beverages and Tobacco products (22) to 5.45 per cent in Textile products (26). All other groups fall in this range and by looking at the overall results one may conclude that the rate of change in labour productivity is high and significant. As mentioned earlier the industry as a whole faced trend growth of 3 29 per cent per annum.

In case of capital productivity, for 'all manufacturing', the value added per unit of capital employed was 0.4341 in 1973-74 and this figure has continuously fallen and reached 0.3375 by 1992-93. This shows a trend growth of - 1.81% per annum. It is surprising to note that not a single industrial group, out of 16 groups (2 digit level) taken up for analysis showed a positive growth in capital productivity for the period of analysis. The least fall of capital productivity was observed for Electrical and Non-Electrical Machinery (35-36) i.e. 0.19 per cent per annum. The high rate of fall is observed in case of Paper and Paper products (29) which estimated a negative growth of 6.34 per cent.

In the individual industries group, when one looks at the labour productivity, it is seen that, the industry of Rubber and Rubber products (30) has highest labour productivity Rs 252.06 i.e. value added per manday of labour for the year 1992-93. In contrast, the industry Jute and Jute products (25) has the lowest labour productivity i.e. Rs.35.83 in 1992-93.

Similarly when one observed the capital productivity among different industries, it is found that in case of Textile products (26) the capital productivity is highest i.e. 0.9899 during 1992-93 and in case of Non-Metallic Minerals (32) the capital productivity is the least with 0.2898, as its value

Table 4.3 : Trend Growth Rates of Labour and Capital Productivity 1973-74 - 1992-93 (per cent)

Industry Code	Labour Productivity	Capital Productivity
Food Products (20-21)	3.31**	-0.40*
Beverages & Tobacco Products (22)	0.06*	-2.19**
Cotton Products (23)	2.13**	-2.82**
Wool, Silk and Synthetic Products (24)	2.36**	-4.39**
Jute and Hemp Produ-cts (25)	1.69*	-1.94*
Textile Products (26)	5.45**	-0.80*
Wood Proudcts (27)	0.12**	-5.06**
Paper Products (28)	0.80**	-6.34**
Leather Products (29)	1.28*	-3.52**
Rubber Products (30)	3.84**	-0.66*
Chemical Products (31)	3.52**	-0.29*
Non-metallic, Mineral Proudcts (32)	3.93**	-4.46**
Metal/Alloy Proudcts (33)	1.04*	-3.02**
Metal Products (34)	1.30**	-3.28**
Machinery, Electrical, non-electrical (35-36)	3.11**	-0.19*
Transport Equipment Products (37)	0.92*	-3.24**
All Manufactures	3.29**	-1.81**

Growth rates are estimated using the following function. Log (P) = f (t) where P indicates productivity of either labour or capital and 't' (time).
eg. $\text{Log}(VA/L) = \alpha + \beta t$
β gives the trend growth.

** Significant at 1% level
* Significant at 5% level.

When one looks at Table 4.3 it is clearly observed that the productivity and changes there in follow different patterns for different industrial groups. The discussion of each industry is presented in succeeding paragraphs.

4.3.1.1 Food and Food Products (20-21) :

The Table 4.1 shows, the labour productivity of Food and Food products industry had increased continuously for the period from Rs. 42.37 per manday of labour for the year 1973-74 to Rs.68.25 for the year 1992-93. The growth rate is 3.31 per cent per annum which is almost equal 'All India' manufacturing sector average.

The capital productivity was 0.42 for the year 1973-74 and increased to 0.83 during the year 1982-83. However, later on, the capital productivity fell continuously and it reached a low of 0.48 by 1992-93. This fall explains the negative overall growth rate of capital productivity, i.e., -0.4 per cent per annum during the period of analysis. As the analysis of capital intensity in the previous chapter shows that like other industries capital labour ratio has increased in this industry which showed increase in labour productivity and a decrease in capital productivity.

4.3.1.2 Beverages, Tobacco and Tobacco Products (22) :

In this industrial group the labour productivity on the whole increased from Rs.40.79 to Rs.45.50 during the period of analysis and annual trend growth rate exhibited by this industry is the lowest among the various industries i.e. of 0.06 per cent. However with in this period, one notices that during early eighties the labour productivity has fallen. Between the period 1979-80 to 1982-83 the labour productivity reduced by 50 per cent. The overall growth of labour productivity of this industry is the lowest the reason is that during 1980s the growth pattern accounting estimates indicate poor performance on the part of consumer non-durables.

The capital productivity for this industry also exhibited different trends. For most of the period it was constant i.e. at around one per unit of capital in terms of value added and later on it came down to 0.7756 during 1992-93. This industry exhibited a trend growth in capital productivity of the order of -2.19 per cent over the period.

4.3.1.3 Cotton Textiles (23) :

In case Cotton textiles (23), labour productivity increased from Rs.42.70 to Rs.50.15 per manday of labour during the period of analysis. However within this period consistency was lacking in rate of increase and that there were ups and downs. Cotton textiles, which is one of the traditional industry in India, faced an annual rate of growth of moderate nature, i.e. 2.13 per cent per annum. The growing capital intensity in the Indian manufacturing, resulted in continuous fall in capital productivity. The capital productivity was 0.6492 during 1973-74 and it has come down to 0.4974 per unit of capital in terms of value added The capital productivity posed negative growth of 2.82 per cent per annum.

4.3.1.4 Wool, Silk and Synthetic Fibre Textiles (24) :

The Tables display the performance of Wool, Silk and Synthetic fibre textile (24) industry in terms of labour and capital productivity. The labour productivity for the industry consistently increased from Rs.57.06 from 1973-74 to Rs.95.77 by 1992-93. The average annual growth was 2.36 per cent which is below the all industry growth of 3.29 per cent.

Capital productivity shows a negative trend, or fall from 0.5559 to 0.3521 during the twenty years time period. The industry revealed a high negative growth of capital productivity i.e. -4.39 per cent per annum, which is well above the all Indian manufacturing growth of -1.81.

4.3.1.5 Jute, Hemp and Mesta Textiles (25) :

Labour productivity consistently has been improving from Rs.26.35 in the year 1973-74 to Rs.35.83 by the year 1992-93. This industry exhibits lowest labour productivity among different industrial groups. The trend growth of labour productivity during the period of analysis is found to be 1.69 per annum.

The capital productivity in this industry showed different trend during this period. Initially it had increased from 0.7415 in the year 1973-74 to 1.2267 by 1980s and later on it started falling and it stabilised at 0.9756 by year 1992-93. The annual rate of growth is observed to be -1.94 per cent which almost equal to 'all manufacturing'. Labour productivity and capital productivity show a different trends in this industry because Jute and hemp products are one of the traditional packing industry which started to show decline because of other substitutes for packing industry used are on the rise. The capital labour ratio has not increased like other industries. The industry utilised more labour intensive techniques in the production process. As there was more plastic and other synthetic packing material available, this particular industry has seen a great fall in the relative demand for their products world wide.

4.3.1.6 Textile Products (26) :

The labour productivity consistently improved over the period of study. It was Rs.43.92 in the year 1973-74 and more than doubled and reached to Rs.104.61 by 1992-93. The growth trend of labour productivity was highest 5.45 per cent per annum, which indicates rise in capital intensity has tremendously improved the labour productivity of this industry.

Regarding capital productivity the trend is quite different. In the early period capital productivity improved from 0.7965 in the year 1973-74 to 1.2969 during 1983-84. However from this period capital productivity of this industry also started falling and it touched 0.9899 during the year 1992-93. The trend growth is observed to -0 80 per cent which lower than industrial sector average growth.

4.3.1.7 Wood and Wood Products (27) :

The labour productivity of this industry was Rs.40.50 in the year 1973-74 and it had continued to increase and became Rs.51.37 by the year 1992-93. The trend growth was nearly 0.12 per annum which is much lower and less than the sectoral average.

The capital productivity of this industry exhibits a different picture as there are ups and downs It was 1.0873 in the year 1973-74 and later on it started falling continuously in the following years. The capital productivity fell to the lowest of 0.4725 by the year 1992-93. The fall in terms of percentage was of the order of 5.06 per cent per annum.

4.3.1.8 Paper and Paper Products (28) :

An examination of Tables indicate the absolute magnitude and percentage change of partial productivities. The labour productivity was Rs.66.67 in the year 1973-74 and was high in the initial period. It started falling and it had become Rs.46.42 by the year 1982-83. However later period it had improved and become Rs.65.47 during the year 1992-93. The annual growth was however positive but only 0.80 per cent over this period.

The capital productivity fell continuously. It was 0.5374 in the year 1973-74 and reached lowest of 0.1976 by the year 1992-93. The fall in terms of percentage was highest in this sector which is of -6.34 per cent per annum. This industry exhibits a very low positive growth in labour productivity and higher negative growth in the capital productivity.

4.3.1.9 Leather and Leather Products (29) :

For this industry the labour productivity was Rs.56.12 during the year 1973-74 and it become Rs.84.55 by the year 1992-93. During this period, variation in the labour productivity is observed to be asymmetrical. But labour productivity improved during early nineties. The trend growth rate of 1.28 per cent was observed during this twenty year time period.

The capital productivity exhibited a negative trend. Started with 1.4329 during 1973-74 and subsequently fell to a low level of 0.6475 per unit of capital during the year 1992-93. The fall in capital productivity was - 3.52 per cent per annum. Which is much above than the sectoral average growth of -1.81 per cent per annum.

4.3.1.10 Rubber, Plastic, Petroleum and Coal Products (30) :

The labour productivity was Rs.138.28 in the year 1973-74 and it was doubled to Rs.282.06 by the year 1992-93. The trend growth rate was observed to be 3.52 per cent per annum which is slightly above than the 'all manufacturing' average.

Capital productivity was 0.4034 in the year 1973-74 and it fell during 1980s and reached lowest of 0.2959 in the year 1984-85. However it has improved by the year 1992-93 and is observed to be 0.4107. The capital productivity exhibited a negative growth of 0.66 per cent per annum.

4.3.1.11 Chemical and Chemical Products (31) :

In this industry, initially during 1973-74, the labour productivity was Rs.166.56 per unit of labour and in the middle of period, i.e. beginning of 80s, it reached a minimum of Rs.99.98. However, it started increasing from and reached Rs.216.91 by the year 1992-93. The annual trend growth of labour productivity was +3.52 per cent for this period.

The capital productivity of this industry as usual like other industries fell during the period of analysis. It was 0.4020 in the year 1973-74 and reached 0.3031 by the year 1992-93. The fall in percentage terms was -0.29 per annum during this period which is low when compared to other industries.

4.3.1.12 Non-metallic Minerals Industry (32) :

The labour productivity in Non-metallic Minerals industry was Rs.50.14 in the year 1973-74 and reached Rs.39.75 during the year 1982-83. However, after this period it had fairly and steady increased to Rs.78.69 by the year 1992-93. The trend growth of this industry was +3.93 per cent per annum during the period of analysis.

The capital productivity throughout this period of twenty years fell from 0.4118 in the year 1973-74 to 0 2898 by the year 1992-93. However if one looks at yearly change, one finds for some period, i.e. till early eighties it remained more or less constant. At the end of this period it had significant fall and trend growth rate was -4.46 per annum.

4.3.1.13 Alloy and Alloy Products (33) :

For the Alloy and Alloy based industries, the labour productivity was Rs.75.53 in the year 1973-74 it has increased steadily over the years and reached Rs.99.37 during the year 1992-93. The annual growth rate of labour productivity was 1.04 per cent which was not much significant compared to sectoral average.

The fall in capital productivity was quite prominent in this industry. In the year 1973-74 it was 0.1787 and because of continuous fall it reached to 0.1178 by the year 1992-93. The performance in the percentage term very poor and it was negative which is -3.02 per cent during the period of analysis.

4.3.1.14 Metal and Metal Products (34) :

In the Metal and Metal product industry, the labour productivity was Rs.75.53 in the year 1973-74 and it had improved continuously till 1983-84. There was little variation in the trend and a fall in the mid eighties was also observed. However it had improved in the later period and had reached 99.37 during the year 1992-93. The annual rate of change in labour productivity was 1.30 per cent during this time period.

The capital productivity had similar falling trend in this industry. It was 0.7125 in the year 1973-74 and had reached 0.4899 by the year 1992-93. However in terms of percentage, this particular industry had -3.02 per cent growth per annum of capital productivity.

4.3.1.15 Machinery, Electrical and Non-electrical (35-36) :

In the case of Electrical and Non-Electrical Machinery industry, the labour productivity steadily increased from Rs.77.60 in the year 1973-74 to Rs.106.69 during the year 1992-93. In terms of percentage the trend growth was 3.11 per annum during this time period.

Corresponding to labour productivity, the capital productivity of this industry also increased from the beginning to the end of eighties It was 0.5314 in the year

1973-74 which has increased continuously and reached 0.6474 in 1986-87. However, the falling trend of capital productivity can be noted in this industry also and it became 0.5229 during the 1992-93. The industry faced the lowest fall in terms of percentage i.e., 0.19 per annum which is the lowest of all industries.

4.3.1.16 Transport and Transport Equipment Industry (37) :

The Transport and Transport Equipments industry also shows similar results to that of other industries. The labour productivity was Rs.77.60 per manday of labour in terms of value added in the year 1973-74 which increased to Rs.106.69 by the year 1992-93. However the annual rate of growth was not even one per cent, it was only 0.92 per cent per annum during this period.

Whereas the capital productivity of this industry has shown a decreasing trend. It was 0.6881 per unit of capital during the year 1973-74 and reached the lowest level of 0.4685 in the year 1992-93. The average annual fall in trend growth in this industry was -3.24 per cent during this period.

4.3.1.17 All Manufacturing Sector :

The analysis of 'all manufacturing' sectors partial productivity and growth is discussed here. It is found that the labour productivity of different industries is increasing and the overall labour productivity of manufacturing sector as a whole has nearly doubled. It was Rs.65.14 during year 1973-74 and improved to Rs.121.56 by the year 1992-93. The trend growth of +3.29 per cent per annum was observed.

Capital productivity had consistent fall from 0.4341 per unit of capital during the year 1973-74 to 0.3379 by the year 1992-93. The trend fall was -1.81 per cent per annum during the period of analysis.

To sum up, labour productivity showed a general rise over the period, whereas, capital productivity showed a general decline. There are number of reasons for the increase in labour productivity the important reason is that most of the industries faced capital deepening over the period.

Chart 4.1 : Industry-wise Capital and Labour Productivity Growth During the period (1973-92)

C A P I T A L	(High $_C$, Low$_L$) India (All Manufacturing) (-1.81, 3.29)	20-21 (-0.40, 3.31) 26 (-0.80, 5.45) 30 (-0.66, 3.84) 31 (-0 29, 3 52) (High$_C$, High$_L$)
P R O D U C T I V I T Y	22 (-2.19, 0.06) 23 (-2.82, 2.13) 24 (-4.39, 2.36) 25 (-1.94, 1.69) 27 (-5.06, 2.12) 28 (-6.34, 0.80) 29 (-3.52, 0.80) 33 (-3.02, 1.04) 34 (-3.28, 1.30) 35-36 (-1.9, 3.11) 37 (-3.24, 0.92) (Low$_C$, Low$_L$)	32 (-4.46, 3.93) (Low$_C$, High$_L$)

LABOUR PRODUCTIVITY

Chart 4.1 indicates different industries and their labour and capital productivity growth rates attained in comparison with 'all manufacturing'. In case of 'all manufacturing' the labour productivity had a trend growth of +3.29 per cent per annum and a trend growth of capital productivity observed was -1.81 per cent per annum. However individual industries results are different. The chart shows most of the industries fall below the national average both in terms of labour and capital productivity growth. Most of the industries have low labour productivity growth than sectoral average of 3 29 per cent per annum. Regarding capital productivity, the fall is more than sectoral average of -1.81 for most of the industries. Industries like Beverages and Tobacco (22), Cotton textiles (23), Jute industry (24), Silk and Wool industry (25), Wood and Wood Products (27), Paper and Paper Products (28), Leather and Leather Products (29), Alloy Industries (33), Metal and Metal Products (34), Electrical and Non-electrical Machinery (35-36) and Transport Industry (37) fall in this category.

Only one industry has high growth labour productivity with high fall (negative growth) in capital productivity, i.e. Non-Metallic Minerals industry (32). It has 3.93 per cent trend growth of labour productivity and capital productivity growth of -4.46 per cent per annum. Four industries perform better than the national average of "all manufacturing". They are Food and Food products (20-21), Textile products (26), Rubber and Rubber Products (30) and Chemical and Chemical Products (31). These industries have high growth of labour productivity and lower negative growth in capital productivity. Comparatively these industries can be classified as better performers in the manufacturing sector.

4.3.2 Problems in Partial Productivity Analysis :

The traditional method of calculating productivity using ratio analysis is quite simple. Hence it has been widely used by various scholars over a period of time. However, the partial productivity analysis have certain limitations and hence cannot be taken as conclusive evidence.

The limitations of this measure are that if the input ratio varies at different points time or different methods of production process in different proportions are used then it becomes difficult to calculate partial productivity without any bias. For example if the inputs labour and capital do not vary in the same proportions, i.e., if suppose capital intensity increases it will show improvement in labour productivity and deterioration in capital productivity. This kind of biases are inherent in the partial productivity analysis. As long as labour and capital are used in fixed proportion there will be no problems. But it is not always so, because improvement in technology, and more labour related problem capital is substituted to labour in such cases the partial productivity analysis will not give a clear picture of factor productivities. There are also evidences from the developed economies that fuel is substituted for labour in new technologies. Therefore total factor productivity measures are used as comprehensive measure of productivity growth. In the following section the total factor productivity measures and growth is analysed.

4.4 Total Factor Productivity : Measurement & Measures :

Considering the limitations of partial productivity ratios, the total factor productivity measures began to be widely used to estimate the overall productive efficiency and also to assess the technical change. The TFP measure estimates the contribution to an increase in output after adjusting for increases in the inputs. In the production process, various factors are not always necessarily having fixed coefficients relationships. Depending upon factor prices, factor substitution takes place.

A distinction can be made between total factor productivity (TFP) and total factor productivity growth (TFPG). TFP is a static concept shows the level of productivity at a point of time, whereas the TFPG being a dynamic concept measures changes in TFP over time. That is, TFPG is calculated by taking ratio of changes in output to a weighted sum of changes in inputs. Any excess of the growth rate of net output over the growth rate of factor inputs appropriately weighted is defined as TFPG. If there is excess in output, the TFPG is positive, otherwise it is negative, in such case TFPG is declining. In a wider sense, the measures of TFPG provides an indication of the changes in the overall efficiency with which the resources are utilised in the production processes. Thus, TFPG and Technological Change (TC) are used synonymously.

However, it is necessary to distinguish between technical progress and TFPG. The TFPG is a broader concept which includes the effect not only of technical progress but also of better utilization of capacities, learning by doing and improved skills of labour. The TFPG is a compositive measure of technological change and changes in the efficiency with which known technology is applied to production.

The technical progress, on the other, is part of effect on TFPG. It may be defined as the advances in knowledge with respect to the production of any commodity using different factor inputs. The introduction of a new technology, mostly takes place in the form of capital goods like new machines. If there is improvement in output using the same inputs, that is the effect of technological change. Sometimes the new capital goods may cost less. In such cases, the surplus over the investment of such capital goods can be diverted elsewhere in the economy. Therefore introduction of new technology brings certain advantages to the economy.

As widely said partial factor productivity analysis produces biased results. Therefore the total factor productivity measure (TFP) have been introduced to measure the effect of productivity in manufacturing sector. In production process different factors are substituted depending upon factor prices or their efficiency measure. Sometimes labour is substituted for capital and vice versa. Especially when more capital is used, fuel is substituted in place of labour to operate the capital equipments.

Various measures of TFPG have been developed during the 70s and 80s. Productivity growth is accepted as important element of growth of an economy. A country can develop faster with a high level of productivity.

It is therefore, necessary to find out exactly the extent by which productivity improvements are occurring at the economy level and in different sectors. Productivity studies of the economy are therefore important for the developing countries. In the Western countries, productivity analysis has been conceptually and empirically developed by the contributions of different economists like Schumpeter, Allyn Young, Tinberger Stigler, Fabricant, Solow, Kendrick, Griliches and others. Kendricks work on productivity trends in the U.S Published in 1961 by the National Bureau of

Economic Research is a pioneering work in this area. Although there are various measures of TFPG, this study employees only Kendrick and Solow measures of TFPG.

4.4.1 Measures of TFPG :

(i) Kendrick Measure :

Kendrick's index (1961)[14] of total factor productivity is based on a linear production function which assumes infinite elasticity of substitution between the factors of production. Kendrick index assumes implicity homogeneous production function with two inputs such as capital (K) and Labour (L).

Kendrick measure of TFPG can be defined as

$$\frac{DA}{A} = \frac{(Y_1 / Y_o)}{SL_o (L_1/L_o) + (1 - SL_o) (K_1/K_o)} - 1 \qquad [1]$$

Where subscript'1', stands for the current period and subscript'0' refers to the base period. The notations such as DA, Y, L,K and SL used in the equation (1) are TFP, real output, labour, capital, share of labour in value added respectively. Using the above equation the Kendricks Index (KI) is estimated as

$$KI = [TFPG \times 100 + 100]$$

Thus the index is 100 for the base period.

(ii) Solow Measure :

Solow (1957)[15] interprets TFPG as "The rate of shift in production function" under the assumption of Hick's neutrality of technical change. Under the restrictive assumption of constant returns to scale, unitary elasticity of substitution and Hicks neutrality of technical change, Solow measure of TFPG is derived as follows

$$Y_t = A_t f(K_t L_t) \qquad [2]$$

Where A_t, which measures the cumulative effects of the shifts in the production function over time, is defined as

$$A_t = A_o e^{ut}$$

Since A and u are constants, then equation (2) becomes

$$Y_t = A_o e^{ut} f(K_t, L_t) \qquad [3]$$

Differentiating, the equation (3) partially with respect to t, we have

$$dy/dt = uY_t \qquad t = 0,1 \ldots T \qquad [4]$$

Where $Y_t = A_l (K_t, L_t)$ then dividing the equation (4) by Y_t we obtain

$$(dy/dt) / Y_t = u$$

Thus `u' measures the equi-proportionate change in output over time when input levels are held constant, Solow attributes it to the disembodied technical change. Following total differentiation with respect to time dividing it throughout by 'Y' and rearranging the terms, we get;

$$(dA/dt)/A = [(dy/dL)/Y] - SL_1 [(dL/dt)/L] - SK_1 [(dK/dt)/K] \qquad [5]$$

Where SL and SK imply shares of labour and capital during the period t under conditions of constant returns to scale and marginal distribution of income, the share of capital, SK_1 is computed by

$$SK_1 = 1 - SL_1$$

Hence, the discrete form of the equation (5) is

$$\frac{\Delta A}{A} = \frac{\Delta Y}{Y} - SL_t \frac{\Delta L}{L} - SK_t \frac{\Delta K}{K} \qquad [6]$$

Here SL_t represents the share of labour at time 't'. Similarly SK_t represents the share of capital at time 't'.

4.4.2 Major Studies of TFPG in Indian Manufacturing Sector :

Most of studies on Indian industries attempted to measure TFPG and technical change, by and large cover the period from the fifties upto the seventies. Few studies have been conducted for eighties. Krishna, K.L.[16] provides a detailed review of the studies on TFPG for the Indian manufacturing sector and reports that except the study of Hashim and Dadi[17], all earlier studies for the fifties and early sixties indicate a decline in TFPG over the period. Different studies have used different measures of TFPG.

A considerable number of studies used two sources of data; they are the Census of Manufacturing Industries (CMI) and the Annual Survey of Industries (ASI). CMI was the major source for data on industrial sector prior to 1959. The ASI, which replaced CMI in 1959 is important source of industrial data in recent years. However some of early studies used both CMI and ASI data though they are not strictly comparable.

In this section, an attempt is made to provide an explanation for the differences in TFPG estimates for the manufacturing sector observed by various studies.

Table 4.4 : TFPG in Manufacturing Alternative Estimates

Study	Period	Data source	Measures of TFPG	Estimates percent
Reddy & Rao (1962)	1946-57	CMI	Solow	- 0.8
Banerji (1975)	1946-64	CMI & ASI	Solow	- 1.6
Hashim and Dadi (1973)	1946-64	CMI & ASI	Solow	2.82
Mehta (1980)	1959-70	ASI	Solow	- 1.6
Brahmananda (1982)	1950-80	CMI & ASI	Kendrick	- 0.25
Ahluwalia (1985)	1959-79	ASI	Solow	- 0.67
			Translog	- 0.43
Goldar (1986)	1959-79	ASI	Solow	1.29
			Translog	1.39
Ahluwalia (1991)	1960-85	ASI	Translog	- 0.42
Present Study	1973-92	ASI	Kendrick	0.39
			Solow	0.41

From the Table 4.4 it can be seen that various studies have come up with different conclusions about the productivity. Reddy and Rao (1962)[18] for the period 1946-57, using Solow measure estimated fall of 0 8 per cent in total productivity over this period.

However for the same period Hashim and Dadi and Banerji[19] have come up with conflicting conclusions about the productivity growth. Hashim and Dadi's estimate shows an increase in TFPG of 2.82 per cent per annum during 1946-64, whereas Banerji's estimate reveals a decline in TFPG of 1 6 per cent per annum during the same period.

The contradictory conclusion is due to the differences in methodology followed for measuring capital stock. Banerji estimated the base year capital stock at the base year prices by doubling the base year book value of fixed assets. This might have possibly given rise to the overestimation of capital stock series at the base year prices resulting in declining TFPG. Hashim and Dadi estimated the base year capital stock at the base year prices from the gross fixed assets at purchase prices using gross net ratio of sample public limited companies fixed assets and also made use the age profile of the machines. These two studies clearly indicate that the productivity measures are highly sensitive to the measure of capital. A number of studies conducted later on have used the methodology developed by Hashim and Dadi for estimation of capital stock. However even this measure is not completely devoid of deficiencies

Mehta (1980)[20] estimated TFPG using Solow measure and found a decline of 1.6 per cent per annum. The study of Brahmananda (1982)[21] for the period 1950-80 using Kendrick measure also indicate fall in TFPG to the tune of 0.2 per cent per annum. The study also estimated TFPG for unregistered manufacturing sector based on Kendrick index for the same period and found that a fall of 1.0 per cent per annum.

The above table also brings out the conflicting conclusions on the pattern of TFPG between Ahluwalia's estimates and that of Goldar for the same period (1959-79). According to Ahluwalia's[22] estimate the Indian industry witnessed a negative TFPG (Translog measure) of -0.42 per cent per annum whereas Goldar[23] finds a positive growth rate of 1.31 per cent per annum in TFPG (Translog measure) during 1959-79. Goldar has used the gross net ratios estimated by Hashim and Dadi for estimating the base year capital stock. In addition Goldar has adjusted the capital stock for foreign investment component for various industrial categories But Ahluwalia has used the two digit classification of Hashim and Dadi's estimates of the base year capital stock. Therefore it is perhaps capital stock which has led to the difference in their estimates of TFPG.

Raj (1984)[24] had pointed out that Indian economy breaking out of the 3.5 per cent per annum `Hindu' rate of growth of the GDP after late seventies. Alagh (1985)[25] had placed the turnaround in industrial growth at around the mid sixties. Ahluwalia (1991) had found a significant improvement in industrial growth only after 1979-80. Nagraj (1990)[26] has found that GDP as well as the sectors have grown at a faster rate between 1980 to 1988 compared to the earlier three decades, specially the secondary manufacturing sector leading the other two.

The Table 4.4 exhibits TFPG estimated using Kendrick and Solow indices. This study shows that by both the measures used, a positive value of TFPG. The Kendrick measure shows TFPG of +0.39 and Solow measure shows 0.41 TFPG during the period 1973-74 to 1992-93. The results exhibit a positive trend. However the growth rate is not a significant contributor of productivity growth.

A separate analysis of TFPG for eighties indicate a different trend, therefore a separate analysis by both Kendrick and Solow methods for the period of eighties is taken up separately in this study.

Bhargava and Joshi (1990)[27] analysed the revised national accounts from 1960-61 to 1986-87. The growth in terms of value added in the manufacturing sector shows an increase after 1975-76 but is not statistically significant. However, the increase after 1980-81 is found to be statistically significant.

To identify the differences in growth, the analysis in this study is divided into two periods. The first period 1973-74 to 1982-83 and the second period beginning 1983-84 to 1992-93.

4.4.3 <u>Results of the Study</u> :

In this section an attempt is made to analyse the long-term trends in TFPG of Indian manufacturing sector over the period from 1973-74 to 1992-93. The analysis covers 16 major industries of ASI two digit level classification. TFPG can be calculated by three indices viz. Kendrick, Solow or Divisia index. Different economists used all these three methods in capturing TFPG. However, in this section Kendrick and Solow measures of TFPG for different industries are presented.

4.4.3.1 Kendrick Measure of TFPG :

The estimates of TFPG of Kendrick index are presented in the Tables 4.5 and 4.6. It indicates that for the period 1973-74 to 1992-93, the TFPG for `all manufacturing' is very low. Within this period there is a slight fall in the index by 2 or 3 per cent. But at the end of the period i.e, 1992-93 the index reaches 103.26 . A change in TFP over this period is marginal and not quite significant.

However within manufacturing sector different industries exhibited different trends in TFPG. The results show that out of 16 industries 8 industries have shown declining trend in the index. And the rest i.e, seven industries showed positive trend and in one industry it remained constant over this period of twenty years.

In the case of Metal and Metal Products (34), the fall in the index was highest i.e. from 100 in the year 1973-74 to 59.03 by the year 1992-93. In case of Textile Products (26), the highest growth in TFP was achieved i.e. from 100 in the year 1973-74 to 175.30 by the year 1992-93. When estimated separately for the period 1982-83 to 1992-93 TFP, exhibited a different trend. Not only `all manufacturing' and almost all industries showed improved trend in TFP. During eighties TFP showed a positive trend viz TFP rose from 100 from the year 1982-83 to 106.96 by the year 1992-93. This increase in TFP quite significantly showed a better productivity performance compared to sixties and seventies. Individual industries analysis also shows that for most industries during eighties, productivity improved marginally. It is noticed that 6 industries showed positive growth and 10 industries exhibited negative growth.

Table 4·5 : Total Factor Productivity Growth - Kendrick Index
(1973-74 to 1992-93)

YEAR	Food 20-21	Beve. 22	cot.tex 23	Silk 24	Jute 25	Syn.tex. 26	Wood 27	Paper 28	Leath. 29	Rubber 30	Chemi. 31	Mine. 32	M.Alloy 33	Metal.P 34	Machi. 35-36	Trans. 37	ALL.Mfg.
1973-74	100.00	100.00	99.32	100.00	100.00	100.01	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
1974-75	123.73	177.30	100.82	106.69	88.37	102.51	82.40	107.36	121.81	131.62	101.83	99.72	101.01	100.80	107.38	97.69	98.26
1975-76	111.95	103.19	84.76	112.59	119.52	115.14	81.97	94.33	82.98	106.43	78.44	89.99	100.37	86.67	86.52	80.69	99.72
1976-77	121.85	129.94	83.11	99.81	120.93	103.95	86.65	86.36	92.40	102.52	85.52	97.51	102.26	89.96	91.43	95.16	102.20
1977-78	130.69	86.05	81.27	97.21	115.80	99.24	84.29	86.01	84.80	101.73	86.45	114.38	95.71	88.26	93.34	89.79	101.39
1978-79	141.40	115.29	99.36	107.33	111.32	109.29	84.86	85.82	77.98	75.02	101.14	97.92	104.43	93.99	96.65	79.34	103.37
1979-80	119.84	99.21	106.06	100.65	126.79	91.61	84.85	83.06	71.38	79.82	84.99	94.61	98.43	91.03	93.01	71.66	99.12
1980-81	113.27	80.54	95.90	93.34	144.59	102.09	68.85	73.62	63.70	104.39	71.65	90.20	100.85	91.86	100.84	71.10	97.39
1981-82	120.92	87.67	74.41	87.88	133.55	118.20	71.77	76.90	68.49	83.96	80.54	87.80	101.20	84.23	101.33	79.00	101.61
1982-83	147.82	89.98	69.67	85.65	117.12	119.46	67.08	60.38	75.22	97.00	93.27	85.31	99.05	82.63	105.94	87.88	102.14
1983-84	165.73	100.87	78.77	78.24	97.70	108.82	69.10	56.16	90.05	83.20	98.34	85.63	100.55	83.17	102.84	90.16	101.16
1984-85	152.52	109.47	69.27	77.73	86.37	106.92	70.34	60.95	95.65	79.02	95.33	93.77	98.54	81.08	119.28	89.61	99.25
1985-86	155.14	82.21	74.47	94.66	85.25	110.71	67.59	64.33	71.82	120.48	93.72	86.41	100.86	89.55	102.25	83.94	100.40
1986-87	148.74	84.74	84.00	96.08	121.83	132.05	70.99	66.38	73.77	116.27	88.56	79.18	116.81	93.24	106.38	93.36	101.00
1987-88	141.98	80.92	76.58	72.95	124.62	124.20	69.23	67.34	89.02	118.03	96.11	76.01	100.36	93.27	108.82	77.05	101.11
1988-89	178.09	88.48	81.13	79.18	101.72	136.30	68.36	67.54	76.39	108.16	102.39	70.67	102.03	90.66	105.61	77.73	102.63
1989-90	172.82	85.54	96.14	98.09	112.05	149.20	68.90	68.78	85.69	113.35	104.06	79.10	100.46	79.22	119.95	88.16	102.92
1990-91	147.28	96.00	99.79	98.68	98.68	162.68	85.39	78.27	89.43	117.98	103.56	100.94	100.25	61.36	117.42	64.07	100.63
1991-92	151.34	114.71	83.35	76.77	101.55	178.09	95.60	76.17	104.18	105.28	109.90	118.38	98.52	73.22	120.51	89.67	103.06
1992-93	134.47	97.50	72.33	73.61	118.42	175.30	82.79	69.00	112.04	114.09	112.49	86.21	100.76	59.03	114.29	86.13	103.27

Table 4.6 : Total Factor Productivity Growth - Kendrick Index (1982-83 to 1992-93)

YEAR	Food 20-21	Beve. 22	cot.tex 23	Silk 24	Jute 25	Syn.tex. 26	Wood 27	Paper 28	Leath. 29	Rubber 30	Chemi. 31	Mine. 32	M.Alloy 33	Metal.P 34	Machi. 35-36	Trans. 37	ALL.Mfg.
1982-83	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
1983-84	116.27	168.47	118.53	95.52	81.26	95.25	114.62	96.54	120.81	58.73	110.98	107.32	99.83	110.01	100.62	102.68	104.60
1984-85	105.60	157.96	108.18	89.64	71.33	124.31	106.94	112.18	126.69	85.27	103.45	111.38	75.06	102.59	113.88	102.21	102.48
1985-86	103.79	122.49	117.55	104.18	77.02	100.18	97.52	93.17	96.78	133.24	104.52	111.21	88.26	113.14	100.09	95.76	103.87
1986-87	94.35	118.94	128.48	100.70	136.46	112.34	103.47	100.92	97.46	123.63	94.03	82.91	77.94	116.43	100.84	106.84	100.85
1987-88	86.56	109.78	114.43	72.86	108.94	79.79	103.03	100.26	113.68	123.07	97.92	78.24	83.21	115.98	100.11	88.85	96.75
1988-89	102.47	117.53	119.50	71.68	85.35	100.79	98.72	106.28	94.92	111.11	98.44	75.24	110.97	113.90	93.34	89.69	100.85
1989-90	97.61	104.92	136.86	88.53	127.14	108.47	86.25	86.18	104.76	112.24	97.19	80.90	115.68	94.85	103.55	102.11	105.47
1990-91	79.82	119.11	142.25	86.74	73.18	115.19	120.83	118.32	108.26	117.26	93.87	98.21	113.59	77.17	99.21	74.29	98.84
1991-92	77.93	134.57	108.29	63.47	80.25	120.15	125.07	109.72	125.84	99.10	92.47	108.66	75.80	87.44	96.23	104.14	92.84
1992-93	68.44	118.48	98.11	60.33	92.44	116.50	110.72	97.39	130.16	127.76	96.66	96.34	94.44	72.52	91.12	100.30	106.96

Table 4.7 : Trend Growth Rate of TFP (Kendrick Index)

Industry Code	1973-74 to 1992-93	1973-74 to 1982-83	1983-84 to 1992-93
Food Products (20-21)	1.96**	0.79	-3.97**
Beverages & Tobacco Products (22)	-1.23	-4.62*	-1.10
Cotton Products (23)	-0.77	-2.28	0 54
Wool, Silk and Synthetic Products (24)	-1.50**	-2.16**	-4.47**
Jute and Hemp Products (25)	0.04	3.25*	0.15
Textile Products (26)	2.82**	1.04	1.37
Wood Products (27)	-0.80	-3.33**	0.84
Paper Products (28)	-2.09**	-4.99**	0.39
Leather Products (29)	0.16	-5.32**	1.03
Rubber Products (30)	0.91	-2.77	3 47
Chemical Products (31)	2.01**	-1.56	1.17**
Non-metallic, Mineral Products (32)	-0.85	-1.55	-2.19
Metal/Alloy Products (33)	-0.50	-2.35**	0.68
Metal Products (34)	-1.67**	-1.57**	-3.41**
Machinery, Electrical, non-electrical (35-36)	1.22**	0.59	-0.96**
Transport Equipment Products (37)	0 56	3.05**	-0.84
All Industries	0.39	-0.62	-0 19

$\text{Log KI} = \alpha + \beta t$

where β is Trend Growth

** Significant at 1% level.
* Significant at 5% level.

The Table 4.7 presents trend growth of TFP for the period 1973-74 to 1992-93. For `all manufacturing' sector the growth rate was 0.39 per cent and this growth is not statistically significant. However compared to earlier studies, most of which showed negative growth of TFP, the results of the present study are some what different. The result for the `All manufacturing' indicate that there is no significant growth in TFP. However the category wise growth in manufacturing sector face different growth rates.

Rate of growth in the (Kendrick index) TFP ranges from -2.09 per cent per annum in Paper and Paper Products(28) to 2.82 per cent per annum in Textile products(26). High rates of growth are observed in Food Products(20-21), Textile Products(26), and Chemical and Chemical Products(31) On the other hand substantial fall in the TFP is noticed among the industries viz. Paper and Paper Products(28), Wool, Silk and Synthetic Textile(24) and Metal Products(34). Out of 16 industries 8 industrial categories show a fall and the rest show rise in TFP. The growth rates are tested for their statistical significance.

However from the Table 4.7 one can also see that there is a clear cut change in growth rates of TFP during 1982-83 to 1992-93, compared with the period 1973-74 to 1982-83. A detailed look at the two sub-periods reveal the difference between the sub-periods and their respective growth rates. Most of the industries which had negative growth in 70s, turned and exhibited positive rate of growth during 80`s. During 1973-74, one finds that out of 16 industries, except five, all other industries exhibit negative growth. Whereas during 1983-84 to 1992-93 seven industries out of 16 exhibit negative growth. Therefore the period of 1980's, during which the economy faced less restrictive policy, started paying back in terms of improving TFP. In case of a number of industries the growth rates have improved during the second period and in some industrial categories the negative growth has turned to positive growth of TFP. This is considered to be a change in the right direction If one look at overall change in Kendrick index for sub-periods it is found that of 16 industries, 10 industries showed positive change either by positive growth of TFP or the declining trend was arrested in many industries. Therefore the period of eighties showed improvement in TFP.

4.4.3.2 Solow Measure of TFPG :

The Solow index of productivity growth in the manufacturing sector of the Indian economy has been estimated and found that the TFPG in this sector has been rather low over the period from 1973-74 to 1992-93. But the later part of eighties shows clear evidence of pick up in TFPG.

The Tables 4 8 and 4.9 show that the TFP for `All Manufacturing' show a declining trend upto 1981-82. During 1981-82 the Index stood at 88.61 and thereafter it started increasing. This gradual increase has reached to 109.20 by the year 1992-93. This index shows a low and positive growth of TFP over this period However the increase is not so significant in itself and is also low when compared to other developing countries, for the same period.

Table 4.8: Total Factor Productivity Growth - Solow Index
(1973-74 to 1992-93)

YEAR	Food 20-21	Beve. 22	cot.tex 23	Silk 24	Jute 25	Syn.tex. 26	Wood 27	Paper 28	Leath. 29	Rubber 30	Chemi. 31	Mine. 32	M.Alloy 33	Metal.P 34	Machi. 35-36	Trans. 37	ALL.Mfg.
1973-74	100.00	100.00	100.00	100.00	100.00	100.01	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
1974-75	117.20	143.90	95.96	104.59	89.15	93.86	88.93	101.98	116.75	114.83	91.93	91.44	121.72	92.44	104.20	97.66	102.75
1975-76	113.22	105.24	77.34	109.87	113.24	105.60	75.53	88.89	46.70	93.63	74.11	84.66	95.91	77.81	84.61	79.03	87.47
1976-77	126.79	117.94	78.91	101.28	113.40	100.84	83.47	85.56	51.69	103.46	81.63	94.19	109.03	85.04	91.84	90.56	95.02
1977-78	144.54	97.96	79.29	106.56	110.73	97.89	83.71	88.18	48.26	106.46	85.60	108.63	94.34	85.33	96.15	85.31	95.64
1978-79	160.29	118.75	94.39	115.57	107.79	108.90	85.44	87.12	45.27	85.56	97.44	92.58	104.19	89.22	98.92	78.04	101.21
1979-80	129.34	102.33	98.51	104.13	121.62	87.37	84.10	83.64	41.63	85.95	83.92	87.29	89.77	88.42	95.49	69.16	93.83
1980-81	108.76	78.25	90.04	102.81	136.50	93.76	68.71	78.13	36.01	80.72	67.34	85.51	92.06	90.77	100.49	68.45	87.45
1981-82	135.75	84.17	66.46	99.17	118.67	105.83	68.90	81.17	38.06	72.08	72.60	84.69	101.79	78.62	99.70	75.19	88.61
1982-83	172.81	82.03	69.24	102.18	106.51	110.68	63.85	64.05	42.13	84.90	79.04	86.04	84.91	79.45	107.07	82.63	93.85
1983-84	202.22	109.74	79.73	98.43	81.65	105.34	68.50	62.25	49.15	59.57	86.27	93.83	81.86	86.58	107.73	84.66	98.24
1984-85	185.56	106.70	71.78	92.82	71.04	128.90	63.60	70.53	51.48	76.85	80.26	97.45	55.91	80.34	119.72	84.33	96.84
1985-86	187.02	76.57	77.49	94.11	82.04	99.37	57.38	56.91	41.37	103.16	81.09	98.71	64.50	88.13	104.27	78.22	99.25
1986-87	186.03	71.63	83.76	91.74	120.74	109.39	61.21	61.63	41.81	95.71	73.55	75.48	51.78	91.06	105.39	86.22	97.33
1987-88	184.84	63.43	73.16	65.97	93.36	85.34	61.67	61.05	47.13	95.36	76.38	74.02	55.09	91.04	105.47	73.76	94.96
1988-89	226.17	66.28	76.18	66.08	82.18	102.78	59.99	65.31	39.70	87.76	77.17	74.09	65.91	91.01	100.40	74.68	100.29
1989-90	249.48	56.61	85.17	77.15	110.17	108.77	52.57	47.83	42.99	88.34	77.24	79.46	67.79	71.53	110.15	85.04	105.09
1990-91	219.71	64.01	87.51	76.76	82.91	114.46	67.97	61.52	44.56	91.80	75.80	94.07	76.78	61.68	106.71	70.55	101.98
1991-92	226.37	68.40	62.18	53.13	93.08	118.47	70.38	56.31	50.95	75.60	74.62	102.54	61.86	69.06	104.07	89.65	96.65
1992-93	213.61	57.52	56.92	51.59	100.97	115.18	62.10	50.27	51.97	90.45	82.82	92.74	74.49	58.32	100.27	87.24	109.21

Table 4.9 : Total Factor Productivity Growth - Solow Index
(1982-83 to 1992-93)

YEAR	Food 20-21	Beve. 22	cot.tex 23	Silk 24	Jute 25	Syn.tex. 26	Wood 27	Paper 28	Leath. 29	Rubber 30	Chemi. 31	Mine. 32	M.Alloy 33	Metal.P 34	Machi. 35-36	Trans. 37	ALL.Mfg.
1982-83	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
1983-84	117.02	133.77	115.15	96.34	76.66	95.17	107.27	97.18	116.67	70.17	109.15	109.06	96.40	108.92	100.61	102.46	104.67
1984-85	107.38	130.06	103.67	90.84	66.69	116.45	99.61	110.12	122.20	90.52	101.54	113.27	65.85	101.07	111.80	102.05	103.18
1985-86	108.23	93.34	111.91	92.11	77.02	89.78	89.86	88.85	98.21	121.51	102.59	114.73	75.96	110.87	97.38	94.66	105.75
1986-87	107.65	87.31	120.97	89.78	113.36	98.83	95.85	96.22	99.25	112.72	93.06	87.72	60.98	114.55	98.42	104.34	103.71
1987-88	106.96	77.32	105.65	64.56	87.66	77.09	96.57	95.30	111.87	112.32	96.64	86.03	64.88	114.53	98.50	89.26	101.19
1988-89	130.88	80.79	110.02	64.67	77.16	92.86	93.94	101.96	94.23	103.36	97.63	86.11	77.62	114.50	93.77	90.38	106.86
1989-90	144.37	69.01	123.00	75.51	103.44	98.27	82.32	74.67	102.04	104.05	97.72	92.35	79.83	89.99	102.87	102.91	111.98
1990-91	127.14	78.03	126.37	75.12	77.84	103.42	106.44	96.05	105.76	108.13	95.90	109.33	90.42	77.59	99.66	85.38	108.66
1991-92	130.99	83.38	89.79	52.00	87.39	107.03	110.22	87.91	120.95	89.04	94.41	119.17	72.85	86.88	97.19	108.49	102.97
1992-93	123.61	70.12	82.21	50.49	94.79	104.06	97.26	978.47	123.37	106.54	104.78	72.92	87.73	73.37	93.64	105.57	116.36

At the aggregate level of manufacturing, growth accounting estimates of TFPG are available for a number of developing economies. Among these economies India's performance is one of the lowest. If one compares estimates of TFPG, the estimates of four Far Eastern tigers i.e. Korea Taiwan, Hong-Kong and Singapore, productivity growth in Indian manufacturing is found to be much lower than in any of these four economies .

However, within the manufacturing sector of different segments exhibit different trends in TFP The results shows that out of 16 industries (2 digit level), 12 industries have negative growth of TFP. Only two industries Food and Food Products (20-21) and Textile Products (26) have positive growth and in two other industries the growth is almost constant viz. Jute and Hemp Products (25) and non-metallic basic minerals industry (32).

In the case of Leather and Leather Products (29) showed highest fall in TFP i e, from 100 in the year 1973-74 to 51.97 by the year 1992-93. The highest growth in TFP is achieved in the Food and Food Products i.e. TFP doubled during these twenty years period of time. The index rose from 100 to 213.61 by the year 1992-93. Therefore, most of the Indian industries do not contribute to TFPG in the Indian manufacturing sector. However during 1980s some of these industries showed a positive growth. According to Solow index for the period 1982-83 to 1992-93 it is found that out of 16 industries 6 industries showed a positive and 10 industries showed negative growth For `All manufacturing' sector during this period the TFP gradually increased and improved to 116.36 by the year 1992-93. Therefore it is observed that the TFP growth is higher during eighties compared to that of 1970s. These results require a deeper look and is taken up in the succeeding paragraphs in analysis of trend growth rates.

Table 4.10 : Trend Growth Rate of TFP (Solow Index)

Industry Code	1973-1992	1973-1982	1982-1992
Food Products (20-21)	4.28**	3.584	2.536**
Beverages & Tobacco Products (22)	-3.89**	-4.395**	-5.345**
Cotton Products (23)	-1.47	-2.593**	-1.169
Wool, Silk and Synthetic Products (24)	-3.37**	-0.209	-6.256**
Jute and Hemp Products (25)	-0.99	2.235**	0.841
Textile Products (26)	0.72	0 506	0.392
Wood Products (27)	-2.29**	-3.789**	-0.023
Paper Products (28)	-3.53**	-3.837**	-2.102**
Leather Products (29)	-2.23**	-10.690**	0.714
Rubber Products (30)	-0.08	-3.787**	1.278
Chemical Products (31)	-0.79	-2.445**	-0.515
Non-metallic, Mineral Products (32)	-1.02	-1.350	-1.620
Metal/Alloy Products (33)	-3.29**	-2.067**	-0.438
Metal Products (34)	-1.49	-1.374	-3.330**
Machinery, Electrical, non-electrical (35-36)	6.63	0.795	-0.681
Transport Equipment Products (37)	-0.45	-3.129**	-0.010
All Industries	0.41	-0.962	0.902

** Significant at 1% level
* Significant at 5% level.

In Table 4.10 the results of trend growth of total factor productivity of Solow index is presented. The study has been undertaken for the whole period 1973-74 to 1992-93 for twenty years. Again looking into policy changes during eighties, the twenty years period is divided into two parts and TFPG is analysed, definitely there was change of TFPG in these two sub-periods.

Solow index for the period of study indicates the growth of TFP for manufacturing sector as a whole was only 0.41 per cent. This rate is quite low and statistically not significant. The absolute growth is not quite significant, compared to other developing countries for the same period. The study of individual industries for the whole period shows that out of 16 industries 13 industries have negative growth and only 3 industries have positive growth rate Even in the industries which are exhibiting positive growth, Food industry (20-21) has significant rate of growth of 4.28 for the period, where as other two industries Textile Products (27) and Electrical and non- electrical machinery (35-36) have less than 1 per cent growth.

Among the industries exhibiting declining TFPG, some industries have greater fall compared to other industries, mostly these are traditional industries like, Beverages, Tobacco and Tobacco Products, Wool, Silk and Synthetic Textile industries, Paper and Paper Products which have more than 3 per cent fall in TFP. Majority of the industrial groups show falling trend in TFP. However during eighties there is improvement in productivity, i e a number of industrial categories have show a positive trend, though the rate is negligible

Growth Differences in Sub-periods :

Similar to Kendrick index, Solow index also exhibit differences in rate of growth TFP in the sub periods. An analysis of these two sub-periods i.e, 1973-74 to 1982-83 and 1983-84 to 1992-93 indicate that TFPG improved in later period. It increased from -0.96 in the first phase to 0.90 by the year 1992-93. Among individual categories also out of 16 industries 5 industries showed a positive growth. The Table 4.10 shows that 9 industries out of 16 industries showed a positive trend in TFPG. This is because in the first period which were showing negative growth have improved their TFP and the declining trend slowed down

4.5 Observations :

In this chapter detailed analysis of partial and total factor productivity are takenup. For measuring the partial productivity two measures are made of. They are labour productivity and capital productivity. The results for 'all manufacturing' shows that capital productivity has declined during the period of analysis and labour productivity has increased. The trend growth rate of capital productivity is -1.81 and labour productivity is 3.29. It is also observed that all the industrial categories studied exhibited a negative growth for capital productivity and a positive growth for labour productivity The results do not speak well of the Indian manufacturing sector. The increase in labour productivity could be because of better working condition, labour is more educated, skill levels are higher, greater skill formation on the job, more capital employed, or better technique of production. Similarly the changes in the capital productivity. The raising labour productivity needs to be taken with caution. The increase in partial labour productivity need not necessarily be the result of increase in the performance of the labour input, but it could be the result of the capital and the technology with which the labour is working. Therefore labour productivity hides more than what it reveals. The economists traditionally favoured partial capital productivity over the labour productivity. The falling capital productivity could be explained through a number of factors viz. over capitalisation itself, low capacity utilisation, workers unrest, technology not suitable to the local conditions etc. As discussed in the earlier chapter the capital deepening itself could be a major factor, over and above, the capacity utilisation in Indian manufacturing is low. The results of partial productivities are not conclusive hence the study has taken up the total factor productivity analysis

Both the Kendrick and Solow analysis exhibits similar kind of results of TFP. Most of earlier studies like Banerji, Mehta, Brahmananda and Ahluwalia all have shown a fall in TFP during 1960 and 1970s. However Ahluwalia's recent contribution showed that there was turnaround in the productivity growth 1980s. The present analysis shows that Kendrick and Solow indices exhibit a growth rates of 0.39 and 0.41 respectively. These values, eventhough positive, can not be considered quite significant. Therefore productivity growth during this period, as a major source of growth in manufacturing sectors is not very significant In this analysis when we divide the periods into two sub-periods, definitely we are able to find better productivity performances during 1980s as compared to 1970s. As it was identified, eighties was the period of high growth rates in the Indian Economy, it was found that improvements in total factor productivity also took place in the manufacturing sector.

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