

CHAPTER - III

CAPITAL INTENSIVE INDUSTRIALISATION

3.1 Introduction :

The developing countries have realised the need for industrialisation and their potential for development of their economies. The future, depends upon how effectively their industrial policies are formulated and how they would be implemented. The higher the level of real income in developed countries is largely attributed to the higher degree of industrialisation. However, pattern of industrialisation vary from one country to another country. The growth of industrial base to a great extent depends upon the process of industrialisation. Some economies have started with production of consumption goods and gradually diversified into capital-good production whereas some economies have emphasised the capital goods sector for development. In general, countries starting with the capital goods industries are said to have faced a faster pace of development. However there are different paths of industrial development followed by developing countries. The basic pattern of industrialisation followed by India since 1950 i.e. during the Indian planning period, reveal certain important features. Apart from the general growth in quantitative terms, there have been significant changes in India's manufacturing structure and production techniques. One of the salient features of industrial development in India is high capital intensive industrialisation. This chapter discusses the growing nature of capital intensity in Indian manufacturing. Some of the economists also refer it as

technology intensive industrialisation. Capital encompasses the technology and techniques of production. In general terms it is understood that newer techniques of production are more capital intensive and the degree of capital intensity increases with the level of automation. For these reasons capital intensive industrialisation is also referred to as technology intensive industrialisation.

The growth of the developing economies is often constrained by the scarcity of certain crucial resources. A developing economy often suffers from relative paucity of capital and plethora of labour. It is important, therefore, that these resources are used optimally. For maintenance of a high level of performance requires that the productive processes be well organised. They have to be so organised as to generate enough of surplus, to make for the progressively higher reinvestment potential in the future. This depends upon the efficient utilization of resources in the system.

It is well known fact that there exist more than one method of production for producing a given output in majority of the cases. In this context the productivity analysis acquires great significance. The methods of production, may be distinguished on the technological characteristic of combination of the factors of production. Thus, such evaluation would raise questions pertaining to the relationship between capital intensity, labour intensity and productivity.

In section 3.2, various capital intensity measures are discussed. Section 3.3 presents the choice of techniques. Section 3.4 discusses the Indian approach to the industrialisation in view of the plans and policies followed. In section 3.5 a brief survey of studies conducted on capital intensive growth in Indian manufacturing is presented.

Section 3.6 analyses the growing capital intensity and changing labour productivity in Indian manufacturing. The measurement and test of efficiency is discussed in section 3.7. Section 3.8 deals with growing fuel intensity in Indian manufacturing followed by observations.

3.2 Capital Intensity Measures :

In a developing nation where capital is scarce and labour abundant, the economy should be exercised in regard to the use of capital, with reference to its objective. If the objective is maximization of Income, then the technique which yields maximum of income per unit of capital should be preferred; in other words, the one which has the lowest capital output ratio. There is no a priori theoretical reason why a unit operated on smaller scale should be more labour intensive or for that matter capital intensive, than one operated on large scale.

In a developing nation like India the factor markets are more imperfect than developed nations. This imperfection is explained by a variety of reasons. As a result the price of capital tends to be low to that of labour than, it would otherwise be. Capital-intensive techniques are adopted, but if markets were perfect labour intensive techniques should have been adopted. In these nations the product markets, are relatively perfect, less imperfect than factor markets. Therefore, the products produced by labour-intensive techniques can not compete in the market with products produced with capital intensive techniques. There is a reason to believe that an industry which is capital intensive is run on modern lines using sophisticated processes. The industries using sophisticated

technologies have more capital backing the labour, hence resulting in higher labour productivity. In the real sense, the increase in productivity can not be attributed to labour alone, but also to other factors which back labour. In case of labour productivity estimated, other things do not really remain constant, as the theoretical assumptions make.

Capital intensity in manufacturing can be measured by different ways. In ratio analysis, it can be viewed in average terms or in marginal terms. One can estimate the following ratios and each measure of these is considered as a capital intensity.

- (i) Capital employed per Net Output i.e., value added
- (ii) Capital employed per Labour
- (iii) Incremental capital - Output ratio

Capital intensity is usually measured in net output terms (i.e. value added). Capital employed for a given level of output shows the capital intensity in average terms. It can be expressed in net output terms taking into consideration of value added, which also refers capital intensity. For planning purposes, the incremental capital output ratios have great importance. This ratio gives the additional capital required to produce an additional unit of output. Capital employed per labour is another widely used measure of capital intensity. For this measure, labour input can be measured in different ways. For the estimation of capital intensity and labour productivity, the present study uses the value added at constant prices of respective industries, Net Fixed Capital Stock (NFCS) and Labour is measured in terms of mandays of labour.

3.3 Choice of Techniques :

The most important argument that has attracted increasing attention over the years is whether the developing countries should go for capital intensive techniques or labour intensive techniques. General perception is that, in the short run, the labour-intensive techniques generate more output, employment and consumption while in the long-run the capital intensive techniques generate more output and consumption.

3.3.1 Labour Intensive Techniques of Production :

Labour intensive techniques are more suited in those cases where the objective is maximisation of immediate employment and output levels. The highly populated and labour abundant countries often opt for labour intensive techniques of production to solve their problem of unemployment. Maximisation of immediate output levels is a desirable objective in those developing countries which face shortage of supply of goods. Such shortages can be taken care of better by adopting labour intensive techniques where time period of supply is short and less dependence of capital goods. For this purpose Indian industrialisation was also emphasised on the small scale sector which was expected to use labour intensive methods of production. The reason behind this strategy is explained in Mahalanobis model (1963)¹.

The role that small-scale sector should be playing in the process of planned development in India started with the formulation of the second five-year plan. These industries were viewed both as generators of surpluses to sustain and possibly to increase the investment in heavy industry, and as a solution to the problem of unemployment. To

perform this objective small scale sector should be given protection against competition from the large-scale manufacturing sector.

However labour intensive techniques might result, in the short-run, in maximising employment and even aggregate output. But their surplus generating capacity of these industries is extremely limited. Because such techniques generate less incomes and would be spent almost entirely on consumption.

3.3. 2 Capital Intensive Techniques of Production :

In the long-run the capital intensive techniques generate more output and income levels. Because adoption of a labour-intensive technique adds to output less than it adds to consumption, so that the volume of inevitable surpluses declines². Therefore if the policy objective is the maximisation of the growth rate, capital intensive techniques are to be preferred, when it is the maximisation of immediate output per unit of investment, the other technique i.e. labour intensive, can be preferred. The potential surplus may be smaller for capital intensive methods, but their surpluses can be well organised for the re-investment purpose. By adding more to savings, capital intensive techniques contribute to the future growth of the economy. Besides this, the possibilities of acquiring technical progress are higher in the case of capital intensive techniques. Such industries contribute for faster industrialisation, modernisation and economic development. The technological developments are fast taking place invariably in capital -intensive techniques, that is a why such technologies are favoured in developing countries too. More over the use of modern capital-intensive technology may be required for the future industrialisation of the country

so that it may become competitive in the international market. It was noted by Donald Evans, "Extensive reliance on less modern technology may divert needed energies and capital from this industrialisation effort, thereby retarding ultimate development"³.

3.3.3 Appropriate Technologies for Developing Countries :

Even though the factor endowments, in developing countries, favour the adoption of labour intensive techniques, generally we find that they adopt the capital intensive techniques of production by importing capital goods. The capital goods imported from developed countries possess capital intensive technologies because of labour scarcity in their domestic markets. Moreover, advanced countries have a distinct labour saving bias. The importing countries have therefore, no choice and have to import the capital intensive technology. Such technological transfers have largely resulted in the growing capital intensity in the developing countries.

Therefore the adoption of capital intensive techniques of production generates little employment opportunities, the cost of each additional job created by adopting the imported technology is very high. Again such techniques have a higher foreign exchange requirement compared with the labour-intensive techniques which these countries find it difficult to organise.

Generally a technology and capital equipment developed in one country may not be suitable to some other country where the economic and institutional factors differ. Shikawa (1981)⁴ pointed out that an appropriate technology developed with a view to using the factors efficiently may not produce the same result when applied to some other

country. In the less developed countries, the usual practice is to import advanced technology from the developed nations but the adoption of this technology to domestic conditions requires continuous research involving huge costs. However with the help of local R and D, the application of labour using technology which is economically efficient is the option to attain employment targets. At the same time it is necessary to apply capital using methods which may also be economically efficient if the appropriate technology could be found out through R and D and used for selective industries (Haan, 1988)⁵.

From the above analysis the question arises that what will be the suitable choice of technique of production for developing countries. In certain sectors and industries, capital intensive techniques are most appropriate and in certain other sectors and industries labour-intensive techniques are more appropriate

Modern manufacturing sector employs advanced technologies which are transferred from developed countries to the developing countries. The introduction of foreign technology leads to capital deepening in developing countries and such direct transfers without any consideration of domestic situation create an inefficiency in the production activities. Most of foreign technologies originated from developed countries are of more capital using and less labour intensive in nature. Therefore without adequate modifications with domestic R & D, developing countries can not make use of technology, transfers suited to their factor endowments.

Therefore, the appropriate policy from the point of view of the developing countries would be to use a mix of the two. Certain large scale industries require the use

of capital-intensive techniques while certain complementary activities and agriculture sector can use labour-intensive techniques of production.

3.4 Approach to Industrialisation : An Indian Experience :

The pattern of Indian Industrial Growth and Structure shows that the industrial base built was capital intensive which was aimed at faster industrialization. In analysing the major features of Indian industrialisation, it is important to note that the pattern of industrialisation keeping in view a number of objectives. Some of these issues were discussed in the previous chapter. The problems of India's industrial development have to be viewed in the context of the Indian industrial system, with reference to Industrial Policies, Plans and Industrial Regulation Acts. The Industrial Resolutions of 1948 and 1956 specify the fields of activity for both public and private sectors. Various plans have laid down, in specific terms, the planned targets and physical achievements for broad groups of industry. The execution of these programmes is sought to be achieved through the system of industrial regulation.

3.4.1 Emphasis on Public Sector :

From the beginning, the Indian planning has aimed at acceleration of the rate of economic growth and speedy industrialisation. The public sector was assigned a greater role and the investment allocations in public sector industries were much high than that of private sector. The importance of public sector was first reflected in the Industrial Policy

Resolution of 1956 and consequently in the Second Five Year Plan. Initially public sector was assigned the role to provide basic infrastructure facilities and in particular the emphasis was to develop heavy and machine building industries. The public sector also had to fulfil other social objectives by providing various public utility services, generation of more employment opportunities, influence the pattern of investment in the economy, industrial dispersal etc. Apart from infrastructure development, the public sector activities were spread over to a vast range of areas like transport, coal, iron ore, steel and steel products, oil exploration, chemicals and fertilizers, machinery and machine tools, banking and insurance services and few consumer items as well. Apart from the Central Government, state and local governments also have establishments engaging in the above mentioned productive activities. The number of establishments kept on increasing in public sector since planning period (Table 3.1).

Table 3.1 : Central Public Sector Enterprises and Investments

Investment in Public Sector		
Plan	Total Investment Rs. crores	Number of Enterprises
At the Beginning of 1 st Plan	29	5
Second Plan (1961)	953	48
Third Plan (1966)	2415	74
Fourth Plan (1974)	6297	122
Fifth Plan (1979)	15602	122
End of Sixth Plan (1986)	35000	215
End of 1993-94	159307	240

There were only 5 public sector units at the beginning of the first plan with an investment of Rs.29 crores. Their number and size of investment kept on increasing and reached 122 public sector units and an investment of Rs.15602 crores during Fifth plan (1979). Their number further rose to 240 by 1993-94 with an investment out lay of Rs.1,59,307 crores. The total number of companies under public sector (Central and State governments) increased from 142 in 1960-61 to 1180 by 1992. These contribute to 0.5 per cent of number of firms with private sector contributing to 99.5 per cent of the firms. In terms of paid up capital the public sector companies have contributed to 71.6 of the total. On the other hand private sector contributes to 28.4 per cent of paid up capital (with 99 per cent of companies). When these figures are compared with output generation it gives a clear indication of how capital intensive the public sector enterprises are. Between 1960-61 to 1992-93 the share of the public sector in the net value added in the organised manufacturing sector grew 8.1 to 33.4 per cent. Between this time period, the share of the public sector in the national income grew from 6.6 per cent to 27.2 per cent at current prices. The development of the public sector has been the principal element in passing the way for over all economic development by providing industrial base for the rapid industrial development of the country. Most of the public enterprises are large projects involving huge amounts of capital and these projects being huge had long gestation periods and the returns were slow.

Compared to the role given to the public sector, the performance of public sector was not satisfactory, there are always shortage in supply compared to growing demand for a number of basic products. Gaps between targets and achievements were regular

phenomenon of Indian planning. For the entire planning period, one finds the actuals achieved was much below the targets. The shortfalls in the returns from public sector investment have been a matter of concern for planners in mobilising resources for the development programmes. However, the criterion for judging the performance of the public sector should be different from rate of return on investment, keeping in view of their social objectives. They are required to share the burden of industrialisation, generate additional employment, promote balanced regional development of the country, develop small-scale industries through spread effects, etc.

3.4.2 Emphasis on Heavy and Capital Goods Industries :

Indian industrial planning strategy placed great emphasis on heavy industries. The Mahalanobis model regarded the allocation of investment between the capital goods sector and other sectors as a critical instrument for determining the future rate of sustainable investment in the economy. Deliberate efforts were made to use public sector investment to build capacity in the heavy industrial sector which included capital goods as well as core intermediate goods such as Steel and Coal⁶. This pattern of industrialisation, however, involved limited absorption of labour and did not enlarge the supply of consumer goods sector. In the beginning, capital goods and basic goods grew relatively fast, while the growth of intermediate goods and consumer goods lagged far behind. Among the input based industries the growth in value added was much faster for the metal based and the chemical based industries. Besides this, the public sector enabled the economy to develop a strong infrastructure for the future.

The development of private sector depended much upon the industrial base provided by the public sector. Therefore investment in heavy and basic industries in public sector encouraged subsequent development of other manufacturing activities. As noted by A.H. Hanson⁷, “Even the view that it is the function of the state to provide only basic services of the produces - goods industries in which private capital is - atleast initially - less interested. Hence one can argue, without any socialistic overtones that as - for instance - textile or food processing industries need the support of native metallurgical and engineering industries and so as no private entrepreneurs show any indication to pioneer the latter, the state must step in and do the pioneering itself”.

The public sector played a dominant role for the rest of industrial activities of the economy. The nature and type of investments in public sector provided base for the development of private sector industrial activities. Gradually public sector entered in to various fields and helped to develop strong industrial base. In the process of capital formation also, the public sector played a crucial role, a level of 2.8 per cent in 1950-51 in the public sector has increased to 11.5 per cent in 1984-85 and public sector investment accounting for over 50 per cent of the total investment in the economy. In the consecutive five year plans substantial investments in public sector was done. The share of output public sector in the total GDP in the economy during sixth plan was 25 per cent⁸. Besides infrastructure, the public sector was expected to set up capacities in the capital goods industries. Such capacities were set up in a planned manner to produce the parts and machines which would meet demands of rapid industrialisation.

The public sector has made impressive progress and played a dominant role during the planning period. The industrial base provided by public sector implicitly directed the private sector units even move towards capital intensive techniques of production both in large scale and in small scale industries. Besides this, the rapid growth of large scale industries and increases in the capital accumulation encouraged application of more capital goods. The modern sector is composed of large scale industries with limited degree of factor substitutability, so that production is characterised by fixed technical coefficients and the production processes are relatively capital intensive.

The Nehru-Mahalanobis strategy of industrial development during the early 60s had contributed the growth of the capital goods industry. The industrial growth rate shows that the capital goods section showed a growth more than 14.5 per cent between 1951 to 1965 and an average of 11.5 per cent 1980-81 to 1994-95. Capital goods industry formed the core of our industrialisation strategy. The capital goods industry picked up in the seventh plan when its annual rate of growth was 19 per cent per annum which in fact boosted the growth rate of capital goods industries in the eighties.

3.4.3 Incremental Capital-Output Ratio (ICOR) :

Another indicator of capital intensive industrialisation in India is the incremental capital-output ratio. Over the years, the country has been able to raise the investment ratio and savings rate. Rate of savings increased from 10 per cent of the GDP in 1950-51 to 24.3 per cent in 1991-92. Gross capital formation as a percentage of gross national

product has risen from 10.2 per cent in 1950-51 to 25.5 per cent in 1991-92 at current prices. This investment led to rise in incremental capital output ratios in most of the industries. The emphasis on industrialisation led to setting up large scale industries which are relatively capital intensive and the output per unit of capital invested is relatively lower. The ICOR observed in Indian economy during the planning period is shown in Table 3.2.

Table 3.2 : Incremental Gross Capital-Output ratio in the Economy (1951-52)

Period	ICOR
1951-52 - 1955-56	2.95
1956-57 - 1960-61	3.40
1961-62 - 1965-66	5.44
1966-67 - 1970-71	3.43
1971-72 - 1975-76	5.80
1976-77 - 1980-81	6.63
1981-82 - 1985-86	4.15
1985-86 - 1991-92	4.35

Source : Government of India, Planning Commission
Eighth Five Year Plan, 1992-97 Volume I
(Delhi 1992), Table 1.1, pp.3.

The ICOR has raised from 2.95 in 1951-52 to 1955-56, to 5.44 in 1961-62 to 1965-66. It attained highest value of 6.63 during 1976-77 to 1980-81. This figure stands at 4.35 for the period 1985-86 to 1991-92. There has been rise in the incremental capital output ratios in most industries. The increase in ICOR is one of the reason for the relatively capital intensive industries. Such capital intensive growth of industries also led

to increase in capital labour ratio and a falling capital productivity in the Indian manufacturing sector. Therefore the dominant role of public sector, increase in capital accumulation, incremental capital output ratio, transfer of foreign technologies, etc. encouraged capital intensive industrialisation in the Indian economy.

3.5 Studies on Capital Intensity in Indian Manufacturing :

A number of studies have been conducted in India on the theme of capital intensity. One of the earliest work is by Singh (1966)⁹ on 'changes in capital intensity and technical change' analyses capital intensity and productivity trends in Indian manufacturing for the period 1951-63. The results show a steady rise in labour productivity and a fall in capital productivity and the increase in labour productivity was observed to be closely linked with increasing capital intensity. Similar conclusions are arrived at, in studies by Shivamaggi, Rajagopalan and Venkatachalam (1968)¹⁰ for 1951-61 and Rajkrishna and Mehta (1968)¹¹ for 1946-66. All these studies conclude that most of the gain in labour productivity were due to capital deepening

Benerji (1971)¹² calculated partial productivity for both labour and capital for the years 1946 to 1964. He also came to the conclusion that increase in labour productivity was achieved mostly through capital deepening.

Goldar (1986)¹³ has studied productivity growth of Indian manufacturing for the period 1951-79. He has observed a rise in capital intensity at the average annual rate of 5.38 per cent and labour productivity grew at the annual average of 3.83 per cent.

Ahluwalia's study (1991)¹⁴ found that the rate of growth of labour productivity in manufacturing was 2.2 per cent per annum between 1959-60 to 1985-86, while capital per unit of labour increased at the rate of 4.9 per cent per annum and capital productivity declined at the rate 2.5 per cent per annum during the same period. This study concluded that the change in labour productivity did not keep pace with the change in capital intensity. For almost all 63 industries, the capital intensity showed a strong and significant upward trend.

Dipankar Coondoo, Chinjib Neoyi and Bhuddhadh Ghosh (1993)¹⁵ studied technology intensive industrialisation in the Indian manufacturing. They found increasing capital intensity and almost constant labour productivity. The study concludes that there is an unidirectional and widening gap between the capital-labour ratio and labour productivity which clearly indicates the growing capital intensity in the Indian manufacturing. The study of Reserve Bank of India on Foreign Collaborations highlights (RBI 1974¹⁶ and 1985¹⁷) that advanced and capital intensive technology through foreign collaborations have entered in Indian industries in many ways. The survey covered 594 companies in the private sector of which 70 were subsidiary. Out of total 62.4 per cent had entered into technical collaborations through 580 agreements, while rest had financial collaborations. This ended up with greater supply of foreign capital and growing capital deepening process.

3.6 Analysis of Growing Capital Intensity and Labour Productivity :

This section analysis the capital intensity and the labour productivity in the Indian manufacturing for the period 1973-74 to 1992-93. During this period, Indian industrial

scenario has undergone major changes. Industrial sector became more liberalised and increasing emphasis was laid on productivity and efficiency. During the eighties, a large number of capital and intermediate goods were placed on the Open General License (OGL) making their imports much easier. The use based industrial classification shows that the capital goods sector and consumer durables showed a significant growth during eighties and nineties.

For analysing the capital intensity in the Indian manufacturing this study makes use of two measures, viz. K/L ratio and K/VA ratio. As mentioned earlier capital refers to NFCS at 1980-81 prices. Labour is measured in terms of mandays of labour and value added is also expressed at constant prices i.e. 1980-81 = 100.

Table 3.3 presents the estimates of capital intensity in terms of capital-labour ratio and capital-value added (Net output) ratios and labour productivity for three points of time, 1973-74, 1982-83 and 1992-93. A first glance at the table reveals that there is an increase in capital intensity over time irrespective of the measure used. For the 'All Manufacturing' the K/L ratio has increased from Rs.142 to 316 during the period of study. The other measure used i.e. K/V ratio increased from 1.952 to 3.072 during the same period. Both these measures clearly indicate growing capital intensity. These results cannot be taken as conclusive evidence as there could be variations during the period and the results might vary from one industry to another. Labour productivity as measured by VA/L also shows increase from Rs.67 per manday in 1973-74 to Rs.111 by 1992-93. This is an indication of increasing labour productivity. The detailed discussion of the results are as follows.

Table 3.3 : Capital Intensity and Labour productivity in Indian Manufacturing

<u>Industry</u>	<u>K / L Ratio</u>			<u>K / VA Ratio</u>			<u>VA / L Ratio</u>		
	<u>1973-74</u>	<u>1982-83</u>	<u>1992-93</u>	<u>1973-74</u>	<u>1982-83</u>	<u>1992-93</u>	<u>1973-94</u>	<u>1982-83</u>	<u>1992-93</u>
Food Products (20-21)	100.313	82.821	177.530	2.364	1.356	2.602	42.273	57.829	68.222
Beverages & Tobacco Products (22)	40.902	31.664	58.662	1.002	0.948	1.289	40.795	39.895	45.500
Cotton Products (23)	65.779	66.817	168.615	1.540	2.009	3.361	42.705	33.250	50.158
Wool, Silk and Synthetic Products (24)	102.658	115.348	379.945	1.798	1.828	3.967	57.065	63.101	95.779
Jute and Hemp Products (25)	35.547	27.439	53.052	1.348	0.928	1.480	26.358	28.555	35.839
Textile Products (26)	55.147	50.784	105.688	1.315	0.972	1.010	43.924	52.229	104.615
Wood Products (27)	37.251	47.723	108.731	0.919	1.467	2.116	40.505	29.117	51.371
Paper Products (28)	124.065	143.367	331.269	1.860	3.067	5.091	66.673	46.732	65.470
Leather Products (29)	39.166	62.391	130.600	0.697	1.252	1.544	56.120	49.922	84.557
Rubber Products (30)	337.883	326.502	688.893	2.479	2.661	2.435	136.668	122.668	282.868
Chemical Products (31)	414.166	309.641	740.348	2.487	2.536	1.775	166.566	137.653	416.858
Non-metallic, Mineral Products (32)	121.782	91.529	414.650	2.428	2.302	5.269	50.148	39.750	78.691
Metal/Alloy Products (33)	422.573	403.856	921.450	5.594	5.773	9.272	75.530	69.956	99.373
Metal Products (34)	94.128	89.053	206.880	1.403	1.626	3.226	67.065	54.736	64.111
Machinery, Electrical, non-electrical (35-36)	181.435	129.487	299.487	1.881	1.444	2.070	96.423	89.680	144.644
Transport Equipment Products (37)	112.783	136.305	289.503	1.453	1.851	2.713	77.609	73.619	106.692
All Manufacturing	142.375	132.625	316.655	1.952	1.996	3.072	67.430	61.250	111.625

The capital labour ratio for almost all industrial categories have increased. The process of application of more capital have resulted increase in capital intensity. For some industries, capital labour ratio has more than doubled. In case of Wool, Synthetic Textile Products (24), capital labour ratio has increased from 102.658 during the year 1973-74 to 379.954 by the year 1992-93. The results show the capital labour ratio has changed marginally during 1982-83, however, it increased rapidly during later part of 1980s and in beginning of 1990s. This can be attributed to the policies that encouraged capital use in the production activities during this period. For 'All manufacturing', the average of capital labour ratio has increased from 142.37 in the year 1973-74 to 316.65 by the year 1992-93.

The same pattern appears when capital intensity is measured by capital-output ratio. Except two industries Textile products (26) and Chemical products (31) all other industries showed increase in capital output ratio. The increase was marginal in some industries and high in most of the industries. The increase in capital output ratio led to capital deepening in the manufacturing sector. The ratio for 'all manufacturing' sector was 1.95 in the year 1973-74 which has increased to 3.07 by the year 1992-93.

The process of 'capital deepening' largely influenced the various characteristics of the pattern of industrial development during the period of this study, i.e. 1973-74 to 1992-93, in the reference to faster industrialisation. The trends during this period also show that the labour productivity and capital intensity moved in the same direction, but the growth

of labour productivity is much lower. The labour productivity for all industries have increased, except Metal and Metal products (34) industry. As far as other industrial categories are concerned labour productivity showed an increase during the period of study (Table 3.3). The Rubber, petroleum products (30) showed highest increase in labour productivity from 166.56 in 1973-74 to 416.85 in 1992-93 conversely, Beverages, Tobacco products (22) showed lowest increase in labour productivity. For 'All manufacturing' labour productivity increased from 67.43 in 1973-74 to 111.62 in 1992-93. A detailed analysis of these ratios is required to be taken up before coming up with any conclusive evidence.

3.6-1 Trend Growth of Output, Capital Intensity and Labour Productivity :

The concept of output growth should be analysed with reference to the input growth ratios, then only it is possible to understand the problem of efficiency of factor used in any industry. Any steady rise in capital output ratios without the growth in output can be taken to be a sign of inefficient use of factors. For this purpose it is necessary to analyse whether the increasing capital output in the manufacturing sector is due to the rise in the share of capital intensive industries or rise in capital output ratio itself among individual industries.

The trend growth rates in terms of value added of various industries over the period from 1973-74 to 1992-93 show that most of the industries have achieved more than 5 per cent growth of output (Table 3.4) Ten out of sixteen industrial categories exhibit more than 5 per cent growth in real output

Table 3.4 : Trend Growth Rates of Value Added, Capital Labour Ratio and Capital Output ratios (1973-74 to 1992-93) (Per cent)

Industrial Category	Value Added	R ²	K / L Ratio	R ²	K / V.A Ratio	R ²
(CGI) Consumer Goods	5.62	0.90	-	-	-	-
20-21 Food Products	6.84	0.85	3.71	0.60	0.40	0.04
22 Beve. Tobacco	6.37	0.80	2.25	0.10	2.19	0.29
23 Cotton Textile	1.23	0.27	4.96	0.74	2.83	0.56
24 Wool, Silk Synthetic	7.71	0.96	7.66	0.80	4.39	0.73
25 Jute Hemp	0.04	0.06	3.64	0.43	1.95	0.11
26 Textile Products	11.18	0.94	4.64	0.68	0.80	0.07
29 Leather/Leather Products	7.54	0.85	4.80	0.84	3.52	0.61
(IGI) Intermediary Goods	7.00	0.95	-	-	-	-
27 Wood/Wood Products	2.11	0.55	7.19	0.89	5.06	0.86
28 Paper/Paper Products	2.43	0.72	7.14	0.87	6.33	0.90
30 Rubber, Plastic, Pet., coal	9.34	0.86	4.51	0.83	0.66	0.02
31 Chemical/Chem. Products	8.06	0.86	3.81	0.46	0.29	0.04
32 Non-Metallic, Mineral	7.21	0.93	8.40	0.78	4.47	0.67
37 Transport Equipment	4.81	0.88	5.11	0.85	5.57	0.60
(KGI) Capital Goods	5.00	0.94	-	-	-	-
33 Basic Metal Alloy	3.79	0.71	4.06	0.56	3.02	0.59
34 Metal Products	3.34	0.84	4.59	0.70	3.29	0.58
35-36 Machinery, Ele., non-ele.	6.35	0.98	3.31	0.44	0.19	0.05

This table presents the trend growth rates of output and capital intensity. The industries are classified into three categories, viz., Consumer goods industries (CGI), Capital Goods Industries (KGI) and Intermediary Goods Industries (IGI). The growth of output of individual industries and their corresponding changes in capital coefficients i.e. capital-output ratio and capital-labour ratio are analysed. It is observed that while output growth is at a moderate rate and the capital-intensity, on the other hand rose at high rates.

Among different industries, intermediary goods sector (IGS) registered the highest growth of 7.00 per cent per annum during the period 1973-74 to 1992-93 in terms of value added. The consumer goods category (CGI) registered 5.61 and the capital goods (KGI) recorded 5.00 per cent growth per annum. Most of industries individually have achieved respectable growth of output. Ten out of sixteen industries achieved growth rates of above 5 per cent per annum. Has this output growth been achieved due to use of more factor inputs and has the efficient utilisation of resources led to a considerable growth of output ? This aspect requires a detailed look and will be taken up later on.

As far as the industries in CGI section is concerned, Wool, Silk and Synthetic Fibre (24), Textile Products (26) and Leather and Leather Products (29), the growth rate achieved was over 7 per cent in value added. The Textile products achieved the highest growth rate of 11.18 per cent during this period. However the traditional industries in CGI section like Jute, Hemp Products (25) and Cotton Textiles (23) recorded low growth rates of 0.04 per cent and 1.23 per cent respectively.

In IGI goods section, the growth rate of output is moderate and is over more than 7 per cent in Rubber, Plastic, Petroleum Products (30), Chemical and Chemical Products (31) and Non-metallic mineral Products (32). However in this group the industries like Wood and Wood Products (27) and Paper and Paper Products (28) registered only 2 per cent of growth in output.

In KGI section, it was noticed that Machinery group (35-36) recorded highest growth rate in output which is of 6.35 per cent per annum. The Basic Alloy (33) and Metal Products (34) achieved over 3 per cent rate of growth.

However at the individual level, for most of the modern industries, the rate of growth of output is reasonably good. The changes in growth of output of industries like Cotton Textiles show that they have been losing their relative position and declining in its importance over time.

The analysis of output growth have to be viewed with the emphasis on input changes in this sector, because the 'capital deepening' industrialisation led to the application of more capital in the manufacturing sector. Capital being the most scarce factor in a less developed economy, the role of capital growth in output growth cannot be neglected. The steady rise in capital output ratio in the Indian manufacturing sector without proportionate growth in output can be considered as symptom of inefficient use of factors.

The Table 3.4 also presents growth rates of capital labour ratio and capital output ratio. The capital intensity can be measured both in terms of capital labour ratio or capital output ratio. For all individual industries K/L ratio shows a positive growth rate of more than 4 per cent growth. The only exception being Beverages and Tobacco (22). The highest growth of 8.40 per cent is observed for Non-metallic Mineral Products (32). Consistent increase in capital-labour ratio over this period shows growth in application of capital in this sector. The capital intensity in terms of K/O ratio also shows positive growth rate for the individual industries. From the table it can be seen that for all most all industrial categories, except Transport Equipment (37), the growth of K/L ratio is higher than K/V.A ratio. The rate of growth K/O ratio is generally high for intermediary goods and capital goods compared to consumer goods section. The highest growth is in the case

of Paper and Paper Products (28) which is around 6.33 per cent and Transport Industry (37) where the rate of growth is 5.57 per cent. It is necessary to find out whether the increasing supply of capital per unit of physical labour across Indian industries has led to increased productivity of labour or not.

The growth rate of capital output ratio ranges from 0.19 per cent in Machineries Electrical and Non-electrical (35-36) to 6.33 in Paper and Paper Industry (28). Among the three categories the growth rate of capital output ratio in consumer goods section is comparatively lower than that of other two groups. On the other hand, most of industries in intermediate and capital goods industries showed a high capital output ratios.

The liberal economic policies of eighties encouraged most of the industries to apply more capital goods. Modernisation of manufacturing sector also led to increased employment of capital which ultimately increased capital intensity in this sector. Meanwhile substitution of capital for labour led to near stagnation of employment of labour. Both rise in capital output ratio and capital labour ratio over sample period resulted into high growth of capital intensity in the manufacturing sector. The rise in K/L ratio across industries was more than 4 per cent per annum in almost all the industries. Only in 6 cases out of 16 the output growth rate is marginally higher than those of K/L ratios. These industries are three from CGI sector, two from IGI sector and one from KGI sector.

The rise in K/L ratio is the result of a simultaneous increase in capital itself and decline in size of employment in all these industries. In the factory sector, average

employment by a firm has been continuously declining and becomes low when capital employment is growing. On the other hand, productivity of labour which is found to play a dominant role does not show any outgrowing trend over time in creating surpluses. The pattern of capital deepening has not contributed much to productivity growth. This result needs a deeper look and a detailed analysis. The consistently widening gap between labour productivity growth and K/L ratio growth also needs a detailed look.

Table 3.5 presents to growth of labour productivity. The results of regression function with time (t) as independent variable and log of labour productivity (VA/L) reveals the following results. The trend growth rate of labour productivity for 'All manufacturing' is positive and significant at 1% level. All industrial categories with the exception of 'Transport equipment' (37) exhibit positive growth in the labour productivity. Eleven out of sixteen industrial categories exhibit statistically significant growth in labour productivity. However the growth in the capital intensity is observed to be much higher than the growth in the labour productivity. This is clearly seen from the graphs presented in this chapter.

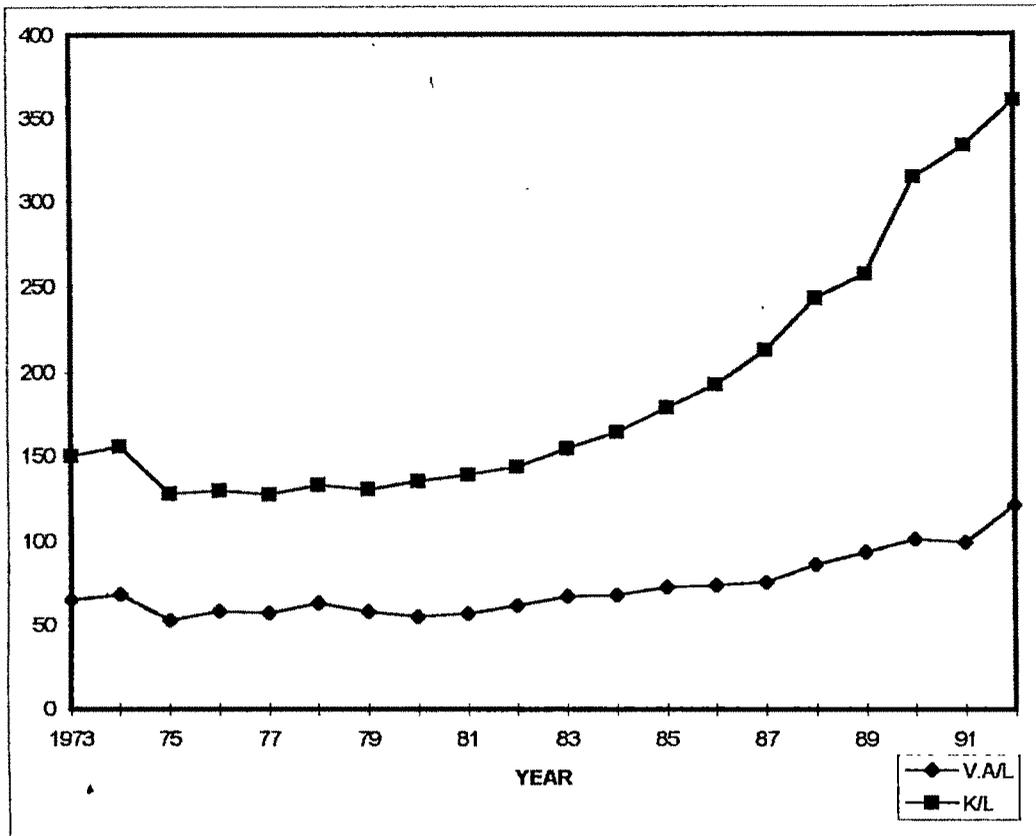
Table 3.5 : Growth of Labour Productivity [Log LPT = f (t)]

Industry Code	Constant	Time (t)	R ²	F Ratio
Food Products (20-21)	3.6984	0.0331 (5.6037)**	0.6356	31.4013
Beverages & Tobacco Products (22)	3.5685	0.0005 (0.0465)	0.0001	0.0021
Cotton Products (23)	3.5059	0.0213 (3.7813)**	0.4427	14.2988
Wool, Silk and Synthetic Products (24)	3.8483	0.0326 (5.9551)**	0.6633	35.4639
Jute and Hemp Products (25)	3.2296	0.0168 (2.3138)*	0.2292	5.3541
Textile Products (26)	3.4567	0.0544 (10.1364)**	0.8509	102.7485
Wood Products (27)	3.3929	0.0212 (3.4289)**	0.3951	11.7574
Paper Products (28)	3.9791	0.0080 (1.4582)	0.1056	2.1263
Leather Products (29)	3.8804	0.0128 (1.8883)	0.1653	3.5659
Rubber, Plastic & Petroleum Products (30)	4.6504	0.0384 (3.9582)**	0.4653	15.6673
Chemical Products (31)	4.6197	0.0352 (3.4803)**	0.4022	12.1131
Non-metallic Mineral Products (32)	3.5738	0.0393 (5.9453)**	0.6625	35.3477
Basic Metals & Alloys (33)	4.1877	0.0103 (1.3584)	0.0929	1.8453
Metal Products (34)	3.9872	0.0130 (3.0273)**	0.3373	9.1647
Machinery Electrical & non-electrical (35-36)	4.2554	0.0311 (6.0742)**	0.6721	36.8969
Transport Equipment (37)	5.8760	-0.0092 (-1.3703)	0.0944	1.8778
All Manufacturing	3.9177	0.0329 (6.6538)**	0.7109	44.27

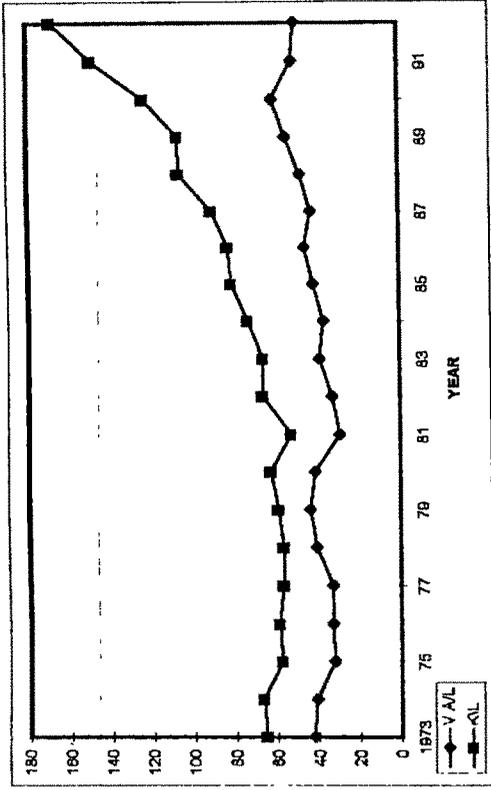
** Significant at 1% level

* Significant at 5% level.

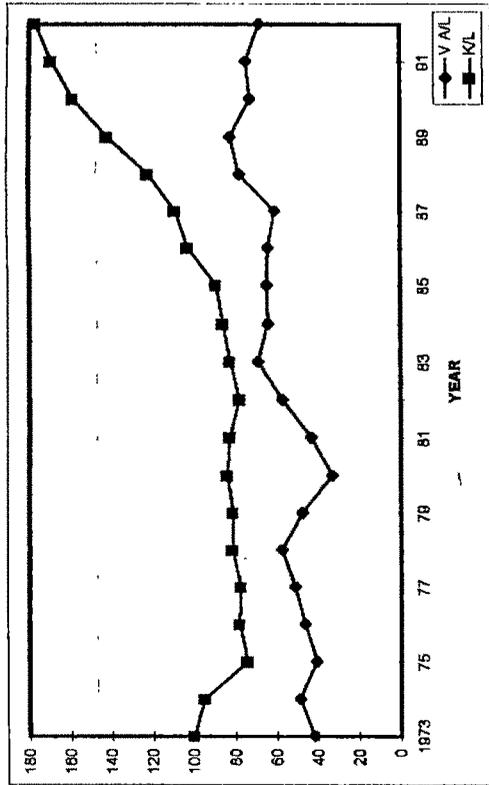
GRAPH - 1 MANUFACTURING SECTOR (ALL . MFG)



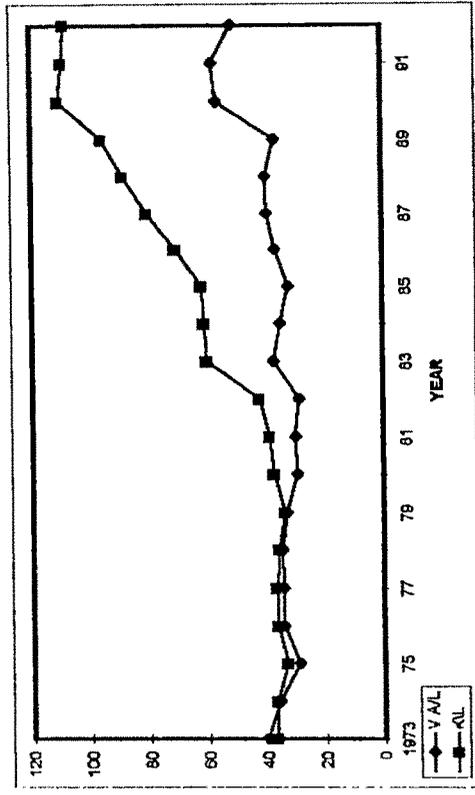
GRAPH - 3 COTTON TEXTILES (23)



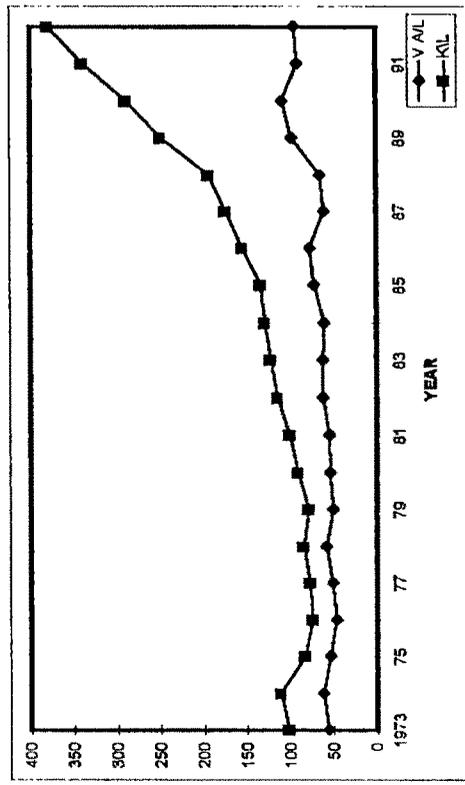
GRAPH - 2 FOOD AND FOOD PRODUCTS (20-21)



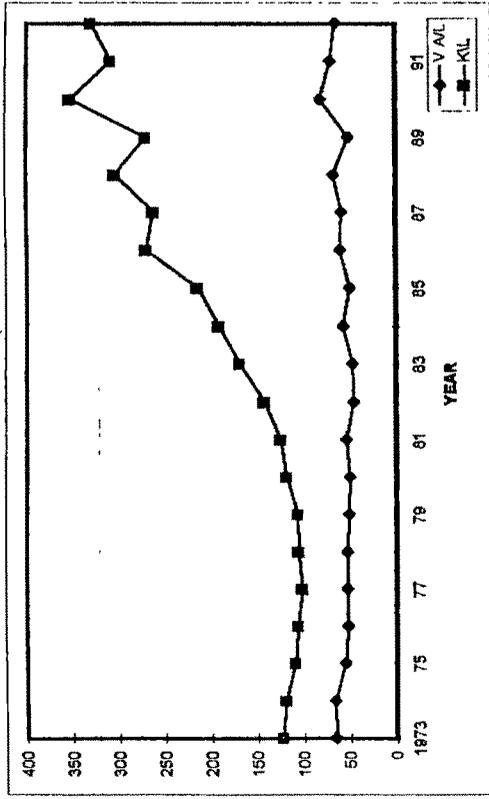
GRAPH - 5 WOOD AND WOOD PRODUCTS (27)



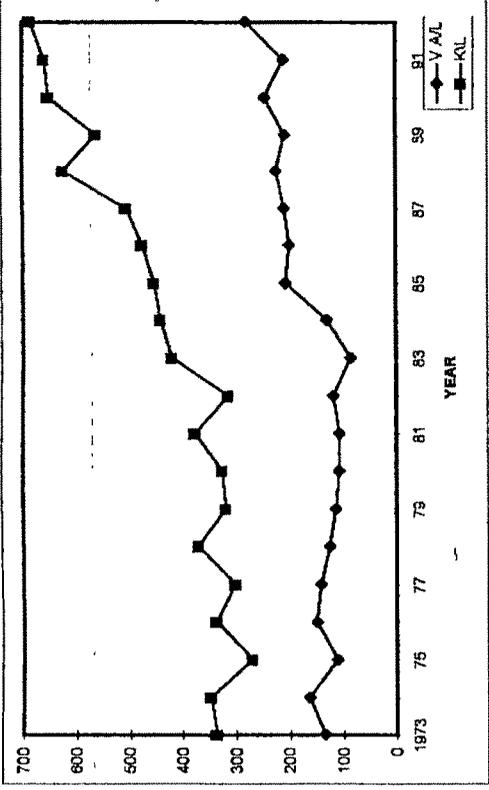
GRAPH - 4 WOOL AND SYNTHETICS (24)



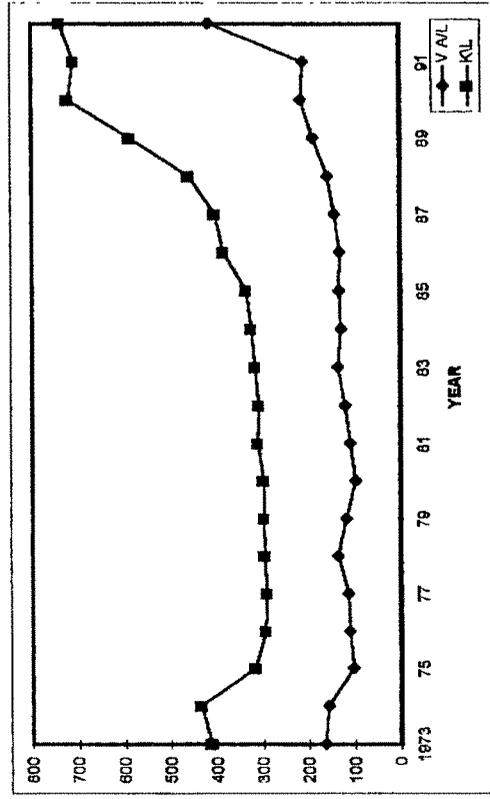
GRAPH - 6 PAPER AND PAPER PRODUCTS (28)



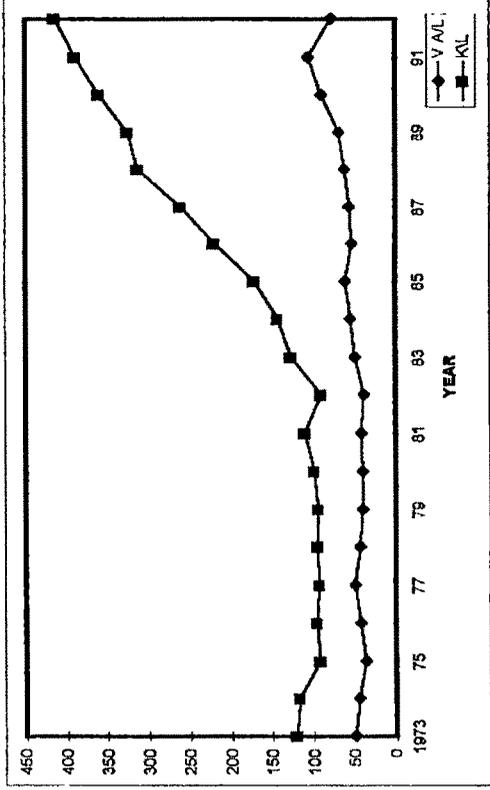
GRAPH - 7 RUBBER, PETROLEUM & PRODUCTS (30)



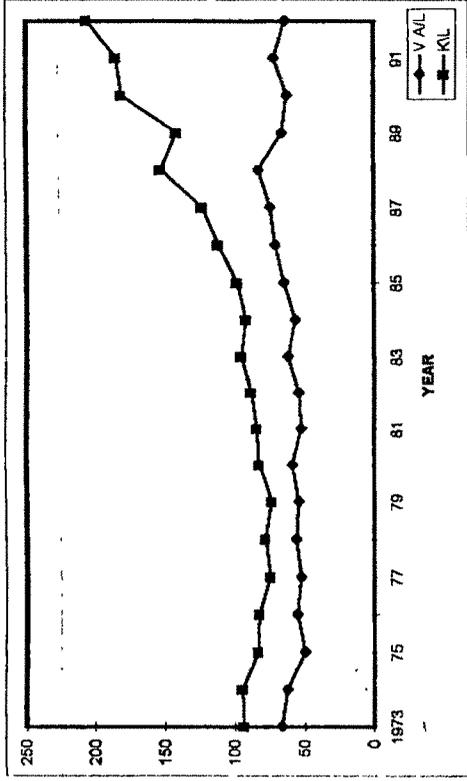
GRAPH - 8 CHEMICAL & CHEMICAL PRODUCTS (31)



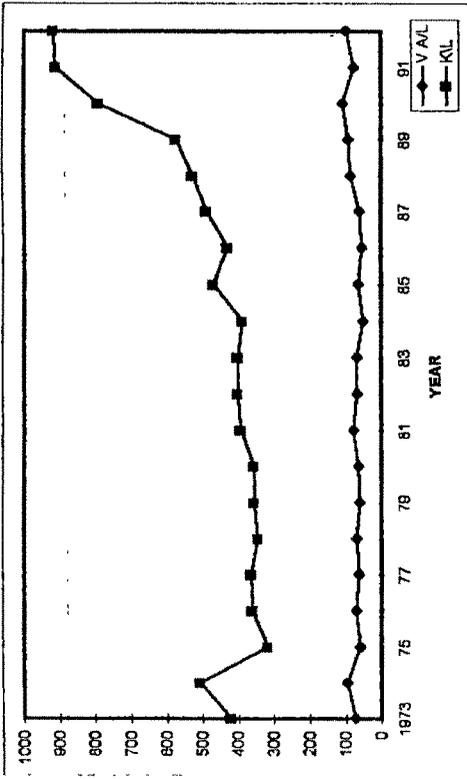
GRAPH - 9 NON METALIC MINERAL PRODUCTS (32)



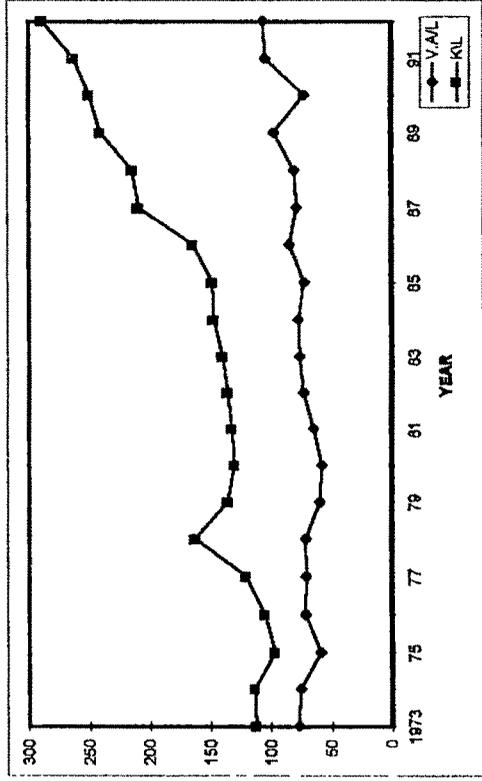
GRAPH - 11 METAL PRODUCTS (34)



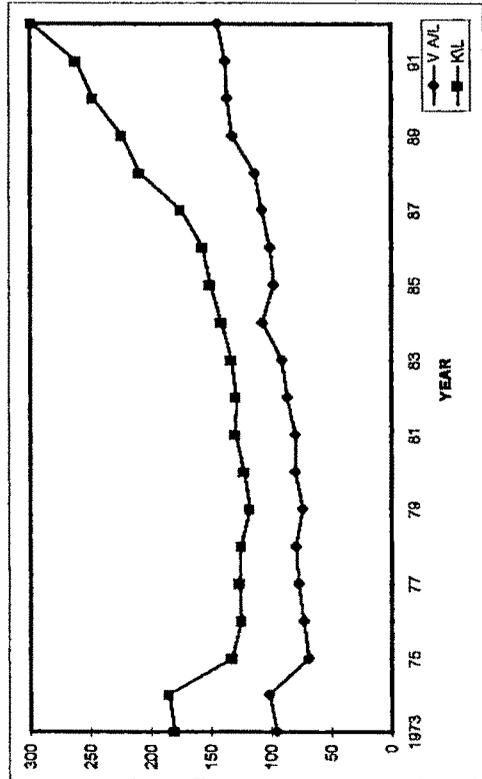
GRAPH - 10 BASIC METALS & ALLOYS (33)



GRAPH - 13 TRANSPORT EQUIPMENT (37)



GRAPH - 12 MACHINERY ELECTRICAL & NON-ELECTRICAL (35-36)



3.6.2 Decomposition Analysis :

In this section an exercise is conducted to analyse the growing capital intensity. The capital intensity can also be measured in terms of K/O ratios. As mentioned earlier, here value added at constant prices is taken as a measure of output. The change in the capital-output ratio could be due to various factors. Over a period of time the share of a specific industry might undergo change and thus have an impact on its capital intensity. The capital intensity may also rise even when the share in output has remained constant. Lastly the changes in both the share of value added and the capital intensity might contribute to the capital intensity. An exercise has been conducted to decompose the result and identify the major factor leading to growth of capital intensity in Indian manufacturing during the period 1972-1993. The method of analysis and the results are presented below.

The change in K/O ratios in 'all manufacturing' industry 'R' can be derived by weighted average of the K/O ratios in all 16 industrial categories. Here, the shares of the individual industries in the total value added of 'all manufacturing' are treated as the weights. Let K and O be the capital stock and the value added in the i^{th} industry respectively; R_i and V_i be the K/O ratio and the share of the i^{th} industry in the total value added respectively. Hence

$$R = (\sum K_i) / (\sum O_i)_{t+1} = (K_1)_t / (\sum O_i)_{t+1} + (K_2)_t / (\sum O_i)_{t+1} + \dots + (K_n)_t / (\sum O_i)_{t+1}$$

$$(i = 1 \dots \dots 16)$$

This can be rewritten as

$$R = \frac{(K_1)_t}{(O_1)_{t+1}} * \frac{(O_1)_{t+1}}{(\sum O_i)_{t+1}} + \dots + \frac{(K_n)_t}{(O_n)_{t+1}} * \frac{(O_n)_{t+1}}{(\sum O_i)_{t+1}}$$

$$\therefore R = \sum_{i=1}^{16} R_i V_i$$

$$\Delta R = \sum V_i \Delta R_i + \sum R_i \Delta V_i + \sum \Delta R_i \Delta V_i$$

Any change in R can be decomposed into three parts (i) $\sum V_i \Delta R_i$ which is due to change in K/O while share remaining constant (ii) $\sum \Delta V_i R_i$ which is due to changes in share of each industry while K/O remaining constant and (iii) $\sum \Delta R_i \Delta V_i$ is the interaction term.

In this study the values of $V_i \Delta R_i$, $R_i \Delta V_i$ and $\Delta R_i \Delta V_i$ for 'All manufacturing' are as follows.

$$\sum V_i \Delta R_i = 1.381612$$

$$\sum R_i \Delta V_i = 0.0850621614$$

$$\sum \Delta V_i \Delta R_i = -0.68526$$

$$\therefore \Delta R = 0.781416$$

The results shows $\sum V_i \Delta R_i$ value is 1.3816, the value $\sum R_i \Delta V_i$ is 0.085 and $\sum \Delta V_i \Delta R_i$ value is -0.6853. Therefore ΔR is 0.7814 which shows rise in K/O ratio itself the main cause of rising capital intensity in all industries.

The decomposition result of above analysis shows that the change K/O is not due to the rise in the share of value added in industries with high initial K/O ratios. Rather it is due the contribution of changes in K/O ratio itself. For the manufacturing sector as a whole, relative contribution of the rise in K/O ratios accounts for over 176 per cent for the period of study, where as the contribution of changes in value added is around 10 per cent.

Therefore, it can be observed that the high rate of increase in K/O in Indian manufacturing industries is the outcome of rising K/O ratio itself despite its technological status. It is noted that a moderate output growth has been accompanied by strictly incremental K/O ratio in almost all the industries.

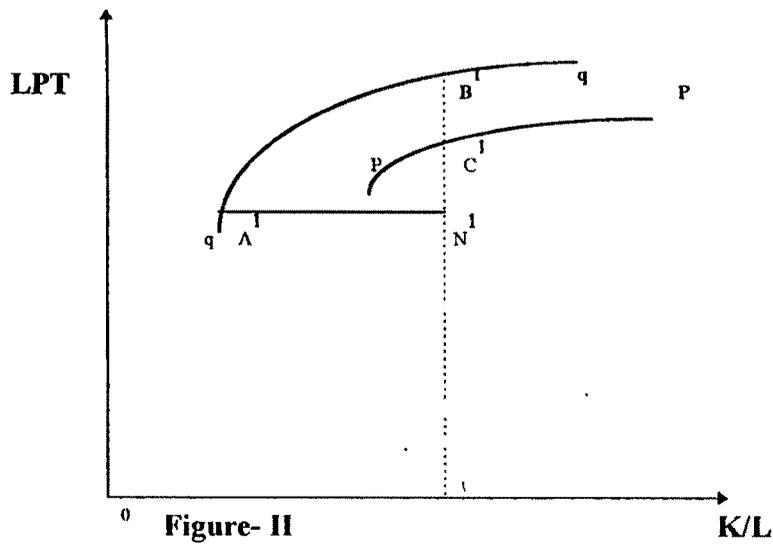
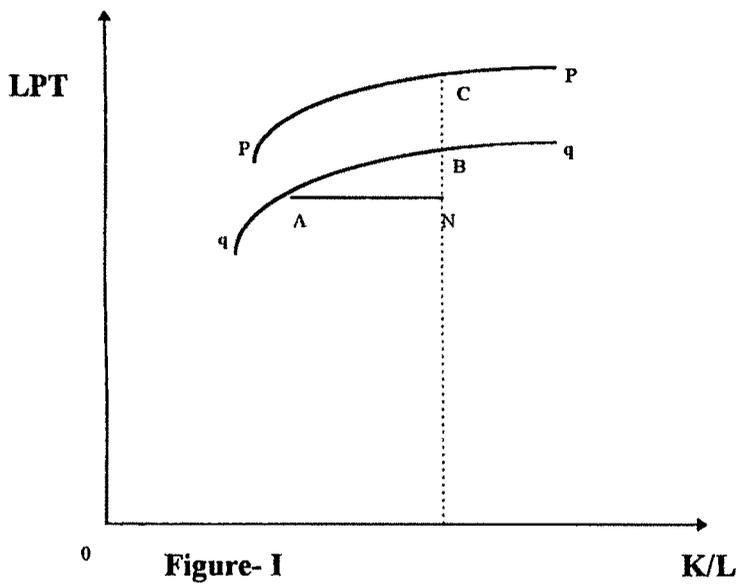
3.7 Measurement of Efficiency :

In developing countries efficient use of factors of production is necessary to improve the productivity and to achieve output growth. Capital, which is a scarce factor in these countries, should be efficiently utilised in the productive activity. The use of capital and the intensity of its use should be analysed in order to understand the efficient factor utilisation. Any steady rise in capital output ratio in manufacturing sector without corresponding growth in output can be primarily taken to be an inefficient use of that particular factor. For this purpose it is necessary to analyse whether the increasing capital output ratio is due to the high production base, initial high capital intensity, rise in the share of value added or rise in the capital output ratio itself.

The efficiency can be measured through varying productivity in relation to output coefficient in a comparative static framework. Adopting advanced technology is to raise the capital labour ratio over time. But if such adoption does not allow for the efficient use of capital, enough capital will not be released through accumulation.

A technique is said to be efficient when there is an upward shift of the productivity curve due to adoption of new technology

Figure 1 graphically represents the concept of technological adoption and efficiency in the less developed countries in a comparative static framework. The curve 'qq' is the focus of the labour productivity at different levels of capital labour ratios before adopting the technology at time 't₀'. After adoption of advanced technology, the curve shifts to 'pp' in the upward direction at time t₁ with corresponding higher levels of output labour ratio.



Let A be the position of an industry on the old curve 'qq' that shifts to C on 'pp' after adoption. This movement from A to C can be divided into two parts. The first is from A to B which means that with a more capital deepening process the productivity increases to B. But after the adoption of new technology using the same input coefficient, productivity rises to point C. Naturally, the segment CB represents the gain in productivity due to efficient use of inputs with the help of advanced technology.

On the other hand any downward shift of the productivity locus is the consequence of inefficient use of inputs. The movement from A^1 to C^1 in figure II composes of two parts A^1 to B^1 to C^1 . Here as a reverse case of Figure I, the drop in productivity from B^1 to C^1 is due to inefficient use of inputs even when productivity of labour rises by N^1C^1 . Thus rising productivity does not necessarily mean efficient use of inputs. In order to improve productive efficiency in manufacturing sector, productivity growth is considered as one of the important source. The productivity measurement and its related studies show that over a period of time the manufacturing has become more capital intensive.

Test of Efficiency :

As presented above the phenomenon of efficiency can be explained in terms of fitted curve (Figures I & II) exhibits the relationship between Labour Productivity (LPT) and Capital Intensity (K/L). For testing the efficiency the productivity curves have been fitted between LPT and K/L ratios using all 16 industrial categories data. The productivity curves are fitted with logarithmic relation and have been fitted for three points of time i.e., 1973-94, 1982-83 and 1992-93. Hence this analysis is comparative

static analysis. Using these three time points 3 sets of productivity curves are fitted viz., (i) Between 1973-74 and 1992-93, (ii) Between 1973-74 and 1982-83 (iii) Between 1982-83 and 1992-93. In each of the set the latter year has been given a time Dummy (i.e., $D = 1$ for latter year and $D = 0$ for earlier year) to capture the shift in the productivity curves between the two points of time under consideration. For each combination three logarithmic regressions are fitted. The equations fitted are.

$$(a) \quad \text{Log LPT} = \alpha + \beta_1 \text{Log (K/L)} + \beta_2 D$$

$$(b) \quad \text{Log LPT} = \alpha + \beta_1 \text{Log (K/L)} + \beta_2 D + \beta_3 [\text{Log (K/L)}]^2$$

$$(c) \quad \text{Log LPT} = \alpha + \beta_1 \text{Log (K/L)} + \beta_2 D + \beta_3 [\text{Log (K/L)}]^2 + \beta_4 \text{Log (K/L)}. D$$

The results of these equations are presented in Table 3.6. The results show that for the nine equations fitted the adjusted R^2 varies from 0.6115 to 0.6939 which indicates that the equations are good fit. The author's interest in fitting these equations is to test whether there is a significant shift in the productivity curve. The results show that between time periods (i) 1973-74 and 1982-83 and (ii) 1973-74 and 1992-93 there is a negative shift in productivity curve but the corresponding 't' value is not significant. However between the period 1982-83 and 1992-93 the shift is positive (for equations a and b) but again the corresponding 't' values are not significant. These results indicate that during the period of 1980's there is a positive shift in productivity curve thus indicating improvement in efficiency.

Table 3.6 : Logarithmic Relation Between LPT, (K/L) and Time Dummy

Equation No.	Coefficients of Independent Variables					R ²
	α	β_1	β_2	β_3	β_4	
<u>1973-74 and 1982-83</u>						
I (a)	0.7757	0.5013 (8.6343)**	-0.0356 (-0.9243)			0.6939
(b)	0.3844	0.8929 (1.3476)	-0.0364 (-0.9346)	-0.0953 (-0.5934)		0.6797
(c)	0.4152	0.8712 (1.2664)	-0.0739 (-0.3022)	-0.0922 (-0.5604)	0.0187 (0.1553)	0.6600
<u>1973-74 and 1992-93</u>						
II (a)	0.8065	0.4860 (7.1797)**	-0.0083 (-0.1574)			0.6546
(b)	0.7727	0.5175 (0.7681)	-0.0083 (-0.1556)	-0.0071 (-0.0470)		0.6344
(c)	0.7755	0.5143 (0.6474)	-0.0053 (-0.0138)	-0.0062 (-0.0328)	-0.0014 (-0.008)	0.6115
<u>1982-83 and 1992-93</u>						
III (a)	0.7460	0.4983 (7.1659)**	0.0231 (0.4306)			0.6793
(b)	0.2665	0.9479 (1.5008)	0.0238 (0.0040)	-0.1022 (-0.7163)		0.6661
(c)	0.1649	1.0681 (1.3951)	-0.0907 (-0.2256)	-0.1360 (-0.7289)	0.0529 (0.2875)	0.6462

** Significant at 1% level

* Significant at 5% level

3.8 Rising Fuel Intensity in the Manufacturing Sector :

In the production process, different factors are substituted depending upon factor prices or their efficiency measure. Modern production techniques employ more capital

equipments in place of labour. When more capital is used fuel is substituted in place of labour to operate the capital equipments. Greater the level of automation greater would be the use of fuel and it substitutes labour to greater extent. Therefore, the process of Indian industrialisation not only characterised with rising capital intensity over the years, it has also become more fuel intensive. The excess of fuel and its extensive use in the industries became more prominent as industries turned out to be more technology intensive. As a consequence, every plan requires more and more allocation of resources for the development of energy sector. It is noted that allocation in various Five Year Plans towards energy sector alone ranges from 25% to 30% of the public sector allocations.

The fuel or energy used in industries are in different forms i.e. Power, Coal, Oil, Natural Gas etc. The supply of energy requires large and heavy investment and massive import of petroleum which also adds to demand for more foreign exchange. In this situation, efficient fuel utilisation techniques of production should be applied to save energy. The problem of energy is a world-wide phenomenon and it is particularly important to the developing countries like India. In India more than 45 per cent of the commercial sources of energy is used in manufacturing and mining sectors. Therefore in future the planning must take into consideration of various possibilities of bringing about technological change that would substitute cheaper fuels such as gas in place of the expensive energy fuels.

Table 3.7 : Fuel Intensity in Indian Manufacturing

Year	20-21	22	23	24	25	26	27	28	29	30	31	32	33	34	35-36	37	All. Mfg
1973-74	0.0240	0.0190	0.0527	0.0570	0.0509	0.0168	0.0332	0.0766	0.0088	0.0709	0.0336	0.1902	0.1216	0.0327	0.0265	0.0332	0.0530
74-75	0.0214	0.0197	0.0650	0.0579	0.0496	0.0168	0.0343	0.0740	0.0099	0.0724	0.0209	0.1799	0.1093	0.0317	0.0233	0.0303	0.0510
75-76	0.0214	0.0234	0.0786	0.0469	0.0450	0.0139	0.0354	0.0829	0.0113	0.0799	0.0180	0.2052	0.1279	0.0314	0.0265	0.0318	0.0549
76-77	0.0229	0.0191	0.0826	0.0581	0.0445	0.0139	0.0362	0.0797	0.0107	0.0829	0.0182	0.2017	0.1272	0.0331	0.0232	0.0301	0.0552
77-78	0.0207	0.0202	0.0860	0.0554	0.0468	0.0148	0.0377	0.0892	0.0121	0.0795	0.0182	0.1849	0.1103	0.0339	0.0240	0.0310	0.0541
78-79	0.0174	0.0217	0.1073	0.0524	0.0509	0.0147	0.0367	0.0862	0.0114	0.0800	0.0245	0.2039	0.1459	0.0333	0.0238	0.0317	0.0578
79-80	0.0224	0.0243	0.0965	0.0533	0.0635	0.0143	0.0384	0.0941	0.0133	0.0783	0.0254	0.2071	0.1468	0.0321	0.0237	0.0374	0.0603
80-81	0.0291	0.0251	0.0812	0.0525	0.0503	0.0129	0.0355	0.0904	0.0156	0.0824	0.0145	0.1872	0.1251	0.0317	0.0203	0.0304	0.0557
81-82	0.0231	0.0235	0.0908	0.0474	0.0466	0.0116	0.0367	0.0863	0.0136	0.0837	0.0152	0.1846	0.1121	0.0294	0.0196	0.0316	0.0542
82-83	0.0182	0.0214	0.1211	0.0525	0.0554	0.0119	0.0436	0.0919	0.0148	0.0803	0.0346	0.2039	0.1192	0.0298	0.0209	0.0294	0.0595
83-84	0.0203	0.0224	0.1253	0.0598	0.0614	0.0145	0.0416	0.0962	0.0163	0.0864	0.0256	0.2156	0.1447	0.0345	0.0219	0.0296	0.0635
84-85	0.0219	0.0238	0.1161	0.0647	0.0756	0.0140	0.0413	0.1020	0.0152	0.0864	0.0184	0.2231	0.1522	0.0378	0.0232	0.0314	0.0659
85-86	0.0217	0.0265	0.1312	0.0491	0.0532	0.0131	0.0438	0.0978	0.0175	0.0781	0.0168	0.2154	0.1502	0.0352	0.0227	0.0295	0.0626
86-87	0.0221	0.0307	0.1219	0.0503	0.0567	0.0116	0.0369	0.0969	0.0144	0.0886	0.0200	0.2269	0.1395	0.0311	0.0205	0.0297	0.0623
87-88	0.0219	0.0283	0.1156	0.0550	0.0601	0.0149	0.0342	0.0950	0.0129	0.0903	0.0291	0.2218	0.1430	0.0348	0.0205	0.0293	0.0629
88-89	0.0200	0.0291	0.1061	0.0595	0.0686	0.0123	0.0338	0.0954	0.0136	0.0778	0.0244	0.2238	0.1388	0.0367	0.0188	0.0285	0.0617
89-90	0.0251	0.0296	0.0745	0.0577	0.0803	0.0126	0.0415	0.1259	0.0137	0.0787	0.0254	0.2389	0.1876	0.0455	0.0195	0.0279	0.0677
90-91	0.0238	0.0328	0.0740	0.0758	0.0790	0.0135	0.0359	0.1150	0.0156	0.0736	0.0254	0.2311	0.1918	0.0508	0.0167	0.0269	0.0678
91-92	0.0237	0.0332	0.0712	0.0569	0.0765	0.0129	0.0328	0.1291	0.0146	0.0725	0.0238	0.2288	0.1230	0.0492	0.0193	0.0309	0.0623
92-93	0.0249	0.0322	0.0742	0.0570	0.0726	0.0129	0.0353	0.1356	0.0131	0.0449	0.0235	0.2400	0.1451	0.0527	0.0192	0.0298	0.0619

Therefore, even the inter fuel substitutability is of crucial importance in India. The inter fuel substitution and price policies should consider the factor endowments position of a country are to be studied. This study analyses changing fuel intensities in Indian manufacturing taking fuel requirements per output as a criteria.

Table 3.7 presents the estimates of fuel output ratio for the period 1973-74 to 1992-93. The estimate for 'All manufacturing' sector shows a rise in the ratio from 0.0510 for the year 1973-74 to 0.0595 by the 1982-83 and reached the level of 0.619 at the end of the period 1992-93. The fuel intensity gradually increased and the sector employed more capital as well as more fuel to increase the output. The fuel increase in this sector is more than 20 per cent during this 20 year period. Table 3.7 also shows individual industry's fuel output ratios. For most of the industries, the fuel intensity has increased over this period. Among various industrial categories, Non-metallic Minerals (32), Metal & Alloys (33), Paper Products (28) and Chemical Products (31) are the most fuel intensive industries.

The table shows that out of 16 industries, Nine industries have experienced increase in the fuel intensity, for 3 industries it remained more or less constant and for four industries it has declined. The rise in fuel intensity ranges from 20 to 40 per cent in the rising fuel output ratio industries. For most of the industries the extensive use of capital equipment led to rise in intensity fuel in one form or other, thus leading to increasing demand for energy. However, industries like Jute, Hemp & Products (26), Rubber and petroleum Products (30), Machineries (35-36) and Transport and Transport Equipment (37) industries showed a decrease in fuel intensity. Some of these industries

are highly energy intensive industries and have adopted the fuel saving technologies. For these industries capital intensity is increasing, but their fuel intensity is falling. It means with employing of more capital the fuel consumption of these industries showed a decline, i.e. capital equipments in these industries became less fuel intensive. In other words the capital equipments in these industries are so designed to be fuel efficient. Therefore such type of technology contributes to the economy by saving considerable amount of fuel. Overall it is observed that Indian industries have not adopted the fuel saving technologies on a large scale. This could be an outcome of the inward looking policies of the economy. The Indian experience is quite contrary to the world experience wherein industries world over have adopted fuel saving technologies after the oil price hike of 70s.

3.9 Observations :

The above analysis of manufacturing sector leads to a conclusion that over the study period the sector became not only capital intensive but also fuel intensive in character. The labour productivity showed growth of 3 per cent, however it is observed the diversity between capital intensity and labour productivity increased. The growth in the capital intensity is observed much higher than the growth in the labour productivity. The increasing divergence between K/L and LPT growth seems to be more prominent and widespread for most of the industries. The industries are becoming more capital using without much improvement in productivity. The decomposition result shows that the changes in K/O ratio itself become major reason for capital intensive industrialisation. The study also shows that there is improvement in the efficiency of production process during eighties though the shift is not very significant.

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