CHAPTER - I

INTRODUCTION

Indian Economic planning assigned a crucial role for industrial sector. Since last fifty years the Indian economy has undergone a considerable amount of structural transformation and the industrial sector played an important role in shaping the economy. Considering the different objectives that were to be achieved, complete assessment of the sector would be difficult. However, a number of studies have tried to analyse various aspects and the changes which took place in this sector. The fundamental aspect of the industrial sector, among other issues, is related to the productivity performance of the Indian industries The studies relating to this aspect have gained much attention in recent times.

During pre-independence period and in the early planning period, the growth and developmental performance of this sector was not satisfactory, however, the sector achieved significant growth rate and has undergone a structural change during fifties and early sixties. The first five year plan (1951-56) emphasised the role of savings in raising the growth rate of the economy based on Harrod Domar Model The second plan (1956-61), through the Mahalanobis model, showed that a planned allocation of investment into the capital goods sector would mean subsequent higher investments and a greater rate of growth of output. The productivity related issues were not included as a important measure to improve the output growth. Special efforts were required to raise savings and investments in a developing country like India.

It is important, in the process of planning, to build a substantially wide industrial base and consequently produce a broad range of industrial products. The role of public sector, with its increasing share of investment, provided a strong base with the establishment of heavy industries which contributed towards widening of industrial base of the economy. However, the rate of growth of industry has been far below than targeted rates in early planning period. Along with productivity aspects, the development of technological capabilities and skills are also equally important to place the sector on higher footing.

Industrial development has played a vital role in the development of the country, particularly with regard to the objectives of structural diversification, modernisation and self-reliance. The process of industrialisation was launched as a conscious and determined policy in the beginning of planning to achieve these objectives. There was a general consensus that the country's economic backwardness was due to its very low level of industrialisation.

The Industrial Policy Resolutions of different periods laid down the basic framework and the roles to be played by the public sector and private sector. Large investments have been made in building up capacities over a wide spectrum of industries. As a result, Industrial production has gone up and the industrial structure has been widely diversified covering the entire range of consumer, intermediate and capital goods. Especially, the growth of public sector and capital goods industries developed the capacity to sustain the future growth of industries on its own effort. The first three five year plans characterised with liberal licensing policies. However later plans in the name of import substitution and self-sufficiency imposed restrictions, started with licensing and imposed restrictions on import of capital goods. This pattern of industrialisation led to a position of favouring displacement of any imports by domestic production.

The major hurdle which slowed down the licensing process was the critical shortage of foreign exchange After mid sixties the underinvestment in infrastructure and consequent shortages of Coal, Power and Rail transport led to under-utilisation of installed capacity in a wide range of industries, with a significant slowing down of the manufacturing sector. The policies to prevent the concentration of economic power, to protect weak producers from powerful producers and to promote indigenous technology led to inefficiency in the production process.

The policy with regional dispersion led to an uneconomic choice of location instead of allowing an economic scale of production at a single location. The lengthy licensing process and the time spent on the examination of applications resulted into the delay of projects. The projects which were started in one plan could not even start production in the next plan. Besides this, the productivity performance of the manufacturing sector was not satisfactory.

1.1 Emphasis on Capital Accumulation in Developing Nations :

The importance of capital formation in an underdeveloped economy like India was fully recognised by Indian planning authority. Nurkse, Rosenstein Rodon and Scitovsky emphasised savings, capital formation and resource mobilisation by state for faster economic growth and development. In this process, India has moved from a saving rate of 10 per cent at the beginning of planning to over 20 per cent in the eighties, but growth rate of the economy has only increased from 3.5 per cent per annum to 5 per cent during this period. It shows that apart from improvement in savings and capital formation there are other aspects which contributed to slower growth and development of Indian economy. These aspects need to be analysed in greater detail. Besides capital formation, effective utilisation of capital is important in a capital scarce economy like India. Efficient use of scarce resources becomes all the more important. The productivity related studies, emphasise the better use of factors of production can improve output of the nation. To justify the efficient use of factors, their productivity aspects have to be analysed. The changes in technology have greater potential towards contributing to the productivity of manufacturing sector. As such technological change can not be treated as separate factor of production, but indirectly the impact of change in technology can be measured in productivity analysis.

There are number of studies on Indian manufacturing sector analysing various aspects such as, performance, structural changes, economies of scale, productivity, elasticity of substitution, capacity utilisation, profitability, industrial dispersal etc.

1.2 Technological Progress and Productivity :

Technological progress, even though is considered as a major determinant of productivity growth, by and large much attention was not given to analyse its effect on productivity. Karl Marx treated technological progress as the vital mover in capitalist development. In the 19th century attention was focused on the optimal resource allocation. In the early part of 20th century technological progress was brought to the attention by economists like Schumpeter. But the analysis on technological progress as a separate aspect was not given due importance, eventhough a substantial part of output growth in the rapidly growing economies was attributable to technological progress and the forces shaping technological progress are mostly economic factors.

From 1940's onwards there is the emergence of a voluminous work on technological progress[1]. Timbergan (1942)[2] indicated significant technological progress in the American Economy at a rate over one per cent per annum during the late 19th and early 20th century. Abromovitz (1956)[3] and Solow (1957)[4] showed that between 80 to 90 per cent of the growth in output per head in the American Economy over the previous decades (1930's and 1940's) could not be accounted for by increases in capital per head and must, therefore, be due to some form of technological progress. Similar findings were reported by Kennedy and Thirwall (1972)[5] for other countries.

Technology in simple terms is defined as a body of skill, knowledge, procedures for making, manufacturing goods and services. Often, technology is identified with knowledge about machines and processes. Technological progress may take the form of new goods, new processes or new modes of organisation. Many a times technological progress and Total Factor Productivity (TFP) are used in economics as synonymous, but a distinctions have to be made between them.

To analyse the efficiency of different factors, their productivity aspects have been considered. Similarly, changes in technology has the greatest potential towards contribution to the productivity of manufacturing sector. As such technology can not be treated as separate factor of production, but the impact of change in technology can be captured through productivity analysis.

Kuznets (1966)[6] pointed out that rapid growth in industrial productivity was an essential element in the development and structural transformation of the present developed economics. Therefore aspects which directly or indirectly contribute to productivity growth should be analysed promptly. The type of technology used in production is reflected in capital which definitely affect the productivity. The application of such capital which is the outcome of change in technology always have some positive effect in productivity improvement either by increasing output or by decreasing cost of production. This change affects the manufacturing sector in diverse angles, like factor substitution, returns to scale, productivity improvements etc.

The concept of technological change has proved extremely useful in empirical analysis and as a consequence has been widely studied. The emergence of new technologies, new innovations, etc. have contributed for faster economic development of European countries Most of the technologies used today have been developed in the western countries in the post industrial revolution era. This process has contributed for faster growth and development of those countries, which also bought new breed of commodities into the market and world economic system opened up widely. Consistent eagerness to develop science and technology in developed countries introduced openness in international market. Such competitiveness gave way to discovery of new inventions and innovations. The sophesticated and advanced technology made producer to outsell his competitors by introducing superior goods to the consumers. Such process spread beyond national boundaries into the field of international trade and increased the productivity by manifold and finally set their countries on the path of economic progress.

According to A.K. Caincross[7], "Development as on going process rests on the constant injection of new technology and on the capacity to generate and absorb technical change". The role and contribution of technology in case of Japan for their faster economic development is well documented. The pre-industrial society of Japan was dependent on Agriculture as their main source of occupation. During the period of development, there was import of technology and the Japanese made serious effects to absorb, to adopt and to expand such technologies according to their own requirement and also place themselves to top on the international market. They also developed the capacity to generate new technologies of high standards.

The rapid economic progress of the western countries and Japan brought out, clearly, the contribution of technology as a promoting factor for innovations and dominance of their countries in the international market. The effective contribution of technology is found in the form of production of greater output, for shorter working hours, the creation of skilled jobs, better and easier maintenance facilities, safer working conditions, production of new and better goods of standardised quality, efficient use of raw materials, lower cost of production etc. However, measuring the input of technology quantitatively pose problems, because contribution of technology cannot be measured directly like other physical factors of production.

As mentioned earlier most of the modern technological changes introduced in different countries are mostly developed in the western countries, in accordance with their factor endowments. Generally expansion of industrial sector in developing countries leads to transfer of technologies through formal and informal ways Whenever new capital goods are imported from developed countries it also leads to inflow of new techniques and also carry new technologies to these countries. There are also technological transfers through foreign collaborations and establishment of multinationals in these countries. It is necessary to adopt a suitable technology which suits to the economic conditions of developing countries. Otherwise such direct transfers without considering domestic economic conditions could create inefficiencies in these countries.

1.3 Indian Experience of Technical Change :

The process of Indian industrialisation also experienced difficulties in technology transfers. One can find two extremes prevailing in Indian industry viz., modern industries and traditional industries exhibiting technological dualism. The modern sector applies new methods of production with application of dynamic technologies which are mostly capital intensive. Whereas the traditional sector applies backward and labour intensive methods of production. This pattern of industrialisation developed with huge technological gap within the manufacturing sector at different levels of labour and capital intensities emerged as a fundamental feature of Indian Industry.

The assumption of export pessimism and import substitution policies restricted import of capital goods and transfer of foreign technologies. A major weakness of such policies have led to relatively high costs and application of second best technologies and less efficient methods of production. It was considered necessary to protect Indian industries from foreign competition but the degree of protection and the time frame have not been spelled out properly to bring efficiency in production. The Sixth Five Year Plan (1980-81 to 1985-86) for the first time made reference to the importance of efficient import substitution. According to Ahluwalia (1991), the import substitution policy was one of the responsible factor for low TFPG. According to the study, TFPG for India during 1959-79 was negative and -0.2 per cent per annum which is disturbing when compared with 4.5 per cent for Korea during 1960-77[8].

However, the strategy of import-substitution did succeed in developing a broad base of industries on the basis of Lall's study of technology imports and exports by several developing countries. Lall (1984)[9] and Bruton (1989)[10] said, "One is entitled to conclude ... that India has created a much broader and deeper technological base than present either in Brazil or Korea or indeed any other developing country. It has accomplished this largely on its own. India has achieved substantial 'know-why' and has thereby created a capacity for continuing technological development and responsiveness in new fields and new activities".

1.4 Retrospects of Adoption of New Technologies :

In the twentieth century, technological change has apparently increased in its pace. These changes in the technologies have impact on the developmental process of an economy. Therefore economists are concerned about incorporating these changes into the model building. They have partially succeeded in constructing models in which technological change is viewed as the accumulation of production - oriented knowledge, which is subject to economic decision making and affects the industrial structure, the nature of markets and the government policy. The policies should enhance economic development by facilitating technological change.

One of the main reasons that the developing nations suffer from low productivities is due to the wide use of the traditional technologies in production. These countries can improve their production by increasing the productivity of various factor inputs and also by using modern methods of production, there by availing the new technology that exist in developed nations. This proposition to be implemented requires huge quantities of capital which is paradoxically the most scarce factor in these economies.

The industrial technology has the potential to transform the economies drastically and thus resulting in faster growth and development. Several examples illustrate the length of time required to effect such change. After the beginning of the Industrial Revolution in eighteenth century, the U.K. needed 58 years to double its real per capita income, it took the U.S.A. 47 years to do the same from 1839, in Japan the process involved 34 years from 1885, for republic of Korea, it was possible in 11 years from 1966, and in most recent case China it was done in less than 10 years.

Therefore developing countries, now are beginning to realise that access to natural resources, availability of cheap labour, improvement in capital formation etc. are no longer the overriding factors for achieving faster economic growth and also for the development of their economies. Increasingly comparative advantage is being based on technological capability and innovation and the ability to adopt new technologies in the production process. Automation and information for technology have been identified as the answer for offering new products at reasonable prices in less time period. Many developing countries, recently upgraded their production capacity due to adoption of such technological informations.

1.5 Retrospects of Transfer of Technology :

Apart from positive effects, the introduction of modern technology has its negative effect, particularly on employment in the modern manufacturing sector. Many developed countries are experiencing a worrisome pattern of growing unemployment, despite the fact that they have managed to increase Gross Domestic Product (GDP) through productivity increase by employing more efficient technologies. The most dreaded negative effect of technological innovations is that they lead to the displacement of labour and thus cause unemployment. However, some economists argue against this possibility.

They argue that the introduction of technological change leads to a reduction in labour costs, the decrease in cost would in turn be transmitted to consumers of the product If the demand for the product is elastic, demand would increase considerably leading to increase in employment If the demand is inelastic, some workers would be unemployed But since the goods are now available at a lower price, the consumers would have some money to spare which would be spent on other goods. Thus employment opportunities would expand in other industries. Thus in the long run no technological unemployment is possible. However, the trade unions protest against this change because the short-run consequences of displacement of labour cause serious problems. According to Philips, "economists are prone to stress the beneficial results of technical change its effect on productivity and consumption ... the trade unions are likely to regard technical change from the point of view of its effect upon the employment and income of the particular group affected"[11]

Technology has been described as one of the most decisive factors for industrial competitiveness in the end of the 20th century. Illustration can be found both in highly sophisticated technology industries, such as Electronics, Telecommunications, Bio-Technology, Iron and Steel etc. The benefits of use of such technological development extensively in production are manifold. It has increased productivity and flexibility, reduced wastages and product defects, optimal inventory levels, economies in management etc The use of technology influence the ability of industry to modernise and compete in world markets.

In this study, the structural change of industries, productivity performance, total factor productivity growth and the contribution of technological change in the Indian manufacturing sector are analysed.

1.6 Methodology :

There are considerable number of studies both at academic and policy making level on the productivity and growth of Indian industrial sector. Comparisons of various results of these studies have to be interpreted have to be done with certain amount of caution as there are certain degree of variations in the use of data and definitions of different variables analysed. Different studies use different base years and employ diverse definitions of the variables. The majority of work conducted in this field is for pre-liberalisation period. The present study uses a number of tools to examine the productivity growth and contribution of technical change in the manufacturing sector.

For analysing factor intensities like capital intensity, fuel intensity, partial labour and capital productivities, the ratio analysis is made use of. These are the conventional methods of measuring productivity, but these measures have certain limitations In a situation where capital intensity is increasing over time, partial productivity measures such as labour productivity may show an increase but this is more of a reflection of rising capital-labour ratios rather than real productivity increases.

Labour productivity may increase because of factor such as learning by doing, experience, improved skills and better and more machines to work with. However the rising capital output ratio will show a bias of increase in partial labour productivity and partial capital productivity will understate the increase in the pure productivity of capital

These problems in partial factor productivity (PFP) can be overcome by using the Total Factor Productivity (TFP) There are various measures of TFP which differ from one another. In most of empirical studies of TFP use either the Kendrick Index[12] or

Solow Index[13]. In this study also Kendrick and Solow indices have been used to measure TFP. The major differences between the alternative indices of TFPG arise from the different assumptions with respects to the elasticity of substitution i.e. how different factors may be substituted for each other in response to a change in the relative price of factors.

Kendrick index of TFP is based on Linear production function which assumes infinite elasticity of substitution between the factors of production. The Kendrick index is the ratio of value added in production to the weighted average of the two factors of production. Here the weights taken are the base year factor shares in value added. Solow assumes a more 'general neo-classical production function', where the elasticity of substitution need not be a constant. The growth of TFP is measured as the difference between the rate of growth of value added and the rate of growth of total factor inputs. Besides these, production functions viz. Cobb-Douglas (CD) and Translog production functions have also been fitted to estimate productivity growth, returns to scale, technical progress and elasticity of substitution.

Translog production function allows elasticity of substitution to be variable and does not require the assumption of technical change which is of a Hicks neutral type. The Divisia index is a discrete approximation of the continuous translog function. Translog is a flexible functional form of production function which is a second order approximation to any arbitrary production function which is twice differentiable It not only accommodates the discrete time analysis, but also imposes fewer a priori restrictions on the underlying technology of production.

1.7 Data Base and Definitions of Variables :

This study is for the time period from 1973-74 to 1992-93 and the basic data source is Annual Survey of Industries (ASI)[14]. Gross value added is expressed at constant prices is taken as the measure of output. The mandays of labour is taken as the measure of labour input. Net Fixed Capital Stock (NFCS) at constant prices is taken as the measure of capital input. In this study all the monetary variables are expressed at 1980-81 prices. As mentioned earlier in the present study, the time series data covering 16 major industrial categories (2 digit level) for the time period 1973-74 to 1992-93 is analysed.

In order to prepare estimates of productivity and to fit production functions, the annual data on raw material, gross output, value added, capital stock, employment, fuel consumed etc. are collected and the study covers all major industries of the organised manufacturing sector The values are adjusted to represent at constant prices (i.e. 1980-81 = 100) The price deflators used for the output and value added are whole sale price indices of respective commodities.

Value added can be obtained by two different ways; (a) the single deflation method (VASD) and (b) the double deflation method (VADD) respectively. In the single deflation method the value added (at current prices) is deflated by wholesale price index (WPI) of respective commodities. The value added thus obtained will be denoted Value Added Single Deflator method (VASD). In the double deflation method, the value of output is deflated by an output price index (WPI) and the value of inputs (raw materials) by the corresponding price index (WPI) The value added thus obtained is denoted as Value Added Double Deflator method (VADD) The value added estimated by these two measures could be different. For this study the value added by single deflator method is made use of

The Goldar's study on productivity have worked with the value added at constant prices as the measure of output, i.e., productivity growth is arrived at by deflating nominal value added by an index of manufacturing prices. This measure ia also not devoid of criticism Such a measure is valid only if the price of materials relative to the price of output is more or less constant for the period of analysis. When this relative price is changing, estimated productivity would vary inversely. Bruno (1984)[15] and Stoneman and Francis (1992)[16] pointed out the biases inherent in using single deflated value added method.

1.7.1 **Measurement of Output :**

In this method the value added at current prices as reported in ASI data is converted to constant prices by appropriate deflator. Here again different deflators can be made use of. It becomes necessary to specify the production function in terms of labour, capital and output. Majority of the earlier productivity studies have preferred the 'value added' as a measure of output. Again one can choose between net value added and gross value added. Dension (1969)[17] regards both gross and net measures as legitimate for productivity analysis. This study uses gross value added and uses single deflation (VASD) method.

1.7.2 Measurement of Labour Input :

For the measurement of labour input, the alternatives available are man hours, mandays, number of employees, wages paid or total emoluments. Though it appears that measurement of labour is quite simple but it is not so because of the fact that the labour is a hetrogenous commodity with different skill levels, education levels, sex and more importantly the environment of work. Taking number of employees for measuring labour input has limitations as it involves the assumption of 'workers' and 'other than workers'. In such case classification should consider quality change arising out of age, sex, educational and occupational composition of the labour force. For making such adjustments, Griliches (1967)[18] assumes that efficiency differences in different classes of labourers are reflected in their rates of remuneration.

Considering the imperfections of the labour market, it is argued that differences in remuneration need not be representative of efficiency differences for Indian manufacturing and accordingly it is hard to see why a weighted index of labour, using remuneration of different classes as weights will be a better measure of labour input than total number of employees In majority of earlier studies 'number of employees' has been used as the measure of labour. In the studies of Sastry (1966)[19], Sankar (1970)[20] and a few other attempts have been made to take into account quality changes of this nature by weighting different components of labour by the rates of remuneration.

However, in this study to avoid heterogeneity of workers and other employees mandays are taken to measure labour input This measure captures more information than number of workers as it takes into consideration the actual work hours or mandays of labour used in the production process. As mentioned earlier this measure is also not devoid of limitations In Indian manufacturing sector which is said to have 'over staffing' in certain segments, mandays may not be an appropriate measure either.

1.7.3 Measurement of Capital :

The measurement of capital stock is a controversial issue both in theory and practice. It is seen that there are differences with regard to the measurement of output and labour input but these are considered to be minor. Considerable differences are observed with regard to the measurement of capital input In fact, the differences in productivity estimates between studies are largely attributed to the differences in capital estimates. Therefore more care has to be taken with regard to the problems related with the measurement of capital.

The concept of capital is difficult to define; in ordinary sense it refers to individuals command over the financial resources, in economics it represents one of the four most important factors of production. Therefore the concept of physical assets of a firm is taken for consideration of capital. However the hetrogeneity makes the aggregation of different types of capital goods into one group difficult. Hence to estimate the stock of capital one has to take resort to the valuation of capital. Moreover, the form that capital goods taken is constantly changing with the passage of time, largely due to technological progress. Therefore the time element also have to be considered in capital estimation

After a careful examination of the problem of capital measurement, E.F Denison (1967)[21] questions, "How are these capital goods, build at different times, at different costs and with different performance characteristics, equated in the construction of the series for value of capital stock measured in constant prices" ? Hashim and Dadi (1973)[22] have summarised the problems involved in defining and measuring capital in five main reasons.

(a) Capital is a composite commodity made up of different types of capital goods - each with its own characteristics and durability.

(b) The composition of this 'composite commodity' keeps on changing over time. A machine which goes out of productive use may not necessarily be replaced by the same type of machine. It might be replaced by altogether a different type perhaps more productive and yet not necessarily more costly. Thus the problem of product change

(c) The future productivity of a capital asset is not exactly measurable, since a capital asset is productive over a considerable period of time and future is unpredictable. This renders utility measurement of capital goods immensely difficult.

(d) The capital stock existing at any time has no linkage with current market valuations

(e) The productivity of a capital asset might not remain the same over its life time. And this leads it difficult even to measure the capital with reference to its original cost. This raises the controversy over the methods of depreciation and the concepts of replacement costs

While making an estimate of capital, important choices arise with regard to depreciation and obsolescence On this issue Kendrick (1956)[23] states as non-permanent assets age, their contribution to net output declines, this is the result of declining gross output capacity, increasing maintenance and repair costs and creeping obsolescence on old equipment, not only when the installation of new equipment leads to reduced product prices or higher factor prices, but also when the old equipment is utilised less intensively or in less productive activities. Empirical and theoretical considerations suggest that these effects may be assumed to occur gradually over the life time of a group of capital equipment".

While making an estimate of capital, it has to be taken into account the fact that the capital embodied in a specific asset goes on declining over time due to depreciation and obsolescence. The question of correcting capital series for depreciation in the context of Indian manufacturing is found to be a complicated problem It has been pointed out in several studies that the figures on depreciation given in the data sources do not adequately represent the actual capital consumption[24]. It has also been argued that the use of gross figures is justified in less developed countries on the ground that capital stock is used at approximately constant level of efficiency for a period far beyond the accounting life measured by normal depreciation until it is eventually discarded or sold as scrap[25]. Hashim and Dadi (1973)[26] point out that a large amount of expenditure is incurred by business firms on repair and maintenance, whose main object is to keep the assets in more or less a similar productive capacity. They argue that, since the main objective of such expenditure is to keep the productive capacity of capital assets more or less intact, such expenditure should be treated as reinvestment It is desirable to have an estimate of net capital stock for economic analysis if a fairly reasonable measure depreciation can be found out. In fact, the available estimates of depreciation are either tax-based accounting concepts or based on certain rules of thumb.

Goldar (1981)[27] reviewed both the theoretical problems and the shortcomings of all the existing estimates of capital stock for manufacturing. Roychaudhury (1977)[28] estimated net capital stock for the industrial sector following the perpectual inventory accumulation method (PIAM)[29]. Using the ASI data, considering the depreciation series at book value as a measure of capital consumption capital stock has been estimated. Since depreciation at book value is known as a gross overestimation of the actual figures, Roychaudhury's capital stock estimates suffer from serious bias. Pinel-Siles (1979)[30] solved this problem by adding the book value of depreciation to the net investment figures and deducting the estimated economic depreciation, which was assumed to be a fixed proportion of the preceding year's capital stock, to obtain the net investment. Hashim and Dadi[31] have estimated gross-net ratios for fixed capital after analysing the balance sheets of about 1000 firms covered in ASI. They provide the gross value of capital purchased during the period 1901-1945 and in each remaining year until 1960. This measure applied to the gross value of fixed capital in 1960 to obtain the yearwise value of fixed capital bought in the past. Most of the later studies for capital estimates are based upon Hashim and Dadi's work. Dholakia's[32] study estimates capital input using both net stock and gross stock measures at 1960-61 prices The study uses the gross-net ratios estimated by

Hashim and Dadi. The study by Roychoudary[33] estimates net fixed capital stock using both ASI data and NAS data.

For the present study net fixed capital stock at 1980-81 prices is used as capital input. The ASI data on Book value of capital, depreciation and net investment are made use of for estimation of the capital stock. In order to bring comparability of different years in NFCS, the changes in the capital stock between the consecutive years are taken to obtain a time series of net investment at current prices. When comparable data on depreciation is added a time series of gross investment obtained. Using the capital stock figures at replacement cost in the benchmark year and gross investment series at constant prices, the NFCS series, is constructed through perpetual inventory accumulation method. Thus this study uses NFCS for 'All manufacturing' and for sixteen major industrial categories for the period of analysis.

1.7.4 Measurement of Fuel Consumed :

The energy or fuel consumption became an important input in the modern industrial sector. The industrial growth rate in an economy is closely associated with the growth rate in the energy supply in the country. There is a necessity of steady supply of the needed type of energy for the efficient functioning of the manufacturing sector. As industries are becoming technologically advanced and capital intensive, the fuel consumption of this sector has increased There are different sources of energy depending upon the type of fuel used in the production process. The conventional sources are coal, petroleum and electricity and these sources are broadly referred to as commercial sources of energy in sense that consumers of energy from these sources have to pay a price.

In this study fuel consumed in each industry is considered to identify fuel intensity of a particular industry. Fuels consumed represent total purchase value of all items of fuels, coal, electricity etc. consumed by the industry during the accounting year It excludes that part of fuels which is produced and consumed by the factory in manufacture i.e. all intermediate products and also fuels consumed by employees as part of amenities. Fuel consumed includes quantities consumed in production of machinery or other capital items for factory's own case

A number of issues have been raised in the discussion above Some of these issues have been dealt in detail by researchers, however the conclusions of the various studies vary from one another. The studies use different data bases and diverse methodologies and as a result the results derived are not always comparable. The present study intends to analyse number of these issues. The following hypotheses are tested for in the thesis in various chapters.

1.8 Hypotheses :

(i) The policies implemented by the government through various plans have resulted in capital - intensive techniques of production in Indian manufacturing sector.

(ii) Is allocative efficiency applicable in Indian manufacturing where in a large part of the registered manufacturing sector is under public sector with administered product prices and employment of both capital and labour not being specifically related to profitability criteria ?

(iii) Indian manufacturing sector has become more capital using without a significant positive impact on productivity.

(iv) The new technologies introduced are not only capital intensive but are also fuel intensive. World over it has been observed that the new technologies lead to substitution of fuel for labour. It is hypothesised that the share of fuel in value added has remained more or less constant in Indian manufacturing.

(v) The simplest indicators of productivity are the 'partial productivity measures' and there can be as many partial productivity ratios as the number of inputs. The commonly used indicator is the labour productivity index, though economists consider capital productivity as a better index. It is hypothesised that with efficient use of factor inputs both partial productivity measures improve over a period of time.

(vi) There exists a positive relation between productivity growth and growth of output at the economy wide level The high growth attained during certain periods in the economy can be attributed to the increasing productivity growth of the factor inputs (TFPG) The study examines this hypothesis dividing the study period into two sub periods.

(vii) The factor inputs acting upon the material inputs produce output. The production process is said to be efficient if the returns to scale are increasing or atleast constant. It is hypothesised that Indian manufacturing sector is efficient.

(viii) In both growth accounting and the production function approaches, the technological change is treated as a residual. The technological change captures unexplained factors in the growth of output, beyond what can be accounted for by the growth of inputs It is hypothesised that in the Indian manufacturing technological change has contributed positively towards the output growth.

1.9 Chapter Scheme :

Chapter II presents the changing structure of Indian manufacturing sector during planning period. It also discusses the growth pattern of industries on the basis of public sector led growth. Chapter III discusses capital intensity in the manufacturing sector. It also analysis the trends in labour productivity and fuel intensity. Chapter IV presents partial and total factor productivity growth of manufacturing sector. The Kendrick and Solow indices of total factor productivity are presented and compared with other productivity estimates. Chapter V analysis productivity, technical progress, returns to scale and elasticity of substitution in the manufacturing sector based upon production function analysis. The Cobb-Douglas and translog estimates are presented for 'all manufacturing' and 16 major industrial categories. Chapter VI draws together the conclusions of the study and suggests an appropriate to policy mix that would bring out the improvement of productivity growth and the development of the economy.

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