DYNAMICS OF PRODUCTIVITY
IN
INDIAN MANUFACTURING INDUSTRIES

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CERTIFICATE

Certified that the thesis entitled "DYNAMICS OF PRODUCTIVITY IN INDIAN MANUFACTURING INDUSTRIES" which is being submitted by Ms. Ravi Kiran, in fulfilment of the requirements for award of the Degree of Doctor of Philosophy in Management, Thapar Institute of Engineering and Technology (Deemed University), Patiala, is a record of candidate's own work carried out by her under our supervision and guidance. The matter embodied in this thesis has not been submitted in part or full to any other University or Institute for the award of any degree.

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ABSTRACT

Since the Great Depression of 1930s, a spontaneous upsurge of interest has developed in measuring the performance of an economy by taking into account data on national income and productivity. The direction in which the economy is heading at a given period of time can be known provided there is a workable knowledge of various indicators such as national income. In case of analysis of productivity to gauge relative performance of individual enterprises a similar interest is discernible in various countries. For maintaining and sustaining a higher level of performance it is imperative that the productivity process is so geared and organised as to yield an optimum and progressively higher reinvestment potential in future. The surplus that the economy generates depends primarily on the qualitative, quantitative and efficient use of inputs in a system. An appropriate index of efficiency in the resource use is provided by the various productivity measures. Productivity analysis, thus, acquires great significance in the context of the growth of developing economies. In its wide sense, the concept of productivity refers to the relationship between economic resources used in production and the resultant output of goods and services. Productivity is thus, a war on waste and inefficiency; it is a way of life and an attitude of mind; it is a constant and continuous effort at improving things.

The drive or movement for higher productivity is the need of the day and the entrepreneurs whether they are in industry, agriculture or tertiary sectors should be conscious and fully aware of making

productivity culture should prevail so that the targets of the enterprise and the nation as a whole may be attained.

Productivity can be measured conventionally using indices like labour and capital productivity. A single yardstick to measure the productivity of any, manufacturing system, with so many inputs is really an oversimplification. One way to overcome this drawback is to compare output to a weighted combination of various inputs such as labour, capital, materials and various other inputs. This is called total factor productivity. The present study uses both partial and total factor productivity indices for analysing the trends in productivity in Indian manufacturing industries from 1973-74 to 1992-93. Partial productivity ratios show unit factor requirement or savings in the use of factors of production and total factor productivity indices indicate the overall efficiency in each industry. A detailed analysis of growth ratios of factor inputs (labour and capital), value added, labour productivity, capital productivity, capital intensity and total factor productivity is carried out for aggregate manufacturing sector and for two digit and three digit industries for the entire period, 1973-74 to 1992-93 as well as for sub periods, period I, 1973-74 to 1980-81 and period II, 1981-82 to 1992-93.

Capital-output ratios play an important role in dynamic growth models. This study examines trends in aggregate capital-output ratios and trends in capital output ratios in different sectors. An attempt is also made to trace the factors that influence productivity. Ordinary least square and stepwise regression techniques are used for analysing the

The estimates for total factor productivity growth rates for different sectors are generally quite low. A detailed analysis for pre-eighties and eighties onwards era shows that performance in terms of partial productivity and total factor productivity has improved in the latter period in aggregate manufacturing as well as for most of the sectors. The eighties onwards period is marked by an increase in value added in most of the industries. There are substantial variations in performance of various sectors. Water works and supply, gas and steam, cold storage, transport equipment and parts, nonmetallic mineral products and chemicals and chemical products show better performance than others on productivity front. The performance of cotton textiles, jute textiles, electrical machinery and repair group is sluggish over the period. For the period under consideration gross capital coefficients are more stable overtime than the net coefficients Interindustry variations in capital coefficients are quite high. Output growth and total emoluments turn out to be the most important factors affecting productivity. The regression results show that coefficients for output growth variable are positive and significant in all the industries. A positive relationship has also been observed between total emoluments and total factor productivity.

The analysis of the performance of the manufacturing sector draws attention to the low capital productivity. It is a matter of grave concern since it reflects low efficiency in the utilisation of capital. A sincere effort is needed to improve capital productivity.

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CHAPTER-I

INTRODUCTION

Productivity is the sine-qua-non of modern state and occupies an important place in the development and growth of the nation. In analysing the sources of economic growth in advanced countries economists have reached a conclusion that it is technical progress rather than capital accumulation or labour which contributes the most to the growth in output. The understanding of the process of growth in developing economies is still quite hazy and is subject to conjecture. A general notion that prevails is that the capital accumulation is the main source of growth because developing economies suffer from paucity of capital to begin with and their adaptation to newer techniques is rather slow. Indian planning and policy have been dominated by the concern for raising the levels of saving and investment in economy. The importance given to capital accumulation in Indian planning process is highlighted by an increase in saving and investment from 10 per cent of gross domestic product in 1950 to over 22 per cent in 1993. Resource mobilisation has, for long, been considered in splendid isolation from resource utilisation and it is only in recent years that complementarity between the two has come to be realised. Productivity growth is recognised as the key feature of economic dynamism today.

Kuznets (1966) pointed out that rapid growth in industrial productivity was an essential element in the development and structural transformation of the newly developed economies. Lindbeck (1984, 1986) drew attention to the poor record of developing countries in "speeding up the rate of productivity growth". While output in manufacturing in developing market economies increased by 5.0 per cent per annum during 1960 to 1981, the accompanying increase in labour input was as high as 3.7 per cent which implies that the increase in labour productivity was about 1.3 per cent. Productivity in developed economies increased at a rate of 4.0 per cent per annum for the period 1963-1973 and 2.8 per cent for 1973-1983, while in developing economies for the same period it increased at a rate of 2.8 per cent and 0.7 per cent per annum [Singh 1994]. Rostas [1948] has pointed out that the high and steady growth in production per man hour in United States has been the result of continued acquisition of technical knowledge, increased emphasis on productivity performance in all National Reconstruction and Development Plans.

1.1 THE CONCEPT OF PRODUCTIVITY

Productivity has become the buzz word of our times. The term productivity has been used in such a variety of senses, that it is exceedingly difficult to find out whether the term 'productivity' is synonymous with 'efficiency' or 'overall effectiveness' of a productive unit, be it a plant, a firm or a company. Productivity is an elusive concept that does not lend itself either to a clear-cut definition or easy computation. Productivity is a subject surrounded by considerable confusion and people employ the same term but mean different things [Fabricant (1969)]. Productivity is a word which we use broadly to express the overall efficiency relating to performance of industries Smith,A. (1776) referred to efficiency and specialisation, what in current nomenclature amounts to the concept of productivity. Although, there is no consensus on the definition of productivity yet everyone accepts it to be a measure of performance. No amount of economic juggling can alter the fact that in the long run, our solvency depends on the efficiency of our industries.

Productivity when defined with respect to any one input ignoring other factors in output-input ratio is termed as partial productivity. Partial productivity reflects the relative efficiency of the factor used; the effect of factor substitution as well as changing productive efficiency. Capital productivity is defined as a ratio of output to capital resources expended. The concept of capital used here relates to fixed capital. It includes plant equipment, buildings and construction. When output is divided by number of workers or man hours the result is termed as labour productivity. Productivity can be measured conventionally using indices like labour and capital productivity, but comprehensive estimate of efficient resource utilisation can be gained from total factor productivity growth as the latter includes, along with labour and capital efficiency, the impact of technological progress and human resource development, e.g., the learning curve, increased skill acquisition etc.

Dr. Balakrishna's (1958) work is one of the earliest done on productivity in India covering the period 1938 to 1948. The main conclusion was that overall productivity continued to decline in 1948 as in 1938 in Indian manufacturing. Krishna (1987) provides a detailed review of the studies of total factor productivity growth and reports that with the exception of the study by Hashim and Dadi (1973) all earlier studies for fifties and sixties report a decline in total factor productivity growth (TFP). Brahmananda's (1982) study reports a decline in TFP in the range of -0.2 to -0.6 per cent per annum for the period 1950-80. Banerjee's (1975) estimate of -1.6 per cent per annum relates to earlier period, i.e., 1948-1964. Mehta's (1980) estimate of large scale manufacturing sector for the period (1959-70) shows a greater decline of -1.6 per cent per annum for Solow index and -2.5 per cent per annum for Kendrick index. Goldar's (1986) estimate for large scale manufacturing sector and electricity was 1.3 for Translog and Solow and for small scale registered manufacturing sector it was 1.1 for Kendrick index and 1.2 for Translog. Ahluwalia's (1991) estimate for total factor productivity by Translog index is -0.4 per cent per annum.

The question of productivity growth in Indian Manufacturing sector is far from settled. First, there is the question of productivity itself. Three recent studies by Mohanty (1992), ICICI (1994) and Srivastava (1996) report conflicting results. Mohanty (1992) reports a deceleration in TFP growth in the 1980s. Mohanty reports declining productivity in the presence of improved growth of value added. ICICI (1994) reports negative growth till 1987, after which a turnaround is reported. The results reported by Srivastava 1996 are non conclusive. When the growth accounting method is adopted total factor productivity growth decelerates and is negative after 1985-86, the year seen by Srivastava (1996) as coinciding with liberalisation. On the other hand when a production function is fit, a higher rate of growth of total factor productivity follows from 1985-86. Balakrishnan and Pushpangadan (1994) point a deceleration in total factor productivity in the 1980's as compared to 1970's but Dholakia and Dholakia's (1994) study confirms the hypothesis of turnaround in TFPG in Indian manufacturing since 1980 if the weights for registered manufacturing sector only are used.

1.2 OBJECTIVES AND ISSUES

From the earlier studies for Indian manufacturing no clear cut picture emerges about the rate and direction of total factor productivity growth. Moreover, almost all studies conducted so far are too aggregative or wherever some disaggregation has been achieved, it does not reflect the underlying process of productivity. An important limitation of the earlier studies in the Indian context is that very little attention has been paid to the explanation of observed productivity change. Most research done till date is basically centred around the dimensions like growth and measurement of productivity but what factors determine productivity is an area where very little work has been done. Hence, it may be inferred that there is an ample scope for research in this field. Keeping in view the importance and scope for research in this area, the present study has been undertaken with the following broad objectives in mind.

1. Study of growth rates of inputs (labour and capital) and output (value added) for the period 1973-74 to 1992-93 and sub periods period I, 1973-74 to 1980-81 and period II, 1980-81 to 1992-93;
2. Study of trends in labour productivity, capital productivity and total factor productivity for aggregate manufacturing industries for the entire period as well as for sub periods;
3. Study of trends in labour productivity, capital productivity and total factor productivity for two digit as well as three digit industries;
4. Study of the capital-output ratios for aggregate manufacturing and for different sectors for the period 1973-74 to 1992-93 and
5. Analysis of the factors affecting productivity.

1.3 SCOPE OF THE STUDY

In this study, aggregate, two and three digit manufacturing industries as covered under Annual Survey of Industries are taken for the period 1973-74 to 1992-93. Productivity estimates at the aggregate level give only an overall picture. With a view to study the inter industrial pattern of productivity growth, an analysis has been conducted at disaggregate level, two digit and three digit level. So, the present study analyses the trends in productivity performance in the organised manufacturing sector at a detailed level of disaggregation with a view to understanding the productivity phenomenon over time and across industries. Productivity growth for any industry is basically the result of complex factors operating in the industry, some of which may be industry specific, while others may relate to overall industrial environment or the overall economic environment. An attempt has been made to study the influences of factors affecting productivity growth in individual industrial groups of manufacturing. Broad ranging constraints on productivity growth are many. There are important factors that vary across firms and perhaps also across industries, which are difficult to measure, e.g., management input and the quality of industrial organization. Data availability imposes serious constraints on experimentation in this direction.

1.4 DATA SOURCES

The basic data source for the present work is 'Annual Survey of Industries'. This survey is being conducted every year since 1959 by National Sample Survey Organisation and processed by Central Statistical Organisation. Annual Survey of Industries relates to the registered sector of manufacturing. The National Industrial Coding (NIC) 1970 was followed to classify factories from Annual Survey of Industries 1973-74 to 1988-89. NIC 1987 is followed for Annual Survey of Industries from 1989-90 onwards. According to recent reclassification of NIC, industry groups 30 (Rubber and Plastics) and 31 (Chemicals and Chemical

Products) have been interchanged. But, the same code name as in earlier study has been used in this study to maintain comparability. Data have been adjusted with respect to changes in classification.

The sources of data for wholesale prices is 'India Data Base' by Chandhok and 'Index of Wholesale Prices' by Ministry of Industry.

1.5 RESEARCH METHODOLOGY

The main objective of the present study is to analyse productivity trends in Indian manufacturing industries for the period 1973-74 to 1992-93. Productivity at the aggregate level gives an overall picture. With the view to study inter industrial pattern of productivity growth, analysis is done at two digit and three digit level of disaggregation. For time series analysis, secondary data have been obtained from various data bases relating to Indian manufacturing. The gross measure of value added is obtained from net value added and depreciation data as given in ASI. Value added is deflated by industry specific deflators. Labour input is represented by total number of persons employed and capital input is measured by estimates of gross fixed capital stock at replacement cost at constant prices. Perpetual Inventory method has been used for estimating capital series. The returns to labour are measured by the total of wages, salaries and benefits (total emoluments) and returns to capital are measured as value added minus the returns to labour on the assumption that returns to two factors of production exhaust the value added in the process of production.

In the study the focus is on the empirical measurement of (a) partial productivity (b) total factor productivity. Partial factor productivities measure the ratio of output to one of the inputs setting aside interdependence of the use of other inputs. An increase in factor inputs often may not bring about proportionate increases in their productivities. Sometimes an increase in one factor may influence the productivity of other factor for example labour efficiency tends to improve with the adoption of improved technology. Therefore, the measurement of productivity by single factor input (capital or labour would not be sufficient to interpret the trends of productive efficiency. As total factor productivity takes into account the productive efficiencies of both capital as well as labour, total factor productivity is a more comprehensive measure to understand the overall trends in productivity of both capital as well as labour.

Little attention has been paid in earlier studies to the explanation of observed productivity change. Taking the two-digit industry level productivity growth for the period 1974-75 to 1992-93 an attempt has been made to explain sector wise differences in productivity growth using regression models. Both ordinary least square regression and stepwise regression models have been used for analysing the factors affecting productivity. The reason for using all these methods of measuring technological changes is that technical progress cannot be measured precisely, only its broad trends can be traced. Each of these methods explains some components of technological change which are utilised for building the entire picture.

1.6 CHAPTERISATION

The study of productivity is an important aspect of the analysis of development. Productivity study has particular significance in the formulation of policies at the state as well as at national levels. Chapter I covers the need and importance of productivity in industries, clarifies the meaning of productivity and defines various types. The relative importance of productivity studies in India has been brought out by presenting a comparison of productivity level of Indian industries with those in developed countries and thereby a need for improving productivity has been registered along with the importance of conducting systematic detailed analysis to determine the dynamics of productivity. The outline of the study along with its objectives and limitations have also been covered in the chapter I.

Modern economists have emphasised that technological progress is a major determinant of economic growth. The earlier focus on capital accumulation has given way to productivity growth Chapter II reviews the earlier studies done on productivity. The review helps to know emphasis and direction of research being done, the time periods of the studies, the scope and limitations of studies conducted, e.g., partial or total factor productivity or both, the methodology adopted for measuring productivity indices, the conclusions drawn from these studies and objectives fulfilled and benefits accrued.

In chapter III, an earnest attempt has been made to define productivity. This treatise then discusses the different methodologies adopted in India and abroad to determine factor productivity. The Chapter also deals with the conceptual issues with regard to meaning and measurement of capital and basic data sources used in the present study. On the basis of these, a research methodology is built up to study trends in productivity in Indian manufacturing.

Chapter IV maps out a growth profile of the Indian manufacturing industries from 1973-74 to 1992-93. An attempt has been made to examine the growth rates of inputs and output. A detailed analysis is done for the entire period, i.e., 1973-74 to 1992-93 as well as for the two sub periods, period I 1973-74 to 1980-81 and period II 1981-82 to 1992-93. Chapter IV also provides an estimation of productivity trends at aggregate level as well as at two digit and three digit level of disaggregation with a view to understand productivity phenomenon overtime. This chapter also contains the capital output ratios for aggregate manufacturing and for two digit industries.

Having had general trends of productivity in Indian manufacturing an attempt is made in chapter V to isolate the main factors associated with productivity growth in the manufacturing sector. Ordinary least square regression and stepwise regressions are run between total factor productivity and factors affecting productivity.

Finally chapter VI discusses the inferences drawn from the present study, with those of the other studies reported in the literature. The main findings drawn from the present analysis are covered and conclusions are drawn. Based on this, the scope for future studies to be carried out in the important area of productivity has been suggested.

CHAPTER-II

REVIEW OF LITERATURE

2.1 INTRODUCTION

The objective of this chapter is three fold. First, an attempt has been made to place the productivity problem in the perspective of Economics. Secondly, it aims at identifying the areas of research on productivity-economy modelling where little work has been done on Indian economy and there exists an ample scope for study. Finally, observations based on the review of study are made. Accordingly, part I of this chapter discusses productivity problem in the context of economic theory; part II deals with the review of studies on the Indian economy and part III embodies the observations made on the basis of this review.

2.2 PRODUCTIVITY PROBLEM IN THE ECONOMIC PERSPECTIVE

Modern economic development hinges primarily on industrial and technological development. Infact, modern economic development cannot be explained satisfactorily in terms of labour and capital alone. A large number of theories of economic development have been propounded in the recent past. Different factors have been identified as determinants of growth in different growth models. According to some descriptive theories of economic growth, a purely structural change will raise the level of per capita income, when there is a shift from sectors of the national economy which require more labour per unit of output, to sectors that require less of it, others being equal [Clark (1957), Kuznets (1963), Lewis (1963)].

Other theories consider capital as the main key to development [Heller (1954)]. The process of capital accumulation is interactive and cumulative. Once the process gets started, it feeds itself on its own stream [Myrdral (1958)], Nurkse (1953)]. Keynes' static analysis pinpointed investment as a determinant of income and employment. Subsequently, the role of investment as a generator of employment and income in a static frame was easily converted into the role of leading factors of growth in a dynamic setting [Harrod (1949), Domar (1946), Kindleberger (1958)].

The modern economists emphasize the catalytic role the technological changes play in the growth of an economy. Empirical studies show significant contribution of technological change to aggregate growth. For developed countries traditional inputs play but a minor part in economic growth. The empirical work of some economists shows that economic growth of developed countries like United States of America cannot be explained in terms of capital formation alone when the technical attributes of labour and capital are assumed to have remained constant [Abramovitz (1956)]. This has brought about an appreciation of the role of technological changes as the prime mover of economic growth. In the developed countries research and development has been institutionalised and the technological advances have taken place in quick succession. Consequently, the techniques of production have changed very quickly in advanced countries. Imitation and adaptation of the techniques of production evolved. The adoption of these technologies provided a short cut to the developing economies for initiating and furthering economic growth [Kindleberger (1958)]. The new capital goods are emphasized as the carriers of more advanced and efficient techniques of production than those embodied in old capital goods [Solow (1962)]. In the narrow sense in which most of the economists have used the term, technology stands for capital goods and equipment and their structure. Technological change, therefore, stands for the change in historically acquired capital structure and the problem of economic growth is then the problem of accumulating a given amount and type of capital. But technological change brings about an increase in per capita income, either by reducing the amount of inputs per unit of output or by yielding more output for given amount of inputs. Technological changes of an economy therefore, refer to changes in the input-output relations of production activities [Mathur (1963)]. Consequently, as economy moves from lower to higher stages of development there occurs a shift from simpler to more modern and complicated techniques of production.

Whichever aspect of economic development we look at, be it industrial growth or performance or export performance, the underlying factors seem to be linked with productivity performance. Kuznets (1966) pointed out that rapid growth in industrial productivity has been an essential element of economic development of the newly developed economies. Hence an open-ended study of the productivity and economic development is the need of the time.

2.3 REVIEW OF STUDIES ON THE INDIAN ECONOMY

Many exploratory and interesting studies have been undertaken in India as well as in the other countries of the world in the field of productivity. A quick review of earlier work is essential to place the present study in proper perspective. Some salient features and broad findings of individual studies on productivity have been highlighted. The earlier studies are of two broad types:

- Studies on the registered sector.
- Studies on the unregistered sector

STUDIES ON THE REGISTERED SECTOR

2.3.1 Studies on the Registered Sector

Balakrishna's (1958) work is one of the earliest done on productivity in India. He studied overall productivity in Indian Manufacturing Industries for the period 1938 to 1958. He also studied partial productivity indices. The main conclusion of the study is that overall productivity continued to decline in 1948 as in 1938. There is a fall of more than 10 per cent per annum in labour productivity in 1948. Productivity improved after 1948. The indices for 1951 and 1953 show a remarkable increase in productivity. There was an 8 per cent per annum increase in productivity during this period. Rehabilitation of economy by 1951 has been the main contributor to this. In this study adequate attention has not been paid to the measurement of capital.

Another pioneering study by **Beri (1962)** estimates partial and total productivity indices for cement, cotton textiles, iron and steel and sugar for the period 1948 to 1955. Labour productivity has been taken as a ratio of value added and man hours. Man-hours used in labour productivity index are those worked by workers directly employed in factories In total productivity fuel and power, material input, labour and capital inputs have been considered. The study concluded that cement Industry and iron and steel industry showed an upward trend in productivity although it was not possible for it to meet the entire home demand. Sugar industry moved at a snails's pace. The cotton textile industry also did not show a happy state of affairs. Plant and machinery in this industry needed immediate replacement. Labour productivity, in general, showed a positive rate of growth in most of the industries. Among the four industries, cement industry registered the highest increase of total productivity (18.81 per cent per annum) as well as labour productivity (125.62 per cent per annum) The capital productivity declined during the period. Increased capital and increased power consumption must have been the most important factors in raising labour productivity. In the computation of Labour productivity man-hours worked by workers directly employed in industries are included. Man hours worked through contraction are not included. They take aggregate of 27 Census of Indian Manufactures Industries (CMI) out of 29 and comparable Annual Survey of Industries (ASI).

Krishna and Mehta (1968) attempted to measure productivity trends in Indian industrial sector for the period 1946-64 in large scale sector. Their study was also a time-series study. Productivity has been measured as value added per employee. They have observed an increase in labour productivity of about 42 per cent over the period 1946 to 1966. Capital productivity declined by 18 per cent. To form judgement about overall productivity, the study considers cost output ratios. These are compounded on the basis of reported figures in CMI and ASI data and no adjustment has been made for price changes. In this study the book-value series on capital stock is deflated directly by price index. The major weakness of this procedure is that it does not take into account the fact that the figures on capital stock as reported include assets of different vintage, bought at different points of time.

Sinha and Sawhney (1970) study wages and productivity in selected Indian industries for the period 1950-1963. This study estimates partial and total factor productivity for five Indian industries. It underscores that the highest increase in labour productivity is in cement industry (4.2 per cent per annum). Capital productivity and total productivity showed an upward trend in cotton textiles industry. They have emphasized accuracy in the measurement of capital stock and on account of it they claim that capital productivity has recorded an increasing trend. Total factor productivity increased in all the five industries, however, only cotton textiles industry showed a significant uptrend. Sihna and Sawhney observe a rise in Kendrick index of total factor productivity over the period 1950-63 in five major industries, namely, cotton textiles, jute textiles, sugar, paper and cement, which together constitute a dominant part of Indian manufacturing. The study is not for the aggregate manufacturing but for some selected Indian industries.

Chatterjee (1973) studied only labour productivity for the period 1946-58 and 1960-65. The study covers twenty six manufacturing industries for the first period and twenty five industries for the period 1960-65. The first period uses CMI data and the second period is based on ASI data. The author observed a rising trend in labour productivity in all the 26 industries except in rice milling industry in the first period. While comparing the two periods, the study found the rate of increase in productivity to be much higher in the former period than in the latter. The sharp upward trend in productivity may be due to the abnormal conditions in base year (1946). This study is based only on labour productivity and data for the period 1946-58 is CMI data and for the period 1960-65 the data employed is ASI data

Banerji (1975) analysed partial productivity indices of labour and capital and total productivity index. He used, Solow and CES indices. The study covers the period 1946-64. It divides the period into two parts 1946-1958 and 1959-1964. Considering the period 1946-58, it is seen that labour productivity as measured by gross value added per person, showed a decline in the year immediately following 1946, probably reflecting the unsettling impact of partition. After 1952, it picked up and crossed the 1946 level. Thereafter it continued to rise. Capital productivity index measured as a ratio of value added and fixed capital, declined over the period 1946 to 1968 and the rate of decline was much more than the rate of increase in labour productivity. All these tendencies were present in labour and capital productivities over the period 1959 to 1964. Labour productivity rose by about 18 per cent, capital productivity decreased by 38 per cent, capital - labour ratio more than doubled and shares of labour and capital remained constant. The total productivity indices showed decline till 1950. After this it rose gradually under the impact of first plan and the Korean war boom. After 1956, however, the index again showed a downward trend.

The trend in TFP index continued to decrease during 1959-64. On the whole, it was concluded that the performance of manufacturing sector was sluggish over the period 1946-64. While labour productivity showed significant uptrend, no evidence was found to indicate the presence of technical progress in the sector.

There were substantial variations in the performance of individual industries. The paper industry registered the highest rate of growth of labour productivity. It was followed by bicycle, sugar, jute textiles and cotton textiles in that order. In all those industries labour productivity was associated with substantial capital deepening. The performance of two oldest industries, the cotton and jute textiles appeared to be sluggish over the period. Neither of the two industries was characterised by technical progress. There is an evidence of technical change and economies of scale in sugar, paper and bicycle industry for the period 1946-63. Banerji's study uses CMI data for the period 1946-58 and ASI data for 1959-64. This study has not made appropriate data adjustments.

Hashim and Dadi (1973) have strongly emphasized the need for accurate measurement of capital. They point out that the data available on capital stock in Indian manufacturing from sources like Census of Indian Manufactures (CMI) and Annual Survey of Industries (ASI) do not give true estimates of existing stock of capital. This study covered the period 1946-64, with suitable adjustments, to make the CMI and ASI data comparable. Hashim and Dadi point out that statistical reporting for the large-scale manufacturing sector in India is inadequate and defective mainly in two ways: (i) only the written down (depreciated) book values of capital stock are reported and (ii) the book value is an aggregate of annual additions in the past, each addition being at different prices. Hashim and Dadi work out a methodology to convert the book values into gross values by using balance sheets of a thousand firms for one year. Analysis of these balance sheets yielded gross-net value ratio separately for (i) building and construction (ii) plant and machinery and (iii) tools, transport equipment and other fixed assets. Using gross-net ratios (GNR), thus obtained, the book value of assets (as reported by ASI) were converted into gross value for the year 1960. The gross value of assets in a particular industry in (category -i) for 1963 is obtained as :

$$G_i^{63} = N_i^{60}(r) + A_i^{61} + A_i^{62} + A_i^{63} \qquad \text{.........(2.1)}$$

where G = gross value,

N = net value (i.e. depreciated book value);

r = gross net ratio for 1960 and A = gross addition to capital stock during a year.

Gross value of additions say during 1963 is defined as:

$$A_i^{63} = N_i^{63} - N_i^{62} + d_i^{63} \qquad \text{.........(2.2)}$$

Where d_i is the depreciation allowed for the year on the particular category of asset i.

This further requires splitting of depreciation for each year. The rates of depreciation are not uniform for all the three categories of the assets. A study of balance sheets reveals that the average rate of depreciation on building and construction should be around 7 per cent, on composite group of plant and machinery around 9 per cent and on other assets around 12 per cent. Using this methodology, gross capital series were obtained at purchase prices of fixed assets. The adjustments for variations in prices require age-structure of the assets for each year. The series starts from 1946 and difference in year to year values along with some adjustments for annual retirements of the assets gives the additions during the two consecutive years. The value of accumulated capital assets in K^{th} year and t^{th} year's prices (K_t) thus, is expressed as:

$$K_t = \sum_{i=1}^{19} A_i \; (P_t/P_i) \qquad ....(2.3)$$

Where A_i is the addition in i^{th} year (i=1,........19, A_1 being the stock existing in 1946 and P_i and P_t are price indices of i^{th} and t^{th} years respectively.

For all the assets acquired before 1946, Hashim and Dadi have taken a simple average of price indices of manufacturing goods during 1919 to 1929 and 1940 to 1945, so as to use it as price inflator for all assets acquired before 1946. Thus, having obtained the age-composition of assets, these were converted into current prices by appropriate price index numbers. They have also adjusted the annual additions for changes in prices so as to express different components of the total stock of capital existing in any year in terms of one set of consistent prices. Thus, one adjusted series was obtained for the period 1946-64. Another series was obtained for the period 1960-64 covering complete ASI sector. Further, for the period 1960-64, industry-wise estimates have also been obtained at 2-digit level of classification of ASI. The capital series for the period 1946-64 relates to 28 ASI industries which are comparable to CMI industries. These 28 industries accounted for 54 percent of total value added and 52 percent of total workers of all the ASI industries in 1964. Industry-wise estimates of capital stock pertain to the total of ASI industries at 2-digit level for the period 1960-1964.

The average capital output ratio for CMI series for the period 1946-52 is 6.54 and for 1954-64 it is 5.13. The average for complete ASI series for 1960-1964 is 4.47. The output over the period 1946-64 has increased at an annual rate of about 5.1 per cent, labour at 1.4 per cent and capital at 3.4 per cent. These growth rates were higher for the period 1953-64, when output and capital both increased at about 6.1 per cent and labour at about 2 per cent annually. The annual increase in labour productivity (g-e) is about 3.7 per cent for 1946-64 and 4.1 per cent for 1953-64. Annual growth in capital productivity (g-k) has been 1.7 per cent for the entire period and almost negligible for the period 1953-64.

The rate of growth of output is divided into three components, i.e., that attributable to (a) growth in capital stock (b) growth in employment and (c) the residual factors generally termed as "technical progress". The conclusion of the study is that the largest contribution to rate of growth in output is due to technical progress, which is quite contrary to the conclusions of many other studies which don't make proper adjustments for statistical inadequacies in the reporting of capital. Contrary to other studies Hashim and Dadi observed a significant rise in total factor productivity since the Solow index increased by 52 per cent during the study period and the contribution of technical progress in the output growth was found to be 49 per cent. The rising trend of capital productivity is in sharp contrast with the findings of other studies mentioned above. This is mainly due to the difference in approach adopted for the measurement of capital. This study employs price index for manufactured articles for deflating investment series. An index based on machinery would obviously be more appropriate.

Mehta (1980) in a comprehensive study has calculated partial and total factor productivity indices for 27 large scale industries. The study also analyses inter industry correlation and parameters of Cobb Douglas and CES production functions. The inter industry correlation study throws light on the pattern of behaviour of economic variables. The Cobb-Douglas production function gives estimates of the marginal product of labour and capital, and sources of output growth and returns to scale. Through CES production function the elasticity of substitution and scale parameters are obtained. Each of these methods explains some components of technological change. The study covers the period 1953 to 1965. An attempt has been made to prepare comparable data from CMI and ASI sources.

The study uses data on fixed capital, working capital, total productive capital, number of persons employed, wages, salaries and money value of benefits, output, depreciation and value added. Fixed capital is deflated by WPI of machinery and transport (1961-62=100). Working capital is deflated by wholesale price index of commodities. Total productive capital consists of fixed and working capital both added to arrive at total productive capital in real terms. Value added and output figures have been deflated by relevant commodity prices from index of whole sale prices.

The overall results demonstrate that growth in output of industries like electric fans, electric lamps, iron and steel, chemicals, paper and paper board and confectionary has been quite high and sustained, whereas industries like cotton textiles, jute textiles and cement have had quite a low output growth. Labour productivity has increased significantly in industries like vegetable oil, chemicals, tanning, glass and glassware and insignificantly in matches, iron, and steel, and cement. However, capital intensity had not increased significantly in most industries, rather the reverse is true in general.

This study of the Indian manufacturing shows that overall efficiency of the industrial sector declined during the period understudy. The detailed analysis shows that the performance of some industries with diversified product ranges like bicycles, glass and glassware and electric fans has been fairly satisfactory, whereas in the traditional industries like cotton textiles, jute-textiles, matches and sugar the overall efficiency has declined. Studies on returns to scale show the existence of economies of scale in many industries up to late fifties. In sugar, chemicals, cotton textiles and iron and steel industries, increase in capital per person is quite significant whereas it declined in confectionery, fruit and vegetable processing, electric fans and electric lamps. In paints and varnishes, plywood, bicycles and sewing machines, it remained almost constant. In some industries, despite a rise in capital per person, it has not led to gains in labour productivity. Thus capital deepening in Indian industries is unwarranted and in many industries questionable. The analysis of Indian data has shown that labour productivity and capital cost increased significantly in consumer goods industry like vegetable oil, rice-milling and woollen textiles. In these industries capital has been substituted for labour. The elasticity of substitution is found to be significantly different from zero and one in many industries. In most cases it is low, which means that a higher quantity of capital (labour) has to be substituted for labour (capital) for same level of output.

To sum up the study shows that the rate of technological change in the growth process of Indian industries is not very significant. The only components of technological change in the growth process that seem to have affected the growth process are capital intensity and factor substitution. Infact, output changes have been accompanied by parallel changes in employment implying that the major source of output growth is labour input. The traditional industries showed an overall declining trend in efficiency. One fact that clearly emerges is that in overall sense, technological progress, unlike in developed countries, has not been a contributory factor in Indian industrial growth.

For macro-trends the study examines productivity trends of Census sector from 1959 to 1970. Labour productivity had an increasing trend, while capital productivity had a decreasing trend along with rising capital output ratio and capital labour ratio increased at a fairly fast rate. The index of total input increased five times (100 to 491) but the index of output increased to only 370. Total productivity index registered a decline. Solow's measure of TFP also showed a continued declining trend (-1.6). The result is that whatever growth of output has taken place is largely due to increased physical inputs.

In Mehta's study the book value series of data is deflated by price index of capital goods. The weakness of using deflated data alone is that it does not take into account assets of different vintage at different points of time.

Brahmananda's (1982) work incorporates both Neo classical and Classical methodologies and has the whole span from 1950-51 to 1980-81 in its preview. Brahmananda's estimates of growth rates are available for both registered and unregistered manufacturing. The figures regarding capital stock for registered manufacturing were taken from the paper by Narayan and Katyal Data were compiled for 1970-71 and 1980-81 using CSO estimates. Data regarding labour employed for three benchmark years 1950-51 1960-61 and 1970-71 have been taken from CSO's National Product books and figures for 1980-81 have been taken from Economic Survey for 1981-82. Value Added figures and gross output figures are at 1970-71 prices.

The study reports that net productivity of capital has fallen by as much as 40 per cent but net productivity per worker has increased by 2.25 times. Capital net output ratio has risen steeply. The study reports that capital stock has increased to nearly nine times and employment to only 2.25 times. There is an evidence of a shift of production in favour of more capital intensive commodities and for more capital intensive techniques. The real wage-rate has risen to nearly 2.12 times. However, the rate of profit has fallen by nearly 50 per cent.

Based on the distribution of weights for 1950-51, indices of composite factor quantity were obtained. By dividing the net product by the above index, indices of productivity change with 1950-51=100 were derived. The study shows an evidence of a rising trend in productivity during 1950-51 to 1970-71. But thereafter a falling trend is reported in productivity. Between 1950-51 and 1970-71 the simple index of composite factor productivity went up at an average annual rate of 0.70 per cent; thereafter it fell. However, on a chain index basis it appears that the composite factor productivity went up during the first decade at 0.77 per cent; during the second decade it went up at an annual rate of 0.87 per cent; but during the third decade it started declining. There is evidence, both on the basis of drift in capital productivity and in composite factor productivity, that from 1970-71 onwards diminishing returns on the net seem to have set in organised manufacturing. Though labour productivity rose, capital productivity seemed to be falling at an alarmingly fast rate. This is also reflected in falling tendency in the rate of profit. In other words, labour productivity did not increase at a high rate to overcome falling capital productivity.

In contrast to single factor productivity and the total factor productivity Brahmamanda's study uses a new measure, a classical measure between total gross output including (a) intermediate input (b) net output and (c) capital; and total gross input including (a) capital and (b) intermediate inputs which they designate as total Gross Output to total Gross Input measure of productivity (GOGI). In registered manufacturing, by working out the weighted index of all inputs (current inputs and factor inputs) and dividing the gross output index by the above, index of total productivity is derived.

The results showed that index of total productivity went up by 22 per cent during 1950-51 and 1970-71, thereafter it fell and the total factor productivity moved in the same direction. Brahmananda's study is aggregative, it doesn't consider the productivity at disaggregated level.

Review of earlier studies would be incomplete without the mention of two important studies conducted by Goldar (1986) and Ahluwalia (1985,1991). **Goldar's** study covers the period 1951-79. The period 1951-78 has been divided into two sub-periods 1951-65 and 1959-79. The sub period 1951-65 covers both CMI and ASI data and the second sub-period is based exclusively on ASI data. Goldar computed both partial and total factor productivity indices for manufacturing sector as a whole. Goldar's study uses Kendrick index, Solow index and Translog index of total factor productivity.

During the period 1951-65, the labour productivity and capital intensity showed an upward trend. The capital productivity recorded a decline of 1.14 per cent per annum. The average annual rate of growth was 1.27 per cent per annum during 1951-79.

In the second sub-period (1959-78) Goldar has observed similarity in the results of partial productivity and capital intensity as in the first period. Goldar's estimates of TFPG for a composite sector including large scale registered manufacturing sector tend to be relatively higher than the other estimates. The average annual rate of growth in case of the Translog index was of the order of 1.31 per cent per annum. This was also higher as compared with Solow and Kendrick indices which were of the order of 1.29 and 1.06 per cent per annum. Goldar's estimate for small scale registered manufacturing is very similar to that for large scale, i.e., 1.2 per cent per annum. Accordingly, Goldar has concluded that technological progress has contributed to output growth, though marginally, and growth in total factor productivity is sluggish.

Goldar also analyses the relationship between import of technology and productivity growth in Indian industries. Scherer (1982,1983), Griliches (1984) and others have shown that technological advancement is a major source of productivity improvement. These studies concluded that the rate of improvement in productivity achieved by a firm or an industry depends on research and development efforts of the firm/industry. Technological advancement is usually a major source of productivity improvement. But in Indian industries while there has been a significant inflow of advanced technology, there has been no appreciable rise in productivity. The failure of Indian industry to take adequate advantage of technology imports may be attributed to low volumes of production (small size of domestic markets), the government imposed phased manufacturing programmes, low research and development intensity of domestic manufacturing firms and slow progress in the development of indigenous technological capabilities. According to this study liberalisation would go a long way in easing the difficulties faced in expanding the potentialities of efficiency improvement offered by imported technology. In the new emerging economic environment, characterised by greater openness and competition, one would expect greater inducement for local research and development efforts and development of indigenous technological capabilities.

In Goldar's study work, two series of estimates are presented : one for the period 1951-65 and other for the period 1959 to 1979. The first series combines CMI data with ASI data. The two data sources are incomparable on various counts. ASI covers 63 industries, while CMI only 29. Although data adjustments have been made for 28 comparable industries but still some problems of comparability of data remain. The study uses a more aggregative deflation procedure (total value added at current prices is deflated by WPI of Manufacturing).

In the studies by **Ahluwalia (1985,1991)** for the period 1959 to 1985 total factor productivity growth for the registered manufacturing was -0.4 per cent per annum. During the two decades of the sixties and the seventies total factor productivity in the manufacturing sector declined at a rate of 0.5 per cent per annum. However, there is also a finding that in the first half of the eighties productivity growth improved. The dominant source of the acceleration in total factor productivity has been the growth of value added which rose from 5 per cent per annum during the period 1965-66 to 1979-80 to 7.0 per cent per annum in 1980-89. The measure of TFPG used in the study is derived from a Translog production function under the assumptions of competitive equilibrium.

$$\Delta\log TFP(t) = \Delta\log V(t)\ [(S_L(t) + S_L(t-1))/2]\ \Delta\log L(t)$$
$$- [((1-S_L)\ (t))] + (1-S_L(t-1)))/2]\ \Delta\log K(t) \quad \ldots.(2.4)$$

Where V, L, K, TFP and S_L denote value added, labour, capital ,total factor productivity and share of labour income in value added respectively.

A check on these estimates is provided by directly estimating alternative specification of the production function. An important feature of the improvement in TFPG in the eighties was that it largely reflected improvements in labour productivity measured in terms of output per worker. Capital productivity, i.e., output per unit of capital was -0.5 per cent per annum in the period 1980-81 to 1988-89 while for the period 1959-60 to 1979-80 the rate of capital productivity was -2.8 per cent per annum. The capital-labour ratio increased at a rate of 5.1 per cent in the period 1959-60 to 1979-80 and it was 8.0 per cent per annum in the period 1980-81 to 1988-89 while in 1965-66 to 1979-80 it was only 3.3 per cent per annum. Ahluwalia's (1991) study shows that the period of eighties is different as increase in labour productivity does not only reflect rising capital-labour ratios but represents pure productivity increases as reflected in strong performance with respect to total factor productivity growth as well. There is, however, another side of the view which is somewhat disturbing; the trend of employment in organised manufacturing sector which actually shows a decline in eighties at an annual rate of -0.5 per cent.

The consumer goods sectors were the leaders in the turnaround in productivity growth after 1979-80. The consumer non durables sector, which is one of the two largest sectors of manufacturing with a weight of over one third in the total value added experienced total factor productivity growth of the order of 5.2 per cent per annum in the first half of eighties. This was in sharp contrast to its negative/negligible growth in TFP in the earlier two decades. The consumer durables sector which has a much smaller weight of around 4 per cent in total value added in manufacturing also showed a rapid growth in TFP of the order of 6.6 per cent per annum in the first half of eighties. Even the intermediate goods sector which is the largest sector of manufacturing and which had been the worst performer, showed significant improvement although its TFPG continued to be relatively low, i.e., 1.4 per cent per annum. In case of capital goods, productivity growth improved considerably from 1.7 per cent per annum to 3.4 per cent per annum. According to Ahluwalia (1991) the reorientation of industrial policy framework which allowed for better utilisation of existing capacities and which emphasised the importance of infrastructure, had a significant effect on productivity. Employment during this period declined as industry adjusted to the over manning of the previous decade and a half and increasing use was made of contract labour to bypass the labour laws.

In order to provide a check on growth accounting estimates of TFPG, Ahluwalia's study (1991) also estimated production functions. The rich time series cross section data base of the study made it possible to estimate Translog production functions for the manufacturing sector and its use based sub-sectors. The production function analysis shows that there has been negligible and insignificant growth in TFP in manufacturing over the period from 1959-60 to 1982-83 and there is a distinct shift after 1982-83. The estimates for the sector as a whole also suggest that the returns to scale are not constant and that technical progress has a capital saving bias. Among the use based sectors, the hierarchy of TFPG remains much the same as with growth accounting estimates; the two larger use based sectors (i.e. intermediate goods and consumer non durables) have performed much worse than the two smaller sectors. The upward shift of TFPG was established in all sectors except in capital goods sector.

A comparison of India's productivity growth performance in the manufacturing sector with other developing economies suggests that India is far behind others. The far Eastern Tigers, i.e., Hong Kong, Singapore, Taiwan, Korea and many other economies, e.g., Argentina, Chile, Thailand, Egypt and Indonesia have done much better than India's negative negligible growth in TFP over the two decades of sixties and seventies. China is the only economy whose performance in terms of productivity is as bad as India's. High growth in China up to early eighties is largely due to much greater investment but not due to high productivity growth.

The analysis of inter industry differentials in TFPG highlights the importance of the growth. The adverse effect of the protective trade regime on productivity growth within the manufacturing sector is found to be significant. The analysis shows that the higher the degree of import substitution in an industry the lower is its growth in TFP. As regards relationship between capital labour ratio and TFPG, the econometric analysis shows that the higher the capital labour ratio in an industry, the lower is its growth in total factor productivity.

The principal source of data for Ahluwalia's study is ASI. The gross measure of value added is obtained from net value added and depreciation data as given in ASI. Labour input is the total number of persons employed and capital input is measured by the estimates of gross fixed capital stock at replacement cost at constant prices using perpetual inventory accumulation method. Data on net fixed capital stock at book value for the census sector was collected for the year 1960 at the detailed level of disaggregation for (i) land (ii) buildings and construction (iii) plant and machinery (iv) other equipment. The sample sector data were available only at three digit level of disaggregation for the net fixed capital stock at book value. Assumption was made that capital stock of a three digit industry group in the sample sector could be divided into its constituent industry groups in the same proportion as was the case with the capital stock in the same three-digit industry group in the census sector. The distribution of total net fixed capital stock at book value among four types of assets for each industry in the sample sector followed the distribution in the corresponding industry group in census sector. Census and sample data were aggregated to arrive at net fixed capital stock at book value for four types of assets. For estimates of gross fixed capital stock at purchase prices, Hashim and Dadi's Gross Net Ratios (GNR) were used. GNR for land was assumed to be unity. To convert the gross value of fixed capital stock at purchase prices to current prices Gross Net Ratio of Hashim and Dadi available for two-digit industry groups were used. Wholesale Prices Index (WPI) of machinery and machine tools with base 1970-71 was used to obtain capital stock at constant 1970-71 prices. The returns to labour are measured by the total of wages, salaries and benefits (i.e. total emoluments), while returns to capital are measured as value added minus the returns to labour. This is done on the assumption that returns to the two factors exhaust the value added in the process of production.

The limitations of the study are infact some of the limitations of ASI data. The survey data are subject to problems of variations in response and therefore, in coverage. The ASI data were deflated using the relevant wholesale prices as deflators.

Shilpa (1990) carried a statewise and industry-wise analysis of the trends in capital productivity for the years 1980 and 1989. The data for the analysis was collected from ASI. The ten major states considered for the study were Andhra Pradesh, Bihar, Gujarat, Karnataka, Madhya Pradesh and West Bengal. The seven major industries considered for the study were (i) manufacture of food products; (ii) manufacture of beverages; (iii) tobacco and tobacco products; (iv) manufacture of rubber, plastic, petroleum and coal products; (v) manufacture of chemicals and chemical products; (vi) basic metals and alloys industries; (vii) manufacture of electrical machinery, apparatus, appliances, supplies and parts and electricity,.

Capital productivity index has been taken to be the ratio of net value added and invested capital. Invested capital is defined as the total book value of fixed capital and physical working capital. Figures of net value added and total emoluments were taken from ASI. Price adjustments were not made to the estimate of capital due to lack of required data. Net value added was also taken at current prices only.

The main conclusions of the study are that capital productivity indices for India as a whole have increased marginally. The states with highest capital productivity were Maharastra in 1980-81, Tamil Nadu in 1984-85 and Maharastra again in 1988-89. The States where capital productivity declined from 1980-81 to 1984-85 but increased from 1984-85 to 1988-89 were Maharastra, Uttar Pradesh and Madhya Pradesh. In contrast, in states like Punjab, Tamil Nadu, Andhra Pradesh and Karnataka, capital productivity increased form 1980-81 to 1984-85 but declined from 1984-85 to 1988-89. Capital productivity in Bihar increased consistently while in West Bengal it declined consistently. Capital productivity for selected industries increased in the period from 1980-81 to 1984-85. However, during the period 1984-85 to 1988-89, capital productivity declined in the manufacture of food products; beverages, tobacco and tobacco products; chemical and chemical products; and manufacture of electrical machinery, apparatus, appliances, supplies and parts. There was a consistent decline in capital productivity in other industries.

From the diaggregated analysis of changes in capital productivity for states it can be seen how the gain or loss in productivity and changes in industry mix affect the levels of capital productivity and how one state can do better in certain circumstances by adopting the industry mix of another state. The ability of service capital is an important indicator which is given by the ratio of difference between net value added and total emolument and invested capital. The ability to service capital is influenced by specialisation and diversification.

At all India level there is an urgent need to improve productivity of capital. The main conclusions of the study are that it is not the industry mix but capital productivity within industries which has accounted for the stagnant levels of productivity. The ability to service capital is also declining overtime and does not augur well for future industrial growth. The study recommends that the barriers to improving capital productivity need to be investigated at state, industry and enterprise levels and be substituted by incentives for improving productivity. The study doesn't make any price adjustment to the estimates of capital stock as reported by ASI. Net value added is also taken at current prices.

Seshaih and Reddy (1992) study productivity trends in some industries of Andhra Pradesh manufacturing sector for the period 1977-78 to 1985-86. To examine trends in productivity the time series data on gross output, capital stock, wages, fuel consumed and labour input was employed. The main source of data was ASI. The Divisia index of TFP was employed to examine trends in productivity in cotton textiles, tobacco and beverages, food products and paper and paper products. Assuming the production process would follow Translog technology in industries, three input Translog function was adopted for the study. The three inputs chosen were capital, labour and fuel consumed.

From the Divisia indices of TFP, a declining trend was observed in all industries except in the cotton textile industry. The impact of technical progress was observed in cotton textiles industry. Technical retrogression was found in tobacco and beverages and paper and paper products industries. In case of food products technological retrogression was observed and it was found to be significant. The study is a state level study and not for all India manufacturing industries.

Ramaswamy (1994) studies size, growth and structure of small scale manufacturing units for the period 1972 to 1991. Data for employment, value added and wages for large scale sector was taken from ASI (Summary Results of Factory Sector and from National Accounts Statistics). Data for small scale industries was taken from Census of Small Scale units Development Commission. Small scale industries data for total manufacturing employment was taken form Census of Population. The focus is limited on analysis of industry groups, at two digit level only.

The study presents data on labour productivity, real wages and corresponding growth rates for the period 1972-88. Nominal wages for the year 1988 were deflated using Consumer Price Index (CPI) for industrial workers and Wholesale Price Index (WPI) was used to deflate gross value added (GVA). The relevant index numbers were taken from Economic Survey, 1982 and 1990-91. Labour productivity is calculated by dividing GVA by total number of workers. Capital intensity in the small scale industries is measured by book value of aggregate stock of fixed capital divided by total employment.

The basic findings of the study are that the decade of 1980s is characterised by changing structure of manufacturing employment. Non-household employment shows a rise while household employment shows a declining trend. There is a rise in the share of non-factory segment between 1981 and 1991 from 56 per cent to 65 per cent and the decline of the factory sector from 44 per cent to 35 per cent. The study regards non-factory non-household segment of manufacturing as the small scale industry. The SSI sector is found to be a small segment of the manufacturing sector. Its estimated share in total manufacturing employment is found to be 12 per cent and in value added the share is 20 per cent. The SSI have recorded impressive growth rates of employment and value added across industry groups. There is significant increase in labour productivity over the period 1972-1973 to 1987-88. Aggregate real labour productivity in the SSI sector increased at the rate above 3 per cent. Capital intensity increased to Rs. 7794 from Rs. 4819 in 1972, an increase in 62 per cent in real terms over a period of 15 years. Aggregate capital productivity fell marginally from 1.09 in 1972 to 1.05 in 1988. Wages and productivity are found to be positively related.

The study employs wholesale price index for deflating gross value added and not the industry specific indices. Moreover, the study uses book value of aggregate stock of fixed capital for calculating capital intensity.

A survey was undertaken by the **National Productivity Council (NPC)** during May-June 1994 with the objective of assessing the impact of economic reforms on the performance of Indian organisations. The survey reveals some important facets of the ongoing economic reforms in India, The reforms encouraged exports from the country. The enterprise managers were found to enjoy more functional autonomy. The most encouraging revelation of the survey perhaps concerns the labour aspects. The labour productivity of a large number of organisations has increased during the period of reforms. Labour productivity is a crucial factor for survival and growth in industries especially in a country like India where most of the Industries are still labour intensive. The survey reveals that reforms have brought in significant improvement in enterprise level labour productivity. As high as 85 per cent of the organisations responded that their labour productivities improved in the post reform period. Nearly 48 per cent of the responded companies recorded impressive, i.e., above 3 per cent per annum improvement in productivity during the period while another 28 per cent reported moderate, i.e., 0.5 to 3 per cent per annum) increase in productivity. In 9 per cent of recorded companies labour productivity increased marginally, i.e., up to 0.5 per cent per annum and in another nine per cent it remained constant. In 6 per cent of organisations labour productivity declined.

Productivity estimates are sensitive to the measure of value added that is adopted. One source of bias in estimation is due to the assumption often made of constancy of the relative price of material inputs. **Balakrishnan and Pushpangadan (1994)** argued that appropriate measurement of value added is a prerequisite for the estimation of productivity. This study attempts to construct a standard measure of productivity for Indian industry having accounted for changes in relative price of material inputs.

The period of study is 1970-71 to 1988-89. The relative price of raw materials remained more or less stable till the late 1960s, therefore the period of study is restricted to 1970-71 to 1988-89. The ASI was not published for the year 1972-73. For continuity the value of 1972-73 were estimated as a simple average of figures for 1971-72 and 1973-74. Gross value added had been used in the study. For Value Added Single Deflation (VASD) this figure has been deflated by index of the price of output. In case of Value Added Double Deflation (VADD), the value of inputs is deflated by the price of inputs and the resulting value deducted from the real output (nominal output deflated by the price of output). WPI of manufacture (1970-71=100) is treated as the price of output. The material price index is a weighted index of wholesale prices of major input groups, the weights having been calculated from the matrix of input-output transactions published by CSO. Inputs were grouped according to the availability of wholesale price indices that could be used to represent them most closely. The implied weights were used to contract a weighted average input price. Perpetual inventory method was followed for generation of capital stock. The year 1960 is taken as benchmark year as for 1960, Hashim and Dadi (1973) provide the ratio of purchase value to book value of capital. For land gross net ratio (GNR) was assumed to be unity. For other three groups GNR is taken from Hashim and Dadi (1973). To adjust for age structure, the estimate for each year is then inflated using current to purchase price ratios to obtain gross fixed capital at replacement cost in 1960 price. The investment figures were obtained using the formula:

$$I_t = (B_t - B_{t-1} + D_t) / R_t \qquad \text{.........(2.5)}$$

Where B is the book value of the fixed capital; D depreciation and 'R' is an appropriate deflator for fixed capital. The capital stock is calculated as follows:

$$K_t = K_o + \sum_{t=1}^{T} I_t \qquad \text{.........(2.6)}$$

Where I_t is investment in t year and K_0 is the capital stock in benchmark year in 1960 prices. As the study is motivated by the argument that appropriate measurement of productivity requires commencement from estimates of value added, adjusted for changes in the relative price of raw material inputs, so the focus is on the difference in estimated productivity arrived at by single deflation and double deflation methods respectively. Ahluwalia has argued that there is a turnaround in total factor productivity growth in 1980. Balakrishnan and Puspangadan's statistical analysis confirms a 'turnaround' if TFP estimates are derived from the VASD series. The point, however, is that if TFP index is derived by double deflation there is absence of an increase in the growth rate of TFP. The results indicate that, contrary to what is believed, productivity growth in the 1980s may actually have been slower than in the earlier decade.

Dholakia and Dholakia (1994) feel that Balakrishnan and Puspangadan's (1994) statistical analysis is based on registered manufacturing sector only while the input-output table used here is based on inputs and outputs of entire manufacturing. Balakrishnan and Puspangadan reworked the exercise using 1981-82 prices and input coefficients for the year 1983-84. The results do not support the claim of higher rate of growth of TFP since 1980. Despite the introduction of a new set of input price deflators, the original results survive. Balakrishnan and Puspangadan point out that the question of productivity growth in Indian Manufacturing sector is far from settled. First, there is the question of productivity itself. Three recent studies by Mohanty 1992, ICICI (1994) and Srivastava (1996) report conflicting results. **Mohanty (1992)** reports a deceleration in TFP growth in the 1980s. Mohanty reports declining productivity in the presence of improved growth of value added. **ICICI (1994)** reports negative growth till 1987, after which a turnaround is reported. The results reported by **Srivastava (1996)** are non conclusive when the growth accounting method is followed, total factor productivity decelerates and is negative after 1985-86, the year seen by Srivastava as coinciding with liberalisation On the other hands when a production function is fit, a higher growth of total factor productivity follows from 1985-86. Dholkia and Dholakia (1994) provide a numerical example of the possibility of negative value added under double deflation. Rao (1996) points out that single as well as double deflation methods used for deflating value added have measurement bias.

Dholakia and Dholakia (1994) study TFPG for Indian Manufacturing from 1970-71 to 1988-89. This study uses double deflation method and points out that the Balakrishnan and Puspangadan (1994) study has a number of limitations (a) the study is based on ASI data, but remains silent on the adjustments for non reporting units; (b) presence of aggregation bias in using weights from input-output transaction table which is further aggregated to form 19 input groups, may distort the results and (c) Balakrishnan and Puspangadan (1994) study considered a large part of registered manufacturing sector. The I-O table is based on the inputs and outputs of the entire manufacturing sector which introduces significant bias.

The basic problem in estimating real value added by double deflation method is the estimation of an appropriate price index for material inputs. The weights attached to each input group play a significant role in the determination of over all input price index This study gives three alternative series of weights CSO (1973-74) Balakrishnan and Puspangadan (1994), WPI (1970-71) and CSO (1973-74). Registered manufacturing industries differ significantly from one another and Dholakia and Dholakia consider the set of weights estimated by them using 1973-74 input-output matrix adjusted for only registered manufacturing sector to be the most appropriate for estimating TFPG in registered manufacturing sector in India. To show sensitivity of TFPG to the weights used for input groups in the double deflation method, Dholkia and Dholakia estimated real value added in manufacturing sector and imputed growth rates using the three alternative sets of weights.

The study reports that the annual growth of real value added in the Indian registered manufacturing sector when measured through single deflation method shows remarkable acceleration during the 1980s as compared to the 1970s (from 3 per cent to 8 per cent). If, however, the same is measured through double deflation method, the acceleration in growth rate is found to be (i) much higher in 1980s as compared to 1970s (3.5 per cent to 11.2 per cent) when the weights for the 19 input groups based on WPI (1970-71) are used; (ii) negligible during the 1980s as compared to the 1970s (7.5 per cent to 8.1 per cent) when weights for the whole manufacturing sector as considered by Balakrishnan and Puspangadan (1994) are used; and (iii) lower in magnitude but significant during the 1980s with 9.8 per cent growth as compared to 5.9 per cent during the 1970s when weights for only the registered manufacturing sector as estimated by Dholakia and Dholakia are used. Thus the estimate of TFPG by using double deflation is sensitive to the weights used.

Hence the study reveals that the estimate of TFPG for the decade of 1970s is negative. It is around -(1.5) to -(1.7) per cent when traditional single deflation method is used to measure the real value added in the Indian Registered Manufacturing Sector. During the eighties TFPG with the method of single deflation turns out to be around 1.9 to 2 per cent. Thus, when single deflation method is used TFPG shows remarkable acceleration of about 3.5 to 3.6 percentage points during the 1980s as compared to the 1970s. On the other hand, when double deflation method is use to measure value added in Indian registered manufacturing sector using WPI (1970-71) weights there is an acceleration in TFPG of about 5.8 percentage points from 1970s to 1980s but when weights for whole manufacturing sector alone are used as by (Balakrishnan and Puspangadan) there is deceleration in TFPG of 0.8 percentage points from 1970s to 1980s. However, when weights for registered manufacturing sector only are used there is a much subdued acceleration of about 2.3 percentage points in TFPG from 1970s to 1980s. So Dholakia and Dholakia's study reports that a refinement in the method used by Balakrishnan and Puspangadan confirms the hypothesis of turnaround in TFPG in Indian registered manufacturing since 1980.

Dholakia and Dholakia's study also points out that the double deflation method would provide different answers for different base years for constant prices, whereas the single deflation method gives a unique answer. Technically also the method of double deflation required dealing at the most disaggregated level which is often not feasible. Even when the double deflation is feasible with complete disaggregation available, the possibility of negative 'real' value added still remains. So the study suggests the use of single deflation as is commonly used to get real value of an aggregate defined in terms of difference between two other aggregates. Balakrishnan and Pushpangadan (1994), want Dholakia and Dholakia to be more explicit about the data across the board.

Sidhu's (1995) study analyses the productivity trends in major manufacturing industries in India and in Gujarat state for the decade 1980-1991. The trends in total factor productivity in the study have been measured by the use of Direct Method, Kendrick Method, Solow method and Divisia method. In direct methods total factor productivity is obtained through the geometric average of partial factor productivity indices. Time series data on capital employed, labour employment, total emoluments paid and value added in major manufacturing industries at two digit classification have been used. The basic source of data are various issues of ASI. This study has taken into account total capital employed instead of fixed capital which is generally considered for the studies of productivity. The justification for considering total capital employed is that two factors of inputs, viz, capital and labour, contribute to the value added. After accounting for the total shares of labour, i.e., total emoluments, the balance that remains is the share of total capital. Total capital includes paid up share capital, reserves and surpluses and long term borrowings. In other wards total capital includes fixed capital, variable capital and non-current assets. As such the exclusion of variable capital and non current assets would underestimate the contribution of capital in the study of factor productivity. Wholesale price index of plant and machinery is used to deflate the value of capital employed while the wholesale price index of respective industries has been used to deflate other financial data.

The industries selected for this study were food products; textiles; chemical and chemical products and electrical and electrical machinery. With a view to comparing the variations in factor productivities across industries at state and national levels, same groups of industries have been selected for all India.

A comparison of capital productivity in the selected manufacturing industries in Gujarat with all India shows that in Gujarat the capital productivity in the manufacturing industries, except for food products, was lower than the national average. The capital productivity in the manufacturing sector registered a negative growth, the decline in Gujarat Cumulative Average Rate of Growth (CARG-2.07 per cent) was higher than for all India which had a CARG of -0.09 per cent. In case of labour productivity, the CARG in Gujarat was 7.01 per cent and it was 7.75 per cent for all India. Labour Productivity increased in all the manufacturing industries under study.

Total factor productivity indices obtained through Kendrick, Direct and Divisia methods, registered declining trends during the years 1984-85, 1987-88, 1989-90 and 1990-91. The CARG of TFP in the manufacturing sector in Gujarat during the decade 1980-91 recorded by different methods were 6.33 per cent in Solow, 2.40 per cent in Divisia and 2.37 per cent in both Kendrick and Direct method. The TFP in manufacturing sector at all India level recorded steady growth during the decade 1980-91 except in the year (1987-88) in which the TFP obtained by Kendrick, Direct and Divisia methods recorded downward trends. The Solow TFPI, however, recorded a steady growth throughout the decade 1980-91. The CARG of TFP recorded by different indices were 8.19 per cent in Solow, 3.88 per cent in Divisia and 3.71 per cent in both Kendrick and Direct Method. The analysis also reveals that the TFP in the manufacturing sector was higher at the national level as compared to the Gujarat state.

The study of factor productivity reveals that during the decade 1980-91, capital productivity recorded lower growth than labour productivity. This may be due to increasing capital intensity resulting from the modernisation of existing plants and adoption of improved process technology by the new industrial units. Different methods provide different pictures about trends of TFP. So the results provided by a particular method should be used cautiously and various alternative methods should be used in order to draw a meaningful conclusion. The study is for some industries and not for all manufacturing industries.

Majumdar (1996) examines the productivity trends in Indian industry for the period 1950-51 to 1992-93 and for the sub-periods; 1960-61 to 1992-93, 1970-71 to 1992-93 and 1980-81 to 1992-93. Productivity is measured using a linear programming based technique called data envelopment analysis. To calculate the relative inefficiencies in Indian industry for the period 1950-51 to 1992-93, data from 1959 onwards is collected from ASI and data prior to 1959 is collected from CMI. The ASI summary results for the factory sector are used as principal data source for the purpose of this study. Four inputs and one output are used The inputs used are rupee value of fixed and working capital, actual number of workers and actual number of administrative and support staff employed. The output variable is gross production, expressed in crores of rupees. Labour inputs are expressed in thousands of employees. To deflate variables expressed in rupees, the WPI is used; the capital inputs and the output values are then expressed in constant rupees. A real capital stock series is constructed using perpetual inventory capital adjustment method given by equation:

$$K_t = (1-D)\ K_{t-1} + \text{deflated gross investment} \quad \text{.........(2.7)}$$

where K_t is capital stock to be used for each year; gross investment is the change in firm's undepreciated capital stock since the preceding year and D is the rate of depreciation taken as 10 per cent which is suggested by Hulten and Wykoff (1981) as a consistent representation, of the weighted average rate, over asset categories, of the economic depreciation. The initial capital stock K_0 equals the net book value of capital stock for 1950. Data Envelopment Analysis (DEA) is a performance assessment tool useful for uncovering patterns of dynamic efficiencies. Using only observed output and input data for observations, the DEA algorithm calculates the export measure of how efficient each observation was in converting inputs to outputs. The results show that in the decade of 1950s, industrial efficiency was relatively high; however, in the 1960s and 1970s there was severe retrogression in efficiency patterns. These patterns began reversing themselves only in 1980s; while efficiency in the 1980s was no better than it was in 1950s. Data indicate that the Indian industry has reached its highest efficiency potential throughout the 1990's, thus, providing some evidence that the reforms are working. The efficiency results show that as the industrial policy became regulation oriented in the 1960s, efficiency dropped steeply. As the regulation and control regime turned authoritarian in the latter part of 1960s and mid 1970s, there were occasional spurts in the efficiency scores. Efficiency scores started rising in 1980s when tinkering with the reforms process started. The study uses the net book value of capital stock for 1950. The book value concept has its limitations.

Rao (1996) feels that work on productivity measurement by Ahluwalia, Goldar and others has left unaddressed, several critical issues of method and the correspondence between theoretical measures and indicators used to measure them. Before issues of interpretation are engaged, these methodological issues need to be clarified, and wherever possible measures be recast. The most important of these relates to the question of the proper deflation of value added, a question first raised in an excellent paper by Balakrishnan and Puspangadan (1994). This study favoured the use of separate deflation of the output and material input components of value added by their respective price indices, against the use of a common output price deflator which most of the earlier studies had employed. Their computations showed that this procedural modification was critical enough that Ahluwalia's conclusion of a turn around in productivity growth was reversed. Rao's study analyses four critical issues: (a) the method of growth accounting at aggregate manufacturing level; (b) biases imposed by particular methods of aggregation; (c) the econometric indentifiability of production function at any level of aggregation and (d) the interpretation of measured productivity growth.

The basic question is whether productivity should be based on a measure of physical output or on a measure of value added in production. So long as separability of material inputs from value adding financial factors in production function is hypothesised, productivity may be based on either output or value added measures of production.

Measuring TFPG with single or double deflation of value added in general leads to bias (generally downward in case of double deflation and in inverse relation to the change in material output price relative in case of single deflation). Rao develops a procedure appropriate to the construction of an index of total factor productivity (TFP) when output is reckoned in value added terms and applies it to the case of organised segment of Indian manufacturing. If production function is assumed to be separable then productivity growth will have to be measured by total productivity growth (TPG) which captures all relevant sources of change.

$$TPG = g_o - \alpha g_L - (I - \alpha - \beta) g - \beta g_M \qquad \text{.........(2.8)}$$

g_o - rate of growth of output

α= imputed competitive share of labour

β= competitive share of material input

Eq(2.8) is a general expression for TPG that holds whether or not production function is separable. If production function is assumed to be separable then a measure of TFPG can be obtained directly from the measure of TPG. In this case, the measurement of TFPG directly from value added data is unnecessary. Growth accounting can proceed without reference to value added even though total factor productivity is measured together with total productivity and no double or single deflation of current value added is needed.

$$TFPG = TPG/1-\beta \qquad \text{.........(2.9)}$$

However, while material inputs have to be measured in real terms using an appropriate price index, this calculation does not require the measurement of value added.

Rao estimated TFP for the organised segment of Indian manufacturing for the period 1973-74 to 1992-93. Manufacturing output used here is total output "less the output of" electricity, gas, water and repairs using WPI 1970-71 as base. Labour input is the number of employees. Unlike in previous studies, total productive capital inclusive of both fixed and working capital is used in Rao's study.

The exclusion of the latter is defensible only if its ratio to fixed capital remains unchanged over time. The ratio varies significantly between 11.3 and 16.3 per cent. Real productive capital is measured as the sum of working capital deflated by manufacturing WPI at (1960-61) prices and fixed capital at replacement values (1960-61 prices). Fixed capital series is computed using perpetual inventory method as by Balakrishnan and Puspangadan. For material price index, Rao sticks to original set of weights proposed by Balakrishnan and Purpangadan. The basket involves 19 items and their weights are based on input-output tables for 1973-74. The first basic observation of Rao is that material output price relation rose in the first half of the period peaking in 1982-83 at 126 per cent of its base year level. It declined virtually steadily thereafter but was still 109 per cent of the base level at the end of the period. Over the period of study the share of material inputs in output in current price terms ranged between 73 and 80 per cent. The substantive results of this study are at variance with the perception of an improvement in industrial performance in the 1980s as compared to the previous 15 years. The principal conclusion is that there was a transition in the early 1980s from a high positive rate of growth (5.5) in 1973-74 to 1980-81 in productivity to a significant negative rate (2.2) in 1981-82 to 1992-93 contrary to Ahluwalia's conclusion. In terms of growth, real value of output shows an exponential rate of 6.9 per cent per annum for the 1973-74 to 1992-93 period which is 8 per cent in period 1 and 7 per cent in period 2 The exponential growth rate of real value added is 6.1 per cent for the study period but 10.6 per cent for period 1 and only 2.3 per cent for period 2.

Rao also attempts to study trends in Indian industry on the basis of disaggregation by dividing the organised manufacturing into sub sectors by criteria of ownership (public versus private) and enterprise size (small versus large). Rao's study tries to eliminate some potential sources of aggregation bias and also sheds light on the public/private and small/large dichotomies that have featured among the main lines of Indian debate concerning industrial performance and policy. Growth accounting estimates at aggregate level yield biased estimates of productivity when factor prices are not identical across included production units. Growth rates of Goldar's output index is the weighted sum of sector growth rates where the weights are output shares at current prices; the growth rates derived from Ahluwalia's index are similar weighted sums but with weights being output shares in base period. These divergent procedures for determining manufacturing output yield (single deflated) productivity measures that are substantially different. For the period 1960-80, Goldar's estimate of TFPG is 1.2 per cent per annum where as Ahluwalia's TFPG is only -0.4 per cent per annum.

Rao's main conclusions of disaggregated productivity growth for the period 1973-1993 are that, for the period as a whole, total factor productivity grew at an annual average rate of 2.3 per cent in public sector, 2.2 per cent in the private large sector and 2.4 per cent in the small sector. During the period (1973-1981), the respective growth rates were 3.7, 5.9 and 10.0 per cent for the respective sub sectors. In period 2 (1982-1993), the rankings were reversed with small and private large sector registering annual rates of decline of 5.3 and 2.0 per cent respectively and the public sector recording 1.8 per cent growth per annum. The substantial deceleration in productivity growth observed in the three sectors is reversed with single deflation measure while TFP by double deflation does conform to the chief result of a deceleration in productivity growth between the two periods though the magnitude and in some cases the sign and significance of the growth rates are scarcely the same. For the manufacturing as a whole the contribution of productivity growth to value added growth was 38 per cent for the study period and 61 per cent and 124 per cent respectively for period 1 and period 2. Productivity growth contributed a larger share of value added growth in the public, i.e., 46 per cent than in the private sector, 37 per cent for Private large and 31 per cent for the small sector.

Rao also evaluates the supply-side interpretation of accounting based in growth decompositions and furnishes some evidences in support of external economies and/or demand side influences on measured productivity. The elasticity of productivity growth with respect to output growth in aggregate manufacturing is 5.1 for private-large, 5.7 for the public and 4.8 per cent for aggregate manufacturing. The elasticity with respect to own output growth are smaller-at 3.7 for Private large sector and 2.8 for the public sector-than the corresponding elasticity with respect to aggregate output growth. Three conclusions emerge from these relationships: (a) Verdoorn's law holds for organised Indian manufacturing as a whole over the period; (b) Verdoorn's link is stronger for the public and private-large sectors than for the small sector; and (c) the 'law' apparently weakened between period 1 and period 2 in small sectors but grew in strength for public sector TFP growth. Although, the TFP proposed in the present study does away with biases induced by single and double deflation procedures, it is nonetheless reliant as are previous studies on price series that have one or another base year. These index numbers cannot accommodate changes in the commodity composition of aggregated output occasioned by the emergence of new products or new materials. An additional problem that the present study makes clear is the need for a secure basis for deriving an input price index for manufacturing. The capital stock series used in this and previous studies may also be faulted for being based on replacement ratios derived from data three decades back in 1960.

Srivastava's (1996) study focuses on the empirical measurement of total factor productivity during the eighties. The study is based on a panel of public limited companies and covers the period 1980-81 to 1989-90. The data has been collected from Reserve Bank of India, consisting of 15,607 observations and 2439 firms. This study examines the impact of reforms on productivity and competition for the Indian manufacturing sector in the eighties.

At the level of aggregate data, labour productivity increased during the period at an average annual rate of 9 per cent whereas the productivity of capital decreased at annual average rate of approximately 6 per cent. This was accompanied by 16 per cent annual rate of increase in capital labour ratio. Estimates of average TFPG rate are higher during the post reform periods (1985-86 to 1988-89). Estimates for post reform period range from 0.10 per cent to 2.00

per cent whereas the estimates for the earlier period (1980-81 to 1984-85) are generally negative. A closer look at the annual TFPG rates suggests that a significant upswing in TFPG rates occurred in 1987.

At the two digit level, the estimates of total factor productivity growth for different sectors are generally quite low with the model value being around 0.5 per cent. The only exceptions to this are the food product and beverages and tobacco sectors. The sectors having higher productivity growth ratio during the latter half of the eighties are paper products; rubber, plastics and petroleum products; chemical products; basic metals and alloys and non metallic mineral products.

Analysing the characteristics common to these sectors this study finds that for each of these sectors, the ratio of increase in capital intensity during the period is slower than the average. With the exception of non metallic mineral products for each of these sectors the proportion of imported raw material used is higher during the post 1985 period. For three of the five sectors for which higher productivity growth is observed during the post 1985 period, i.e., in sectors-rubber, plastic and petroleum products; chemical products and basic metals and alloys, there is an increase in the share of export in the total sales during post 1985 period. So relying on econometric estimates of pre and post reform productivity growth, the study finds evidence of significantly higher productivity growth ratio after mid eighties both at aggregate and at two digit sector levels.

The time period covered by the study is small, a longer time series would have helped in arriving at more definite conclusions, particularly with regard to the observed increase in productivity growth in the post reform period. The wage deflators used for 1988-89 and 1989-90 were obtained through extrapolation and were probably not very accurate. The study is restricted to only public limited companies.

2.3.2 Studies On The Unregistered Sector

Very few studies have been done on unregistered manufacturing sector. The estimate for TFPG available for unregistered manufacturing by **Brahmananda (1982)** are based on Kendrick index for the end points of 1950 and 1980. The unregistered manufacturing includes traditional industries like khadi, village industries, handloom, sericulture, coir as well as modern small scale industries in textiles particularly powerlooms and engineering. National Sample Survey data is used for 1980-81 Narayan and Katyal's capital stock figures were adjusted for the period.

The results indicate a rising capital-output ratio and also increasing labour productivity. For the period 1950-51 to 1970-71 the compound rate of productivity increase was 3.29 per cent. For the period between 1950-51 to 1980-81 the annual compound rate of productivity increase was 1.62 per cent for the unregistered manufacturing. The chain index showed a compound rate of increase of 4.14 per cent for the first decade, 2.42 per cent for the second decade and a decline of a point 2.42 per cent for the third decade. The rate of productivity improvement had turned negative. The estimates for Kendrick index for unregistered sector are available only for the end points of 1950 and 1980.

2.4 OBSERVATIONS BASED ON THE REVIEW

The review of earlier studies shows that research done till date is focused around the dimensions like growth and measurement of productivity. The following issues emerge from the review of studies:-

(1) Almost all studies conducted so far are either too aggregative or wherever some disaggregation has been achieved, it does not reflect the underlying process of productivity.

(2) Little attention has been paid in these studies to the explanation of the observed productivity changes. So what exactly determines productivity is still an uncovered area.

(3) Productivity as measured by various indices measures efficiency in resources allocation in a particular firm or a sector of the economic system. This is only a direct effect. But this is a fact that productivity change in one firm/sector of the system leads to a chain of effects which affect productivity in various firms/ sector. To account for total effect one must take direct and indirect effect. But paucity of data in India does not allow an efficient exercise in this direction.

(4) Very less work has been done to examine the impact of reforms on productivity for Indian manufacturing sector.

Hence from the review presented, it may be inferred that there is an ample scope for research in this field.

CHAPTER III

MODEL AND METHODOLOGY

In this Chapter the model and methodological issues in the measurement of productivity have been discussed. The chapter is divided into four sections. Section 3.1 describes the concept of partial and total factor productivity. Section 3.2 discusses the data base used for the present study and measurement of output and inputs. Sections 3.3 and 3.4 deal with the data sources and methodology used in the present study.

I

3.1 CONCEPTUALISATION OF PRODUCTIVITY

An essential prerequisite of a sound statistical analysis is that all terms involved in the interpretation be precisely defined and their scope be delimited. The term "productivity" has been used in such a variety of senses, that it is exceedingly difficult to find out whether the term 'productivity' is synonymous with 'efficiency' or 'overall effectiveness' of a productive unit: be it a plant, firm or a company. Productivity is an elusive concept that does not lend itself either to clear cut definition or easy computation. Productivity is a subject surrounded by considerable confusion people employ the same term and mean different things [Fabricant (1969)]. Productivity is a word which we use broadly to express the overall efficiency relating to performance of industries. Smith, A. (1776) referred to efficiency and specialisation, what in current nomenclature amounts to the concept of productivity.

Although there is no consensus on the definition of productivity yet everyone accepts it to be a measure of performance. No amount of economic juggling can alter the fact that in the long run, our solvency depends on the efficiency of our industries. Productivity is the key feature of economic dynamism today. Kuznets (1966) had pointed out that the rapid growth in industrial productivity was an essential element in the development and structural transformation of the newly developed economies. In a broad sense, productivity means goods and services produced in relation to the resources utilized in producing the same. Productivity means utilizing appropriate resources, avoiding wastage, producing more with same constituents while preserving quality. Thus, productivity becomes a path of progress and raising productivity becomes a condition of material progress.

Section 3.1 to 3.3 critically review the methodologies adopted in India to determine the factor productivities. The methods used by most Indian studies may be classified into following categories:

(a) Partial factor productivity method;

(b) Methodologies based on production functions:

   (i) Kendrick's total factor productivity method based on liner production function;

   (ii) Methods based on non-linear production functions such as: Log linear regression form; Solow methodology and

   (iii) Translog index based on Transcendal logarithmic production function.

3.1.1 Partial Productivity

Productivity, when defined with respect to any one input ignoring other factors in the output-input ratio is termed as partial productivity. Partial productivity reflects the relative efficiency of the factor used; the effect of factor substitution as well as of changing productive efficiency.

Partial productivity is classifiable, according to factors, as:

(a) Capital productivity;

(b) Labour productivity.

3.1.1(a) Capital Productivity

It is defined as the ratio of output to capital resources expended. In the determination of performance of the economy, of late, much attention has been paid to the value of capital-output ratios. The concept of capital used here relates to gross fixed capital. It includes plant, equipment, buildings and construction. Working capital is mostly not used because of its volatile nature.

The ideas of capital consumption allowance, calculation regarding replacement amount of capital, average life of capital goods, net stock, gross stock, rates of depreciation, correction of historical costs of components, replacement, cost accumulated expenditure on investment etc. have come up from time to time to transform capital as an input measure, which can be used as a meaningful denominator in productivity measurement. Moreover, the statistics available of capital input are not free from inherent defects and vary from one source to another, so much so that the results show a marked difference and often lead to dubious outcomes and misguide the researchers.

3.1.1(b) Labour Productivity

Although a number of variables combine to affect changes in productivity, yet it is necessary that a particular yardstick of input factor be chosen that manifests in all types of production. It is generally believed that number of workers or man-hours worked should be used as an input factor. When output is divided by number of workers or man-hours the result is termed as labour productivity.

Several points are made in defence of the choice of labour man hours or in defence of the number of workers employed in calculation of productivity. Labour force in any country is one of the most important resources. Adequate supply of skilled and efficient labour is a great asset. Another, but in no way less convincing argument in favour of this measure, is that labour time is more readily measurable than other input factors and that it possesses a universal element common to all plants, processes and industries. This universality provides a common basis for measuring and comparing the relative productivity, not only in different units but also of different sectors of a country.

This definition, despite its simplicity and widespread usage, has not removed confusion either from analysis of interpretation and the reasons for it are manifold. It is difficult to dislodge the deep rooted notion from the mind of common man, inexperienced in the technique and methodology of productivity analysis that labour productivity data measure the productivity of labour and not the productivity of all the combined input factors. Indeed, it would be difficult to visualise a situation in which a country can achieve higher standards of labour productivity despite its comparatively low standard of labour efficiency. Seigal (1961) says, "Labour productivity indices do not reveal changes in the intrinsic efficiency of labour, but rather the changing effectiveness with which labour is utilised in conjunction with other factors. "As such labour productivity is not a measure of specific contribution of labour or of any one factor of production: it reflects the cumulative influence of operation of a large number of interrelated influences such as technological improvements, the rate of operation, the degree of efficiency achieved in different processes, the availability of supply and the flow of materials and components, as well as employer-employee relations, the skill and effort of workers as well as the efficiency of management.

It is often maintained that the element of labour input is quite obvious in the creation of capital to a great extent when it is assumed that capital plays a great role in determination of labour productivity. It is conceivable that the quality of capital employed is of overriding significance in explaining the magnitude of differential in productivity. Nevertheless, it is assumed that the quality of machine unquestionably reflects the role of labour in the creation of the machines. Thus, it is considered appropriate to use labour input as the denominator.

3.1.2 Total Factor Productivity

The expression of productivity as a ratio between output and any single input factor like invested capital, or units of horse power consumed, number of workers or man-hours consumed is subject to limitations. In all these partial productivity indices, output is compared with only one input at a time without an explicit recognition of the changes in other inputs. Thus, a given rise of labour productivity may be caused by substitution of capital for labour, a rather familiar and less interesting case, or by the work of mysterious and therefore, more interesting "Other forces" such as technological change, broadly defined economies of scale, better management, education and so on. These problems can be resolved by analysing total factor productivity growth which identifies the contribution to an increase in output, of influences other than increases in the factor inputs. Total factor productivity growth encompasses the effect not only of technical progress but also of better utilisation of capacities, learning by doing, improved skills of labour etc. Total factor productivity and technical progress are synonymously used in the literature. However, a distinction does seem to warrant between the two. Total factor productivity is an average concept. It has a broader meaning than the technical progress. Technical progress is defined as the shift in production function. Total factor productivity may occur even without a shift in the production function. It is a composite measure of technological change. Changes in the efficiency with which known technology is applied to productivity growth has important limitations, but it certainly is useful supplement to conventional analysis of partial productivity measures.

The important measures of total factor productivity are:

3.1.2(a) Kendrick Index

John W. Kendrick developed a total factor productivity index using a linear production function. Kendrick index is an arithmetic index where factor inputs are combined arithmetically by base year fixed weights.

$$P = \frac{V_n}{a_0 L_n + b_0 K_n} \qquad \ldots\ldots\ldots\ldots\ldots (3.1)$$

Where P is the productivity index, V_n is the value added during period n using the amounts of labour and capital L_n and K_n respectively. a_0 and b_0 stand for base year efficiency of labour and of capital. Kendrick assumed that a_0 and b_0 are appropriately measured by the wage rate and the rental rate during the base period respectively.

$$\text{Wage Rate during base period} = \frac{W_0}{L_0} \qquad \ldots\ldots\ldots\ldots (3.2)$$

Where W_0 = Wage bill during base period,

L_0 = persons employed during base period.

$$\text{Rental rate during base period} = \frac{V_0 - W_0}{K_0} \qquad \ldots\ldots\ldots\ldots\ldots (3.3)$$

Where V_0=Value Added during base period,

W_0=Wage bill during base period and

K_0= fixed capital stock during base period.

Kendrick developed this productivity index to estimate changes in national productivity overtime in the United States' economy. The assumptions of perfect competition, perfect substitutability between labour and capital, constant returns to scale and profit maximisation are implied. This measure involves comparing, "what the output of period II would have cost at the factor prices and unit factor requirement of I (real output) with what they did cost in constant I factor prices, but at the II level of productive efficiency (real input). Alternatively, we are comparing the actual real output of II with what the output of the factors would have been in II had the productive efficiency of I real input, prevailed." [Kendrick 1961]

The arithmetic index of Kendrick has its own limitations. Domar (1962) has pointed out that an arithmetic combination of inputs implies that marginal productivities vary only due to other factors and not due to variations in capital and labour. In the Neo classical scheme of things it would imply the assumption that capital and labour increase in approximately the same proportion and their ratio remains constant. For relative rate of growth of the index, it may be useful to use ratio concept throughout and combine inputs and output geometrically.

Beri (1962), Sinha and Sawhney (1970), Banerji (1975) used this method to arrive at total factor productivity index.

3.1.2(b) Domar Index

The total factor productivity index of Domar is a geometric index.

The Domar index corresponds to the following manipulative production function:

$$V_t = P_t \, L_t^{\alpha} K_t^{\beta} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.4)$$

Where P_t is total factor productivity. The rate of change is obtained by taking logarithms of the variables.

$$\text{Log } V = \log P + \alpha \text{Log } L + \beta \text{Log } K \ \ldots\ldots\ldots\ldots\ldots\ldots (3.5)$$

Differentiating with respect to time we get:

$$\frac{1}{V}\frac{dV}{dt} = \frac{1}{P}\frac{dP}{dt} + \alpha\frac{1}{L}\frac{dL}{dt} + \beta\frac{1}{K}\frac{dK}{dt} \ \ldots\ldots (3.6)$$

This can be expressed as:

$$\frac{P^{\cdot}}{P} = \frac{V^{\cdot}}{V} - \left(\alpha\frac{L^{\cdot}}{L} + \beta\frac{K^{\cdot}}{K}\right) \qquad \ldots\ldots\ldots\ldots\ldots\ldots (3.7)$$

where dots denote time derivative. Thus, the rate of total factor productivity is given by difference between the rate of change of output and weighted sum of the rates of change of capital and labour. The Domar Index also assumes fixed weights like the Kendrick index. Despite its merits the geometric index is not as commonly used as the arithmetic index. Domar calculated single factor productivity and total factor productivity growth rates for U.S.A, Canada, U.K. Germany and Japan for 1948-60. The total factor productivity was highest for Germany and Japan and lowest for U.K.

3.1.2(c) Solow Index

Solow's methodology is based on Cobb-Douglas production function.

The production function is homogenous of degree one in capital and labour and the factors are rewarded according to their marginal products. Technical change is assumed to be neutral in the sense that marginal rate of substitution between capital and labour is unchanged with change in output. The functional form is:

$$V/L = A(t)\ (K/L)^{b} \qquad \ldots\ldots\ldots\ldots\ldots(3.8)$$

where V/L is output per person, K/L is capital per person and A and b are constants. Expressing the above relation in log form:

$$\log V/L = \log A(t) + b \log (K/L) \qquad \ldots\ldots\ldots(3.9)$$

Putting this in incremental form:

$$d\ (V/L)/V/L = dA(t)/A(t) + b\ d(K/L)/K/L \ \ldots(3.10)$$

$$\text{or } dA(t)/A(t)=d(V/L)/V/L-bd(K/L)/K/L \qquad \ldots\ldots(3.11)$$

d(V/L)/V/L is the rate of change in output per person, d(K/L)/K/L is rate of change of capital per person and b is capital's share of output. Therefore, the rate of change of total factor productivity is the difference between the rate of change of output per person and a rate of change of capital per person multiplied by capital's share of output. This yields dA(t)/A(t) series from which A(t) series can be computed by assuming the initial value of A(t) as one. A Whole series of technical change can be derived from:

$$A(t+1) = A(t)\,(\,1 + \Delta A(t)/A(t)) \text{ assuming that } A(0)= 1 \ \ldots.(3.12)$$

Banerji (1975), Mehta (1980), Goldar (1986), Ahluwalia (1985) used this index to arrive at total factor productivity index. In this average rate of technical change g can be expressed as:

$$\log V(T)-\log\bar{V}(T-1)=\bar{V}_K[\log K(T)-\log K(T-1)]+\bar{V}_L[\log L(T)-\log L(T-1)]+\bar{g} \quad \ldots\ldots\ldots\ldots(3.15)$$

Where: $\bar{V}_K=1/2[V_K(T)+V_K(T-1)]$ and $\bar{V}_L = 1/2[V_L(T) + V_L(T-1)]$

V_K and V_L are income shares of the factors capital and labour respectively:

$$\bar{g} = 1/2[g(T)+g(T-1)] \quad \ldots\ldots\ldots\ldots\ldots(3.16)$$

The above expression for the average rate of technical change g is referred to as the translog index of technical change.

II

3.2 VARIABLES OF THE STUDY

3.2.1. Capital Input

In spite of its crucial place in economic theory, capital is the most difficult concept to deal with in empirical context. The statistical and conceptual problems involved in its measurement make it so, and the problem of defining and measuring capital is hardly settled as yet. Most of empirical analysis of productivity and growth would not be possible unless one agrees on some definition and method of measuring capital in practice. Considerable differences are observed on the other hand, with regard to the measurement of capital input. Infact, the difference in total factor productivity estimates between studies may be attributed largely to the difference in capital estimates.

The problems of defining and measuring capital arise because of the following reasons:

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

(b) The composition of this "composite commodity" keeps on changing over time. The change in composition renders it difficult to compare one quantity at one time with another at another point of time. A machine which goes out of productive use is not necessarily 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. In a stationary economy where nothing changes and nothing grows, perhaps the problem would not be so difficult.

(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 the utility measurement of capital goods immensely difficult.

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

(e) The productivity of a capital asset might not remain the same over its life time. And this renders it difficult even to measure capital with reference to its methods of depre ciation and the concepts of replacement cost etc.

Apart from the conceptual problems outlined above, another set of problems arises in empirical works due to inadequate or defective statistical reporting about capital.

3.2.1(a) Components of Capital

Capital is the stock of all the goods with the firm at any moment of time whether they be fixed assets like machines and buildings or circulating assets like consumable stores.

3.2.1(b) Approaches to Measurement of Capital

In theory the value of capital is defined as the discounted future income stream to be derived from it. This is a forward looking concept; significance of a stock of capital good lies in its earning power. Capital can also be defined as quality of labour time expended in the past. This is a backward looking concept of capital, the capital stock of particular year is measured by the amount of resources that would have been required in the base year to produce the capital goods (of possible different vintage). Similarly, gross additions to the capital stock and capital consumption are valued in terms of base year costs for the particular capital goods added or consumed. Thus, by this method, if two machines had the same cost in the base year in whose prices the estimated capital series is expressed they are considered to embody the same amount of capital regardless of the differences in their ability to contribute towards production. The method is not so simple and straight forward as the changes in prices of capital goods lead to various conceptual and practical problems. In a situation of changing prices a price index for capital goods would be required for deflation purpose.

Replacement Cost

A related concept, i.e., 'replacement cost' is very often used as a reference to the value of capital. However, 'replacement cost' concept again has two variants (i) replacement cost new, and (ii) replacement cost written down. The first one amounts to the cost of new equipment of similar type, while the second one is based on the vague notion of decline in productive capacity and its measurement.

Depreciation

While making an estimate of capital, important choices arise with regard to depreciation and obsolescence. Kendrick (1956) argues that while making an estimate of capital, we have to take into account the fact that the capital embodied in a specific asset goes on declining over time due to depreciation and obsolescence and argues that obsolescence should be charged at the time the capital good is discarded and that it should be handled as a deduction from gross capital formation rather than as an addition to capital consumption.

Richard and Ruggles (1961) question the relevance of such considerations when backward looking concept of capital is taken. When efficiency improvements have been excluded from the measurement of capital stock, it seems incongruous that decrease in efficiency through ageing should be so carefully taken into account. For deriving a consistent estimate of capital, no allowance should be made for depreciation during the life of a machine (and 100 per cent charge be made on retirement) despite the fact that producers may for financial reasons and in order to derive a more meaningful profit figure, amortize the cost of a machine over its life.

There are essentially three options available for dealing with the issue of depreciation.

(a) Exogenously determined Depreciation Rates : one can rely on meaningful depreciation rates estimated in other studies. King and Fullerton (1984) calculate depreciation rates for U.K, Sweden, Germany and the U.S.A. The estimates for manufacturing machinery range from 7.9 per cent for the U.K. to 13.31 percent for the U.S.A and for buildings from 2.5 per cent for the U.K. to 4.56 per cent for Germany. Depreciation rates at a more disaggregate level are available for the U.S.A. in Hulten and Wykoff (1981).

(b) Endogenously determined Depreciation Rates: Another possibility is to make an attempt to estimate economically meaningful depreciation rates based on information contained in the data. Making the assumptions : (a) all the firms capital stock has useful life L_t; (b) firms use straight line depreciation and (c) the depreciation rate $\delta_t = 2/L_t$; it can be shown [Salinger and Summers 1981] that,

$$L_t = GFA_t/DEP_t \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.17)$$

where DEP_t is depreciation provision in year t. Instead of L_t.

$$L = \Sigma_t L_t/T \quad \text{and } \delta = 2/L \text{ can be used.}$$

(c) The One Horse-Shay Model: This assumes that economic deterioration is zero during the life of the machine. The justification for the approach is that machines do not really deteriorate during their useful life and are kept in their initial conditions through expenditure on repair and maintenance. Hashim and Dadi (1973) point out that a large amount of expenditure is incurred by business firms on repair and maintenance, when main object is to keep the assets in more or less a similar productive capacity. A large part of such maintenance cost is treated as current cost and is deducted from gross value of output to obtain gross value added. Accordingly, Hashim and Dadi (1973) argue that since the main objective of such expenditures is to keep the productive capacity of capital assets more or less intact, such expenditure should be treated as reinvestment. Under such a situation there is no need to subtract depreciation from gross capital stock so as to correct for capital consumption.

The one Horse Shay Method has been used to obtain series for gross capital stock at replacement cost and at base year prices. In the present work, value of gross fixed capital stock at constant prices has been taken as measure of capital input. The use of gross figures is justified in less-developed countries. Most analysts have favoured the gross stock over the net stock on the ground that the net value typically declines much more rapidly than does the ability of a capital good to contribute to production. Barna (1961) revealed that capital goods in United Kingdom are generally maintained in good condition until a decision is made to scrap them. As against this Denison (1967) points out that the use of gross stock involves the other extreme assumption that the ability of a capital good to contribute to production remains constant throughout its service life. Further, according to Leontief (1953) "Recent information indicates that the undepriciated coefficients correspond much more closely to the incremental coefficient than do the depreciated ones". Hence, gross capital output ratio would be more relevant for forecasting the incremental capital requirements. Domar (1961) has also argued in favour of gross capital figures as, "working with net investment and net stock of capital in the conventional sense one loses sight of gross investment as a major vehicle of technological progress................. Hence, gross figures may be more meaningful with some unknown deduction of a smaller magnitude than conventional depreciation to account for the deterioration of existing capital".

However, even unknown deductions of smaller magnitude are not required if we consider the point that a large amount of expenditure is incurred to keep the assets in more or less similar productive capacity. Sinha and Sawhney (1970), Banerji (1975) and others point out that the figures on depreciation reported by CMI and ASI are calculated at the rates allowed by income tax authorities and they seldom represent the true capital consumption. Working capital has been excluded from the measure of capital input. On this question, Sinha and Sawhney (1970) argue that "While the importance of working capital to industrial productivity cannot be denied, the inventory and cash holdings are more often determined by supply and market expectation than technological pipeline requirements and have, therefore, far less bearing on productivity than fixed investment".

Rosen (1959) also points out that the relationship between working capital and output is less influenced by technological factors than the relationship between fixed capital and output. Perpetual inventory method has been used in the present study for estimating capital. Investment is the net addition to capital stock within the country in the form of plant, machinery, building and other capital goods. The investment figures are obtained using the formula:

$$I_t = (B_t - B_{t-1} + D_t) \;/\; R_t \qquad \ldots\ldots\ldots\ldots\ldots\ldots (3.18)$$

Where B is the book value of fixed capital D is the depreciation and R is an appropriate deflator for fixed capital. For R wholesale prices index of machinery (base 1981-82=100) has been used. Capital stock for any year may be calculated as follows:

$$K_t = K_0 + \sum_{t-1}^{T} I_t$$

where I is investment in year t and K_0 is capital stock for bench mark year, i.e., 1973-74.

The figures on fixed capital available from ASI are the book values of fixed assets. The use of undeflated book value amounts is inaccurate and the book values are deflated by a price index. The weakness of using deflated data alone is that it does not take into account assets of different vintages brought at different points of time. Therefore, perpetual inventory method is used. For this replacement cost for the benchmark year is needed. What should be the relationship between book value and replacement value of fixed capital has been examined by Mahalanobis (1955). This study points out that every type of capital good has a certain life after which it must be replaced. Consider any particular type of capital good and let its average life be T years. Also consider that any particular item of the given type has been in use for a certain period, say, t years; it then has (T-t) years of useful life still left. If the stock of capital goods includes a large number of items of the given type then there would be one item which still has a useful life of t years left then the combined useful life of the two items taken together is (T-t)/t or equal to T years for two items . The average life is thus 1/2(T) for each item. This argument would be valid for all items under the simplified conditions mentioned above. Hence, the average useful life at any time is half of the total life so that as a first approximation the current book value should be half of the replacement value. The replacement value of capital can therefore be taken as double the book value. A rough check was made by Mahalanobis. It was found that the estimate of replacement value is actually double the present value of total paid-up capital (which is assumed to be the same as the present book value of net block capital). Mahalanobis (1955) cited a survey of small scale industries conducted during 1952-53 in which the replacement value of plant and machinery was found to vary form 2 to 6 times the book value. Also using relationship between investment and output available for a number of projects, Mahalanobis estimated replacement value of capital stock of a number of enterprises and noted that the ratio of replacement value of book value varied from 2 to 4. On the basis of studies cited above, it was decided by Mahalanobis to use double the book value as a reasonable estimate of current replacement value.

Banerji (1975) has also taken double the book value in 1946 as a measure of replacement value at 1946 prices of fixed assets for the year. Hashim and Dadi (1973) calculate gross net ratio for various three digit ASI industries separately for three categories of assets: (a) building and construction; (b) plant and Machinery and (c) other assets for 1960 separated into the above mentioned categories. They derive gross fixed assets at purchase prices for the year 1960. Then defining gross addition to fixed assets in year t, denoted by A_t as:

$$A_t = B_t - B_{t-1} + D_t \qquad \ldots\ldots\ldots\ldots\ldots\ldots (3.20)$$

Where B_t and D_t denote book value of fixed assets and depreciation in year t. Then purchase prices for preceding and subsequent years are derived. Let G_{60} denote fixed assets at purchase prices for 1960 and G_{63} that for the year 1963; then the relation between G_{60} and G_{63} can be written as:

$$G_{63} = G_{60} + A_{61} + A_{62} + A_{63} \qquad \ldots\ldots\ldots\ldots (3.21)$$

The ratio of replacement value to book value of fixed assets from their estimate turns out to be 8.7. Goldar feels that Hashim and Dadi have overestimated the capital stock particularly for the earlier part of their series. Goldar's ratio for replacement cost to book value turns out to be 3.4. The estimates were worked out with the help of Report of Taxation Enquiry Commission from the balance sheets of 448 public limited companies. The ratio of gross fixed assets to net fixed assets is computed for each industrial group and this ratio is applied to the figure on fixed capital. Net book value obtained from this gives an estimate of gross fixed assets at purchase prices as existing at the end of 1951. Using the proportions of assets acquired before 1946 and after 1946, Goldar's estimate of gross fixed assets at purchase prices is divided into two parts. The second part is inflated by the average price index of capital goods for the period 1919-29 and 1940-45 (with base 1951). The ratio of market value of book value turns out to be 3.4. Goldar has also worked out another estimate using gross net ratios for 1960 computed by Hashim and Dadi. The estimates turn out not much different from the first set of estimates. The ratio of gross fixed assets at purchase prices to book value in Hashim and Dadi series is 5.3 for the year 1946. From the report of Taxation Enquiry Commission (statement III page 268-69) Goldar finds that the ratio of gross fixed assets (at purchase prices) to net fixed assets (book value) for 212 major companies in cotton, jute, iron and steel, sugar, and chemicals, paper, vegetable oil, matches and cement was only 2.4 in 1946. Roy Chaudhry (1977) has doubled the value of fixed capital stock also at book value for the benchmark year to estimate the replacement cost figure.

In a recent study Balakrishan and Puspangdan (1994) estimated capital stock for 1960 for three digit industries for the census sector using GNR from Hashim and Dadi for various three digit industries. The gross net ratio for land in this study is assumed to be unity. Where the gross net ratio is not given, it has been taken to be twice the book value of fixed capital. The ratio of the value of fixed capital at replacement cost to its book value in this study in 1960 (2.42) was used to arrive at an estimate of fixed capital at replacement cost in the sample sector.

Chaudhuri's (1996) estimate of aggregate net fixed capital stock from ASI for 1959 is Rs 1,08,960.5 lakh and aggregate replacement cost estimate for 1959 at 1959 prices is Rs. 2,11,473.3 lakh which is almost double the book value.

Hence, considering the above empirical evidence and on the basis of studies on the lines explained above it may be decided to use double the book value as a reasonable estimate for the current replacement value of assets at any given time.

Once estimation of fixed capital stock for 1973-74 is done the rest of the series of the fixed capital is worked out by first estimating real investment in fixed assets in subsequent years and then by adding such investment to the benchmark estimate.

3.2.2 Measurement of Output

Gross value added at constant prices is taken as the measure of output in the present work. The gross measure of value added is obtained from the value added and the depreciation data as given in Annual Survey of Industries. The data on gross value added is deflated using the industry specific wholesale prices (at 81-82 prices)

In the measurement of output an important choice arises between value added and gross output. The former option leads to a notion of total productivity while the latter gives rise to the widely deployed measure of total factor productivity. The choice hinges on whether one believes the production function to be separable in material inputs and factor input. A majority of the earlier studies have preferred the value added measure. Griliches and Ringstad (1971) advance the following arguments in its favour:

(a) It facilitates comparison of results for different indus tries with different material intensities;

(b) It facilitates aggregation of output across industries; and

(c) Inclusion of 'material' as an argument in the production function leads to the problem of dominant variable. In such a formulation almost all variation in output tends to get explained by 'material' thereby obscuring relations of greater interest.

Bruno (1978) and Diewert (1978) analyse the biases inherent in using single and double deflated value added in place of the correct output in production function and total factor productivity (TFP) studies. It has been shown that functional separability, fixed intermediate input proportion and constant relative intermediate goods prices are three possible hypotheses which, if satisfied may lead to a justification of the use of 'value added'. Danny and May (1978) test these hypotheses for Canadian manufacturing and reject each of the three. Regarding the measurement of TFP , Bruno points out that the use of single deflated value leads to a biased estimate. Denison (1969) regards both gross and net measures as legitimate for productivity analysis. Denisom, however, prefers the net measure as "gross products is larger by the value of capital consumption." There is no reason to wish to maximise capital consumption. It may however be pointed out, that from the data available to us it is extremely difficult to make a proper estimate of capital consumption. The figures on depreciation that are presented in ASI are at the rates allowed by income tax authorities and are seldom representative of the true capital consumption. So gross value added is used in this study for analysing productivity trends.

The study uses single deflation method as getting suitable deflators for materials considering its severe heterogeneity is a rather difficult task. The method of double deflation requires dealing at the most disaggregated level which is often not feasible CSO (1980: 26); CSO (1989: 84). Any grouping or aggregation can lead to serious errors. The estimates of real value added are highly sensitive to the set of weights used to arrive at the overall input price index. Moreover, Dholakia (1994) points out that even if we consider the case where double deflation method is feasible with complete disaggregation available, the possibility of negative real value still remains.

3.2.3 Labour Input

Regarding the measurement of labour input there are three alternatives available: (a) man-hours; (b) workers and (c) employees. The present study uses the number of employees data from Annual survey of industries for the period 1973-74 to 1992-93. Denison (1961) disfavours taking man-hours as a measure of labour input, as reduction in man-hours per week leads to an increase in labour input per hour. Thus, measuring labour by the number of persons is more satisfactory. Total employees as a measure of labour input include both workers and persons other than workers. Employees include supervisors, technicians, managers, clerks and other similar types of employees. It has been argued that such employees are as much important for getting the work done as the workers who operate the machines and therefore their services should be taken into account in the measurement of labour input. Data for employees after 1980 is reported in the Annual Survey of Industries, under the heading 'total persons engaged'. The share of total emoluments in value added is taken as the share of labour. Wholesale price index is used to deflate total emoluments. Assuming constant returns to scale, the share of capital is got as one minus the share of labour.

3.3 DATA SOURCES

The basic data source for the present work is 'Annual Survey of Industries'. This survey is being conducted every year since 1959 by National Sample Survey Organisation and processed by Central Statistical Organisation. Annual Survey of Industries relates to the registered sector of manufacturing. Registered factory is one which is registered under section 2 m (i) and 2 m (ii) of the factory Act 1948. The sections 2 m (i) and 2 m (ii) refer to any premises including the precincts thereof (a) wherein ten or more workers are working or were working on any day of preceding twelve months and in any part of which manufacturing process is carried on with the aid of power; or (b) wherein twenty or more workers are working or were working on any day of the preceding twelve months and in which or in any part of which a manufacturing process is carried on without the aid of power. The National Industrial Coding (NIC) 1970 was followed to classify factories from Annual Survey of Industries 1973-74 to 1988-89. NIC 1987 is followed for Annual Survey of Industries from 1989-90 onwards. According to recent reclassification of NIC, industry groups 30 (Rubber and Plastics) and 31 (Chemicals and Chemical Products) have been interchanged. But, the same code name as in earlier study has been used in this study to maintain comparability. Data have been adjusted with respect to changes in classification.

The sources of data for wholesale prices is 'India Data Base' by Chandhok, and 'Index of Wholesale Prices' by Ministry of Industry.

3.4 RESEARCH METHODOLOGY

The main objective of the present study is to analyse productivity trends in Indian manufacturing industries for the period 1972-73 to 1990-93. Productivity at the aggregate level gives an overall picture. With the view to study inter industrial pattern of productivity growth, analysis is done at two digit and three digit level of disaggregation. For time series analysis secondary data have been obtained from various data bases relating to Indian manufacturing. Detailed data about registered manufacturing units have been compiled from Annual Survey of Industries (ASI). Data on suitable deflators have been obtained from Index numbers of Wholesale Prices, [Ministry of Industry] and India Data Base: The Economy [Chandhok 1990]. The gross measure of value added is obtained from net value added and depreciation data as given in ASI. Value added is deflated by industry specific deflators. Labour input is represented by total number of persons employed and capital input is measured by estimates of gross fixed capital stock at replacement cost at constant prices. Perpetual Inventory method has been used for estimating capital series. The capital stock at any year has been calculated as follows:

$$K_t=K_0+\sum_{t=1}^{T}I_t \qquad \text{................(3.22)}$$

Where I is investment in year t, K_0 is capital stock for benchmark year, i.e., 1973-74. Investment figures have been obtained using the formula:

$$I_t=(B_t - B_{t-1} + D_t) \;/\; R_t \qquad \text{................(3.23)}$$

Where B is the book value of fixed capital, D is the depreciation and R is an appropriate deflator for fixed capital. For R wholesale price index of machinery (base 1981-82=100) has been used. The returns to labour are measured by the total of wages, salaries and benefits (total emoluments) and returns to capital are measured as value added minus the returns to labour on the assumption that returns to two factors of production exhaust the value added in the process of production.

In the study the focus is on the empirical measurement of (a) partial productivity (b) total factor productivity. Partial factor productivities measure the ratio of output to one of the inputs setting aside interdependence of the use of other inputs.

Labour productivity (V/L): It is measured as a ratio of value added to number of persons employed.

Capital productivity (V/K): It is measured as a ratio of value added to gross fixed capital.

An increase in factor inputs often may not bring about proportionate increases in their productivities. Sometimes an increase in one factor may influence the productivity of other factors for example, labour efficiency tends to improve with the adoption of improved technology. Therefore, the measurement of productivity by single factor input (capital or labour) would not be sufficient to interpret the trends of productive efficiency. As total factor productivity takes into account the productive efficiencies of both capital as well as labour, therefore, total factor productivity is a more comprehensive measure to understand the overall trends in productivity of both capital as well as labour. Trends in partial factor productivity, however, do provide an inference about the movement of total factor productivity index because it is a composite index of labour and capital productivity indices. The concept of total factor productivity is defined as the ratio of output to a weighted combination of inputs. Various total factor productivity indices are in vogue and they differ from each other with regard to the weighing scheme involved in their computation. The most important among these are Solow index and Translog index. Both Solow and Translog indices are used for analysis. Solow's Index is given by:

$$\text{or } dA(t)/A(t)=d(V/L)/V/L-bd(K/L)/K/L \qquad .....(3.24)$$

$d(V/L)/V/L$ is the rate of change in output per person, $d(K/L)/K/L$ is rate of change of capital per person and b is capital's share of output. This yields $dA(t)/A(t)$ series from which $A(t)$ series can be computed by assuming the initial value of A(t) as one. A Whole series of technical change can be derived from: A(t+1) = A(t)(1+ΔA(t)/A(t)) assuming that A(0)=1 ...(3.25)

Translog Index of total factor productivity is derived as:

$$\log V(T)-\log \bar{V}(T-1)=\bar{V}_K[\log K(T)-\log K(T-1)]+\bar{V}_L[\log L(T)-\log L(T-1)]+\bar{g}$$

............(3.26)

Where: $\bar{V}_K=1/2[V_K(T)+V_K(T-1)]$ and $\bar{V}_L = 1/2[V_L(T) + V_L(T-1)]$

V_K and V_L are income shares of the factors capital and labour respectively:

$\bar{g} = 1/2[g(T)+g(T-1)]$ ....(3.27)

Growth rates have been estimated from the following equation.

$Y=ab^t$ ....(3.28)

Taking logarithm of both the sides, the equation can be written as

$\log Y= \log a + t \log b$ ....(3.29)

In this equation, the time variable is independent and the concerned variable is dependent variable. Little attention has been paid in earlier studies to the explanation of observed productivity change. Taking the two-digit industry level productivity growth for the period 1974-75 to 1992-93 an attempt has been made to explain sector wise differences in productivity growth using regression models. Both ordinary least square regression and step wise regression models have been used for analysing the factors affecting productivity. The reason for using all these methods of measuring technological changes is that technical progress cannot be measured precisely, only its broad trends can be traced. Each of these methods explains some components of technological change which are utilised for building the entire picture.

CHAPTER-IV

PRODUCTIVITY TRENDS IN INDIAN MANUFACTURING

In this chapter productivity trends are calculated for the period 1973-74 to 1992-93 for the aggregate manufacturing sector as well for two digit and three digit level of disaggregation. The growth pattern of individual industries during the period 1973-74 to 1992-93 is also mapped out. The growth rates of inputs and value added have important analytical and policy implications for the economy. If the use of factors of production increases in an industry, the output should also increase. The divergence between growth of inputs like capital and labour has important implications for the nature of technical change. The study covers a period of twenty years from 1973-74 to 1992-93. This chapter is divided into three sections. In section 4.1, the findings at the level of aggregate data are discussed. A detailed analysis of growth rates of factor inputs value added, single factor productivity, capital intensity and total factor productivity is carried out for aggregate manufacturing sector for the entire period 1973-74 to 1992-93 as well as for sub periods, period I, 1973-74 to 1980-81 and period II, 1981-82 to 1992-1993. In section 4.2 a detailed analysis is done at two digit and three digit level of industries. Section 4.3 discusses the capital-output ratios at the aggregate level and at two digit level.

4.1 AGGREGATIVE ANALYSIS

In analysing the sources of economic growth in advanced countries, economists have reached a conclusion that it is technical progress rather than capital accumulation or labour which contributes the most to the growth in output. The understanding of the process of growth in developing countries is still quite hazy and is subject to conjecture. A general notion that prevails is that capital accumulation is the main source of growth largely because such countries suffer from paucity of capital to start with, and their adaptation to newer techniques is rather slow. Chenery, et al (1986) had found that for a group of developed economies total factor productivity growth (TFPG) accounted on average for nearly 50 per cent of total growth, for the developing economies the contribution of total factor productivity growth to output growth was only 31 percent. Pack (1988), however, has drawn attention to the fact that this was, to a large extent, due to a much faster (4.3 percent per annum) growth of factor inputs in developing economies than 2.7 per cent per annum in developed economies. The absolute growth of total factor productivity was 2.7 per cent per annum for the developed economies and 2 per cent for the developing economies.

Table A1 Growth Rates of Value Added, Capital and Employment and Productivity Trends in Indian Manufacturing (Aggregate Data)

	Entire Period	Period I	Period II
Value Added	11.91	8.06	12.22
Capital	10.64	7.04	9.74
Employment	1.05	5.13	0.12
Labour Productivity	6.13	3.71	7.91
Capital Productivity	-3.28	-6.01	-3.13
Capital Labour Ratio	6.87	10.05	11.17
Total Factor Productivity	0.54	-1.14	0.61

Computed

The picture that emerges for Indian manufacturing sector is even worse. The overall long term growth of 11.91 per cent per annum in value added in manufacturing sector during 1973-74 to 1992-93 is associated with a rapid growth of capital (10.64 per cent per annum) and a low growth of employment (1.05 per cent per annum). The entire growth of output is accounted for by the growth in factor inputs (mainly the capital). Comparing the annual growth rates during 1973-74 to 1980-81 with those of 1981-82 to 1992-93, it is found that there is a further rise in growth rate of value added from 8.06 per cent in period I to 12.22 per cent in period II.

Labour productivity for the whole period increases at an annual rate of 6.13 per cent while capital productivity registers a decline at a rate of -3.28 per cent per annum. Capital intensity for the period is 6.87 per cent per annum. Estimates for the sub periods reveal marked intertemporal differences in the growth rates. Labour productivity increases at a higher rate, i.e., at a 7.91 per cent per annum in the post 1981 period as against 3.71 per cent in the earlier period. Productivity of capital shows a negative trend in both the periods, but the rate of decline is less in the second period. There is no significant difference in the rate of increase in capital intensity during the two sub periods. Estimate of growth of total factor productivity for the entire period is 0.54. A robust finding is that annual rate of growth of total factor productivity is higher in the post 1981 period as compared to pre 1981 period when the growth rate was negative. This shows that there is an improvement in productivity during the period under analysis.

In the studies made by Beri (1962), Banerji (1975), Krishana and

Mehta (1968), Goldar (1986), Ahluwalia (1991), labour productivity shows an increasing trend while capital productivity shows a declining trend. In Banerji's study, labour productivity decreases in the years following 1948 but after 1952 it starts rising. Capital productivity shows a decline over the entire period 1946-58. In Krishna and Mehta's study for the period 1946-64, labour productivity increases by 42 per cent while capital productivity decreases by 18 percent. In Goldar's study for the period 1959-79, labour productivity increases at an annual rate of 3.58 per cent per annum while capital productivity declines at an annual rate of 1.14 per cent. In Ahluwalia's (1991) study the annual rate of growth of labour productivity was 4.9 per cent in the period 1959-60 to 1965-66, 1.46 per cent in 1965-66 to 1979-80 and 8.3 per cent in 1980-81 to 1985-86. The growth of capital productivity was -3.8, -1.9 and -0.5 per cent in the above periods respectively. Hashim and Dadi (1973) also observe a rising trend in labour productivity and capital intensity. This study also observes a rising trend for capital productivity as well. In Srivastava's (1996) study labour productivity increases at an average rate of 9 percent whereas capital productivity declines at an annual average rate of six per cent during the period 1981-82 to 1989-90. This study is based on a panel data of public limited companies. In the present study it is found that labour productivity shows an increasing trend and capital productivity presents a declining trend for the period 1973-74 to 1992-93. The results of present analysis are in agreement with the results of the earlier studies. Ahluwalia's study reports a rapid rise in labour productivity in the eighties. The rate of growth in labour productivity is higher in the second period, i.e., after 1981-82 as compared to that of the earlier period. The present study reports a sharper decline than reported by Ahluwalia in capital productivity from 1981-82 onwards.

The estimate of total factor productivity growth for the registered sector of Indian manufacturing (based on the Translog index) is 0.54 per cent per annum over the period 1973-74 to 1992-93. Total factor productivity growth is higher during the period 1981-82 to 1992-93 than during the earlier period. Estimate for pre 1981 period is -1.14 while in the post 1981 period total factor productivity growth increases to 0.61 per cent per annum. The estimate of total factor productivity growth for the registered sector in Indian manufacturing is similar to other estimates for registered manufacturing sector in the earlier studies. All the studies report a low or negative rate of growth of total factor productivity. Goldar's (1986) estimates of TFPG for the composite sector including large scale registered manufacturing sector and electricity tend to be relatively higher than other estimates in Table A2 although the highest TFPG shown in these estimates is still quite small i.e., 1.3 per cent per annum. Goldar builds in his methodology the assumption of a positive rate of discard of capital stock. The present study, like most other studies, uses a zero discarding of capital stock.

So, to analyse total factor productivity two sub periods are taken, period I 1973-74 to 1980-81; and period II, 1981-82 to 1992-93. Estimate for total factor productivity for the entire period is 0.54 per cent per annum. Estimate for pre 1981 period is -1.14 per cent per annum while for the post 1981 period it is 0.61 per cent per annum. An important feature of total factor productivity is that it largely reflects improvement in labour productivity. Moreover, the decline in capital productivity is not as marked as in period I.

Table A2 Total Factor Productivity Growth in Manufacturing: Alternative Estimates

Sr.No.	Study	Translog Index	Solow Index	Kendrick Index
1.	Current (1973-74 to 1992-93)	0.54	-	-
2.	Ahluwalia, I.J. (1960-86)	-0.4	-	-
3.	Rao, J.M.(1973-74 to 1992-93)			
	TFP (Single deflation)	1.3	-	-
	TFP (Double deflation)	2.2	-	-
4.	Balakrishnan & Puspangandan (1973-74 to 1988-89)			
	TFP (S. Deflation)	.0002	-	-
	TFP (D.Deflation)	-.05	-	-
5.	Mohanty (1970-71 to 1988-89)	.0092	-	-
6.	Brahmanada (1950-80)	-	-	-0.2
7.	Banerji, A. (1948-64)	-	-1.6	-
8.	Goldar, B (1960-78)	1.3	-	-
9.	Mehta, M. (1959-79)	-	-1.6	-2.5

4.2 SECTORWISE ANALYSIS

Food Products Sector

The growth rates of value added, capital and labour are presented in table 4.1(a). Value added depicts an annual growth rate of

Table 4.1 (a) Growth Rates of Value added, Capital and Labour for Food Products Sector

Industry Code	Value Added			Capital			Labour		
	Entire Period	Period I	Period II	Entire Period	Period I	Period II	Entire Period	Period I	Period II
200	14.33	17.74	12.11	12.06	24.96	7.88	7.36	4.04	0.21
201	10.49	7.92	15.34	11.39	13.78	11.58	5.65	7.49	4.37
202	11.25	11.38	5.86	11.44	10.24	10.85	3.66	7.73	2.00
203	10.02	15.17	13.15	9.81	18.19	8.33	5.81	13.95	4.03
204	08.51	12.49	6.32	12.13	12.86	9.98	4.98	7.67	2.86
205	5.99	2.49	7.19	11.60	11.74	9.99	3.98	2.12	3.84
206	8.27	6.33	6.18	10.41	15.25	9.39	-1.54	12.70	-2.75
207	2.81	5.28	-0.79	7.31	15.16	3.84	-0.54	11.95	5.69
208	4.06	11.25	5.38	9.37	15.29	6.38	0.24	7.88	-0.49
209	12.75	3.37	9.42	14.41	5.36	20.98	5.26	-3.56	10.06
210	4.74	13.46	3.47	11.06	10.58	11.51	1.25	1.61	1.52
211	6.68	1.55	9.65	14.10	13.54	16.11	0.64	-0.05	3.80
213	11.68	24.27	11.92	13.90	10.31	15.98	0.83	4.06	-0.83
214	3.04	4.07	7.21	8.52	12.00	8.14	-2.09	-0.62	-0.18
215	3.81	7.76	3.95	8.54	9.48	7.94	2.12	1.54	1.77
216	11.27	20.06	6.85	12.01	15.00	9.37	9.24	14.67	5.22
217	2.83	8.34	3.50	10.85	13.55	10.30	1.54	1.74	2.21
219	7.55	14.03	5.00	11.74	10.09	12.55	1.26	5.16	-2.04
220	5.66	1.08	10.68	11.88	16.55	11.62	3.79	8.97	3.09
20&21	7.91	5.97	7.82	11.03	14.16	10.26	0.62	8.39	-0.42

Computed

7.91 per cent for the entire period. An analysis of sub periods shows that the rate of growth is higher during the period 1981-82 to 1992-93 than during the earlier period. Capital grows at a rate of 11.03 per cent per annum. This rate of growth in post 1981 period is 10.26 as against 14.16 per cent per annum in the first period. There is a decline in rate of growth of employment from 8.39 per cent in the first period to -0.42 per cent per annum in the latter period.

Table 4.1(b) presents the growth rates of partial productivities and capital intensity. The sector shows a growth in output labour ratio over the period at a rate of 4.28 per cent per annum. The decline in labour productivity at a rate of -2.17 per cent in the earlier period is reversed by a positive and rising trend rate of 8.26 per cent in the latter period. Capital productivity for the group as a whole declines at a rate of -2.81 per cent per annum. The rate of decline is very sharp in the first period as compared to that in the post 1981 period. Slaughtering, preparation and preservation of meat industry (200) is an exception. It has a positive rate of growth of capital productivity for the entire period as well as for the sub periods. Three industries needing mention here are dairy products (201); canning preserving and processing of fish (203); and prepared animal feeds industry (216). These industries show positive rates of growth of capital productivity for the second period of analysis. Capital intensity for this sector is 4.31 per cent per annum for the entire period. The rate of growth of capital intensity is high in the pre 1981 period.

Table 4.1(b) Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity for Food Products Sector

Industry Code	Labour Productivity			Capital Productivity			Capital Intensity		
	Entire Period	Period I	Period II	Entire Period	Period I	Period II	Entire Period	Period I	Period II
200	6.45	13.02	11.80	2.03	2.62	3.92	-1.02	-1.96	3.16
201	4.97	0.89	10.28	-0.81	-5.15	3.37	1.74	3.13	1.66
202	6.43	0.21	3.45	-0.17	1.02	-4.51	3.47	0.36	4.22
203	4.71	1.58	9.48	0.19	-2.54	4.45	2.92	6.74	1.45
204	4.42	5.89	3.88	-3.22	-0.34	-3.31	4.42	-0.64	3.31
205	4.22	-2.22	3.44	-5.03	-8.27	-2.55	5.44	14.08	3.86
206	9.64	-6.32	9.02	-1.93	-7.74	-2.92	3.40	9.08	1.81
207	0.89	-1.37	5.30	4.20	-8.59	-4.46	3.83	7.12	3.59
208	3.71	3.37	5.80	-4.85	-3.53	-0.94	5.74	9.44	2.05
209	6.57	5.27	8.13	-1.46	-1.91	-1.28	4.12	2.62	2.23
210	3.14	1.98	1.58	-5.68	2.60	-7.19	6.00	5.17	5.94
211	6.24	0.63	5.58	-6.49	-10.56	-5.55	7.61	11.33	2.90
213	10.64	19.40	12.54	-1.94	12.76	-3.49	7.52	3.38	8.21
214	5.81	-4.30	7.80	-5.05	-14.34	-0.86	7.53	7.21	1.11
215	2.16	6.14	2.41	-4.37	-1.59	-3.70	4.18	5.88	2.65
215	2.16	6.14	2.41	-4.37	-1.59	-3.70	4.18	5.88	2.65
216	2.38	5.07	1.78	0.67	-0.37	2.31	-0.41	-1.20	-2.06
217	1.71	4.63	1.19	-7.23	-4.58	-6.16	-0.41	-1.20	-2.06
219	6.46	7.33	6.74	-3.76	3.57	-6.16	6.75	4.92	0.08
20&21	4.28	-2.17	8.26	-2.81	-7.15	-2.21	4.31	7.40	2.82

Computed

Table 4.1(c) Growth Rates of Total Factor Productivity in Food Products Sector

Industry Code	Industry	TFPG
200	Slaughtering, preparation and preservation of meat	0.28
201	Dairy products	0.192
202	Canning and preservation of fruits and vegetables	0.242
203	Canning, preserving and processing of fish, crustacean and similar foods	0.203
204	Grain mill products	-0.101
205	Bakery products including bread and biscuits	0.054
206	Sugar	0.088
207	Boora, khandsari, gur etc from sugar cane	-0.016
208	Common salt	0.206
209	Cocoa, Chocolate and sugar confectionery	0.187
210	Hydrogenated oil	-0.227
212	Tea processing	-0.227
213	Coffee curing, Roasting and grinding	-0.065
214	Cashewnut processing like drying, shelling roasting, salting etc	-0.060
215	Ice	-0.303
216	Prepared animal feeds	-0.024

Contd.....

Industry Code	Industry	TFPG
217	Starch.	-0.073
218	Food products not elsewhere classified	-0.136
20,21	Food Products	
Entire period		0.108
Period I		-0.38
Period II		0.48

Computed

The growth rates of total factor productivity are presented in table 4.1(c). Productivity for the food products sector as a whole increases at a rate of 0.108 percent per annum. An analysis of the sub periods reveals that the growth rate improves in the post 1981 period. Five industries in this group show comparatively higher productivity growth. These are : (a) slaughtering preparation and preservation of meat (200); (b) dairy products (201); (c) canning, preserving and processing of fish (202); (d) cocoa, chocolate and sugar confectionary (209) and (e) common salt (208).

A detailed analysis of these industries reveals the fact that with the exception of slaughtering, preparation and preservation of meat labour productivity improves in the second period for all other industries. Even though in slaughtering, preparation and preservation of meat the growth rate in labour productivity falls slightly, it is still 11.80 per cent per annum. Moreover, in this industry capital productivity is positive for both the periods as well as for the entire period. Capital productivity improves and becomes positive in dairy products and canning, preserving and processing of fish. In the other two industries the rate of decline in capital productivity is less in the latter period, as compared to that in the earlier period.

An analysis of the food sector highlights that this sector is a growing sector of the economy so far as the output is concerned. The second period shows a larger growth as compared to the first one. The growth rates of labour and capital input are higher in the pre 1981 period than in the post 1981 period. The period 1981-82 to 1992-93 is marked by a shrinkage in growth of labour employment and a significant increase in labour productivity growth rate. Capital productivity growth rate is negative in both the periods but the rate of decline is less in the post 1981 period. The total factor productivity analysis is indicative of the fact that this is a growing sector of the economy. A detailed analysis of industries in this group points out the fact that the industries showing better performance in terms of overall productivity are the ones which show improvement in capital productivity. These industries have also performed well in terms of labour productivity.

Beverages, Tobacco and Tobacco Products Sector

Table 4.2(a) presents data on growth of value added and factor inputs. An analysis of this sector is indicative of the fact that there has been a rapid growth in the value added, i.e., at a rate of 6.84 per cent per annum for the entire sector, and that there has been an acceleration in the rate of growth of industrial output in the eighties onwards era. Analysis of factor inputs for this sector shows that capital input has grown at a rate of 12.24 per cent and labour at a rate of 4.68 per cent per annum for the entire period, 1973-74 to 1992-93. The rate of growth of capital is almost the same for both the sub periods. The growth of labour has been at a rate of 4.31 per cent per annum in eighties onwards era as against 11.21 per cent per annum in the pre eighties period. Most of the industries covered in this group depict a high growth rate in value added and capital input. All the industries in this sector report a fall in employment growth rate in the eighties onwards era.

Table 4.2(a) Growth Rates of Value Added, Capital and Labour in Beverages, Tobacco and Tobacco Products Sector

Industry Code	Value Added			Capital			Labour		
	Entire Period	Period I	Period II	Entire Period	Period I	Period II	Entire Period	Period I	Period II
221	5.99	5.05	6.17	10.84	21.23	13.67	6.00	5.72	3.51
222	12.57	12.47	6.28	14.19	14.28	13.85	6.06	6.16	3.62
223	9.34	17.81	3.96	16.00	13.70	17.42	8.16	12.11	9.84
224	8.28	7.69	9.43	10.45	10.36	12.19	4.62	3.71	1.98
225	3.66	6.30	-0.01	8.64	9.69	9.20	-6.10	1.09	-1.68
226	11.56	6.87	6.91	17.22	21.75	13.43	9.30	6.88	5.60
227	4.98	0.01	10.43	10.35	10.64	11.28	-0.34	1.61	0.15
228	5.25	0.93	6.61	10.82	5.26	12.24	0.93	7.46	1.62
229	17.66	16.61	9.15	13.18	7.12	12.64	3.31	6.65	8.74
(22)	6.84	4.57	10.56	12.24	12.22	12.90	4.68	11.21	4.31

Computed

An analysis of partial productivities highlights that labour productivity has grown at a rate of 2.08 per cent per annum. A note- worthy development of this sector is that labour productivity growth rate which has been negative for the first period registers a positive growth rate of 8.26 per cent per annum in the second period. Capital productivity registers a negative growth rate of 4.81 per cent per annum for the entire period and the rate of decline is high in the pre eighties period. Capital intensity records a significant improvement in growth rate in the eighties onwards era.

Table 4.2(b) Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity in Beverages, Tobacco and Tobacco Products Sector

Industry	Labour Productivity			Capital Productivity			Capital Intensity		
Code	Entire Period	Period I	Period II	Entire Period	Period I	Period II	Entire Period	Period I	Period II
220	1.78	-7.34	7.06	-5.56	-13.27	-0.83	4.63	7.33	2.98
221	0.11	-2.26	1.60	-4.38	13.34	06.61	4.80	4.63	7.28
222	5.52	4.66	2.71	-1.42	-1.61	-11.46	2.75	0.72	1.26
223	1.37	4.68	-4.80	-5.74	3.61	-11.46	2.75	0.72	1.26
224	2.37	4.32	6.61	-4.21	-3.26	-2.31	4.75	5.21	4.25
225	4.06	4.78	4.01	-7.62	-3.09	-8.50	12.26	7.53	13.23
226	2.52	0.63	1.36	-4.83	4.21	-5.76	5.17	5.29	7.01
227	5.38	-1.28	10.48	-4.87	-9.61	-0.76	8.59	8.81	8.33
228	2.97	2.52	3.76	-5.03	04.11	-5.55	5.09	5.81	8.33
229	4.12	3.42	5.26	-4.48	-8.29	-3.52	12.14	16.21	11.59
22	2.08	-6.04	8.26	-4.81	-6.82	-2.07	5.66	2.15	7.34

Computed

Table 4.2(b) also highlights that malt liquors and malt (222) and cigars cigarettes, cheroot and cigarette tobacco (227) have a rate of growth of labour productivity above five per cent per annum for the entire period.

Table 4.2 (c) Growth Rates of Total Factor Productivity in Beverages, Tobacco and Tobacco Products Sector

Industry Code	Industry	TFPG
220	Distilling, rectifying and blending of spirit	0.042
221	Wine industries	-0.197
222	Malt liquors and malt	0.159
223	Country liquor and toddy	0.034
224	Soft drinks and carbonated water industries.	0.312
225	Preparing raw leaf Tobacco for manufacture	0.028
226	Bidi	0.039
227	Cigars, cigarettes, cheroot and cigarette tobacco	0.312
228	Chewing tobacco, zarda and snuff	-0.066
229	Other tobacco products.	0.092
22 Entire Period	Beverages, Tobacco and Tobacco Products	0.04
Period. I		-2.23
Period.II		0.08

Computed

Total factor productivity indices of the beverages sector are shown in Table 4.2(c). This group as a whole registers a mild positive growth rate. In the period, 1981-82 to 1992-93 there is a surge in the rate of growth of total factor productivity. The pre 1981 period is marked by a decline at a rate of -2.23 per cent per annum. Soft drinks and carbonated water industry (224) and cigars, cigarettes, cheroot and cigarette tobacco industry (227) show comparatively higher growth in total factor productivity. These industries are characterised by higher growth in capital, value added and labour productivity in the post 1981 period. Capital productivity rate in these industries shows an improvement in this period.

The overall analysis of this group indicates that output growth is quite satisfactory. Furthermore, the output growth rate registers an increase in the eighties onwards era. As compared to the pre-eighties period the labour input registers a decline and the capital input growth registers a very small increase. As capital intensity records a strong acceleration in the eighties onwards period compared with the earlier period, there is an increase in the growth of labour productivity. Capital productivity remains negative throughout the period although the rate of decline in the second period is less. The sector as a whole shows total factor productivity growth of 0.04 per cent per annum. The results indicate that with a gradual increase in capital deepening over successive periods the beverages sector shows a distinctly better performance with respect to labour productivity and it also shows a slight improvement in total factor productivity growth in post 1981 period.

Cotton Textiles Sector

The cotton textiles sector occupies an important position in Indian economy. The cotton textiles is one of the oldest industries. The structure of the textile industry is extremely complex with the modern sophisticated and highly mechanised mill sectors on the one hand and spinning and hand weaving (handloom) sector on the other. Despite being a major industrial group, the performance of this sector is not very satisfactory.

Table 4.3(a) Growth Rates of Value Aadded, Capital and Labour in Cotton Textiles Sector

Industry Code	Value Added			Capital			Labour		
	Entire Period	Period I	Period II	Entire Period	Period I	Period II	Entire Period	Period I	Period II
230	3.84	4.69	2.97	7.24	9.11	6.76	-1.43	4.14	-2.02
231	1.92	4.83	3.25	2.41	11.56	7.57	-2.35	0.54	-3.29
232	6.42	10.64	4.63	11.99	18.96	8.36	2.52	7.75	-0.26
233	8.14	10.24	9.99	7.97	0.72	3.36	5.76	-10.28	6.60
234	5.81	2.72	3.61	5.52	6.95	9.69	7.29	7.98	12.18
235	6.58	3.93	7.48	16.98	8.56	10.93	1.34	-0.28	-0.29
2.36	6.18	4.23	6.11	11.76	15.48	10.57	2.40	5.31	1.51
(23)	3.26	5.33	2.02	9.51	11.69	7.75	1.66	0.51	-2.66

Computed

The industrial output has grown at a rate of 5.33 per cent per annum in pre eighties as against 2.02 per cent per annum in the eighties onwards period. The analysis of the input structure underscores the fact that capital input has grown at the rate of 9.51 per cent per annum and employment has declined at a rate of 2.66 per cent per annum for the entire period under study. The capital input has grown at a rate of 7.75 per cent in period II as against 11.69 per cent in period I. Employment growth has become negative in period II as against being positive in period I. Most of the industries covered in this group depict a higher growth rate of value added in pre eighties period and decline in employment growth rate in the eighties onwards period.

Table 4.3(b) Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity in Cotton Textiles Sector

Industry	Labour Productivity			Capital Productivity			Capital Intensity		
Code	Entire Period	Period I	Period II	Entire Period	Period I	Period II	Entire Period	Period I	Period II
230	4.37	12.90	5.38	-3.16	-4.06	-3.52	2.60	4.20	1.16
231	4.23	4.14	6.67	-6.85	-6.04	-4.02	9.94	9.15	8.27
232	3.83	2.92	5.18	-4.97	-7.01	-3.55	8.73	10.33	5.82
233	5.01	1.43	3.99	-6.54	-6.83	5.84	5.37	5.19	4.96
234	3.74	3.22	4.12	-5.22	-5.62	-4.82	6.52	8.16	7.14
235	4.07	2.19	5.19	4.53	4.26	4.12	6.99	6.01	6.34
236	4.04	0.44	4.62	-5.00	-9.71	-4.04	7.24	6.23	5.48
(23)	1.95	4.79	1.65	-8.44	-5.70	-8.13	9.49	9.00	7.80

Computed

An analysis of partial productivities highlights that the labour productivity has grown at the rate of 1.95 per cent per annum for the entire period under study. Growth of labour productivity has been 1.65 per cent in period II as against 4.79 per cent per annum in the pre eighties era. Capital productivity has been -8.44 per cent per annum for the entire period. The rate of growth of capital productivity has been -8.13 per cent in period II as against -5.70 per cent in period I. Most of the three digit industries covered in this group show a trend rate of labour productivity between three and five per cent per annum for the entire period. An important feature of this sector is that capital productivity growth rate is positive for cotton weaving and handloom industry (235) and it also becomes positive for cotton spinning (other than in mills) industry (233) in the second period.

Table 4.3(c) Growth Rates of Total Factor Productivity in Cotton Textiles Sector

Industry Code	Industry	TFPG
230	Cotton ginning, cleaning and bailing	0.06
231	Cotton Spinning, weaving and finishing in mills	-0.018
232	Printing and dyeing of cotton textiles	-0.123
233	Cotton Spinning other than in mills	0.779
234	Production of Khadi	0.323
235	Cotton weaving on handlooms, other than Khadi	0.292
236	Cotton weaving on powerlooms	0.076
23 Entire Period	Cotton Textiles	-0.010
Period. I		0.72
Period. II		0.15

Computed

Total factor productivity indices for the group are given in table 4.3(c). Cotton textiles which is one of the larger sectors in the Indian manufacturing experiences a negative annual growth of -0.01 in total factor productivity for the entire period of analysis. The growth rate is more in the earlier period as compared to that in the latter period. It is surprising that the two industries namely (a) cotton spinning other than in mills (233); (b) production of khadi (234) and cotton weaving on handloom (235) show a comparatively higher annual growth rate of total factor productivity.

On the basis of analysis of cotton textile sector we conclude that output growth rate has remained almost stagnant for the period under observation. As compared to pre eighties era when output growth was positive, output rather started falling. Both labour and capital inputs also behave in the same manner. In both the cases the annual growth rates are higher in the pre 1981 period as compared to those in the post 1981 period. Capital productivity growth rate Which is already negative has further deteriorated. Growth of productivity of labour inspite of high capital intensity has also slowed down in the eighties onwards phase. The sluggish performance of this sector could be attributed to poor labour and capital productivity for the period under consideration. The negative trend rate of growth of total factor productivity indicates that this sector failed to record any appreciable technological progress. Infact, cotton spinning, khadi and hand weaving and handloom sector have performed well as compared to the highly mechanised mill sector.

Wool, Silk and Synthetic Fibre Textiles Sector

Trends for various summary statistics for this sector are discussed in Table 4.2a, 4.2b and 4.2c. This sector shows a rate of growth of 8.85 per cent per annum in value added for the entire period, 1973-74 to 1992-93. The rate of growth in value added registers a small increase in the eighties onwards era as compared to the first period. The rate of growth of capital input is 14.59 for the entire period and the rate of growth is more in the first period as compared to that in the second period. The eighties onwards period shows a decline in employment growth rate. Most of the three digit industries covered in this sector reveal a growth in value added above six percent per annum for the entire period except dyeing and bleaching of woollen textiles industry (243) and printing and dyeing of silk textiles (246).

Table 4.4(a) Growth Rates of Value Added, Capital and Labour in Wool, Silk and Synthetic Fibres Sector

Industry Code	Value Added			Capital			Labour		
	Entire Period	Period I	Period II	Entire Period	Period I	Period II	Entire Period	Period I	Period II
241	6.78	10.25	5.71	13.84	18.79	11.08	1.55	-1.46	-1.20
242	10.00	2.95	6.35	11.15	2.02	19.30	1.72	-19.17	4.60
243	3.71	-7.98	-3.56	2.65	0.49	2.03	-6.71	-3.67	-8.45
245	6.74	3.33	11.43	14.16	2.47	15.74	-1.95	-5.09	-1.48
246	2.04	-9.64	14.45	10.31	6.77	14.07	-3.05	13.99	2.88
247	10.88	7.63	11.82	14.99	15.28	12.15	4.47	6.60	1.56
248	13.63	20.45	12.03	15.83	24.13	12.02	6.10	13.81	-5.70
(24)	8.85	7.56	7.75	14.59	15.54	11.98	3.46	5.66	-1.29

Computed

An analysis of partial productivities highlights that labour productivity has grown at a rate of 5.21 per cent per annum for the entire period under study. Growth in labour productivity registers a strong acceleration in the eighties onwards era when the rate of growth is 6.39 as compared to 1.81 per cent per annum in the earlier period. The capital productivity growth has been negative for the period. It is -5.01 per cent per annum for the entire period. The rate of growth is -6.89 per cent per annum in period I as against -3.78 in period II. This sector shows a high growth rate of capital intensity in the pre 1981 period. Only dyeing and bleaching of woollen textiles (243) has a growth rate of 3.29 per cent per annum in labour productivity whereas all others have a growth rate above five per cent per annum for the entire period.

Table 4.4(b) Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity in Wool, Silk and Synthetic Fibres Sector

Industry	Labour Productivity			Capital Productivity			Capital Intensity		
Code	Entire Period	Period I	Period II	Entire Period	Period I	Period II	Entire Period	Period I	Period II
241	5.86	3.29	7.12	-6.20	-7.19	-4.84	10.27	9.62	9.36
242	8.19	0.69	9.82	-1.03	-1.86	-0.92	6.25	7.93	3.85
243	3.29	-3.46	5.22	-6.19	-8.46	-5.47	10.59	11.74	1.06
245	8.94	8.89	12.99	-6.49	0.85	-3.72	11.26	5.68	10.58
246	5.35	4.87	11.12	-7.49	-1.54	0.34	12.31	12.30	9.64
247	6.02	1.02	9.83	-3.58	-6.65	0.29	7.77	8.84	7.48
248	7.37	6.12	9.18	-1.90	-2.97	0.01	7.03	3.91	6.43
(24)	5.21	1.81	6.39	-5.01	-6.89	-3.78	8.16	8.15	7.61

Computed

All the three digit industries in this sector show a higher growth in labour productivity in the second period as compared to the pre eighties period. Capital productivity growth rate is negative for all the three digit industries covered in this sector for the entire period. Capital productivity growth rate becomes positive for printing and dyeing of silk textiles (246), spinning and weaving of other textiles (247) and printing and dyeing of synthetic textiles (248) in the eighties onwards period.

Table 4.4 (c) Growth Rates of Total Factor Productivity in Wool, Silk and Man Made Fibre Textiles Sector

Industry Code	Industry	TFPG
241	Wool spinning and weaving in mills	0.084
242	Wool spinning, weaving and finishing other than in mills	0.547
243	Dyeing and bleaching of woollen textiles	-0.005
245	Spinning and weaving of silk textiles	0.283
246	Printing and dyeing of silk textiles	0.131
247	Spinning, weaving and processing of other textiles, synthetic fibres, rayons, nylons etc	-0.005
248	Printing and dyeing of synthetic tex.	-0.123
24 Entire Period	Wool, Silk and Man Made Fibre Textiles	0.003
Period. I		-0.010
Period. II		-0.236

Computed

Considering the period as a whole there is an extremely mild positive growth (.003) per cent per annum in total factor productivity [Table 4.4c] trend. However, the performance of this group is to be regarded as poor as is evident from negative total factor productivity growth in both the periods. Wool spinning, weaving and finishing other than in mills industry (242) shows a growth rate of 0.547 per cent per annum. This industry shows a high rate of growth of labour productivity and a lower rate of decline in growth of capital productivity in the post 1981 period.

All these factors point out that this sector has not experienced any appreciable technological progress. Detailed analysis of this group is indicative of the fact that value added is mainly due to increase in capital input. As far the employment growth is concerned, there has been a slowdown in the period 1982-83 to 1992-93. While labour productivity growth rate registers an increase in the eighties onwards period, capital intensity rate registers a small decline in this period. Capital productivity growth shows a negative trend for the entire period as well as for both the sub periods. The Translog index of total factor productivity shows an extremely mild positive growth for the entire period.

Jute, Hemp and Mesta Textiles Sector

Jute Textiles is one of the oldest sector. The overall growth rate of value added is a negative -3.98 per cent per annum for this sector. In terms of value added the rate of growth was 5.29 per cent per annum in the pre-eighties period. But eighties onwards period is characterised by a negative growth rate of -3.43 per cent per annum.

An analysis of the input structure highlights that the rate of growth of both capital and labour is deteriorating over time. The rate of growth of capital is only 5.96 per cent in the second period as against 8.20 per cent in the first one. Labour input growth rate is -4.35 in period II as against 0.97 in period I.

Table 4.5(a) Growth Rates of Value Added, Capital and Labour in Jute, Hemp and Mesta Textiles Sector

Industry Code	Value Added			Capital			Labour		
	Entire Period	Period I	Period II	Entire Period	Period I	Period II	Entire Period	Period I	Period II
250	3.16	8.14	-0.40	4.00	5.49	3.85	-6.29	4.62	-4.63
251	-2.64	1.74	-5.97	4.94	7.89	2.79	-0.38	0.75	-2.62
252	-4.24	2.53	-4.68	9.15	10.36	8.48	-3.78	1.44	-4.30
25	-3.98	5.29	-3.43	5.11	8.20	5.96	-1.76	0.97	-4.35

Computed

Table 4.5(b) Growth rates of Labour Productivity, Capital Productivity and Capital Intensity in Jute, Hemp and Mesta Textiles Sector

Industry Code	Labour Productivity			Capital Productivity			Capital Intensity		
	Entire Period	Period I	Period II	Entire Period	Period I	Period II	Entire Period	Period I	Period II
250	4.12	-0.36	3.77	-7.06	-6.39	-4.7	12.23	9.08	15.27
251	0.91	0.93	1.02	-2.56	-5.69	0.92	8.89	6.52	6.40
252	-0.55	-1.09	-3.21	-4.27	-6.64	-7.58	16.16	18.08	24.2
25	3.34	4.30	2.58	-8.17	-2.69	-3.37	7.05	6.84	5.89

Computed

An analysis of partial productivities [Table 4.5b] highlights that both labour and capital productivity are shrinking overtime. Labour productivity as against rate of growth of 4.30 per cent in period I has come down to 2.58 per cent per annum in period II. Similarly, capital productivity growth rate has become -3.37 per cent in period II as against -2.69 per cent per annum in period I. Annual growth rate of capital intensity has also slowed down in the eighties onwards phase.

Table 4.5(c) Growth Rates of Total Factor Productivity in Jute, Hemp and Mesta Textiles Sector

Industry Code	Industry	TFPG
250	Jute and Mesta pressing and bailing	-0.279
251	Jute and Mesta: Spinning and weaving	0.809
252	Bleaching, dyeing and Printing of Jute and Mesta textiles, jute bags and other Jute textiles	-0.014
25 Entire period	Jute, Hemp and Mesta Textiles	-0.77
Period I		-0.17
Period II		-1.31

Computed

Total factor productivity growth for this sector shows a negative rate of -0.77 per cent per annum for the entire period. Growth rate already negative in the first period has further deteriorated in post 1981 period. Only jute and mesta spinning and weaving industry

[251] shows a rate of growth of 0.809 per cent per annum. Most likely, the reason for the growth in total factor productivity is an improvement in capital productivity in the second period.

An analysis of this industrial group highlights the fact that value added growth rate which is positive and above five per cent in pre 1981 period becomes negative in the post 1981 period. Capital input records a steeper increase in growth rate in pre eighties periods as compared to that in the second period. There is a strong decrease in the growth of labour employment in the period 1981-82 to 1992-93. The slowdown in the growth in value added in post 1981 period is accompanied by a decline in rate of labour productivity and capital productivity. Capital Intensity growth rate has been 5.89 per cent in the second period as against 6.84 per cent per annum in the first period. All these indicators point towards a declining overall productivity of factor inputs.

Manufacture of Textile Products (Including Wearing Apparel) Sector

Value added in this group records a rate of growth of 10.34 per cent per annum. There is an appreciable increase in the growth rate of value added in the second period. The rate of growth is 13.29 per cent per annum in post 1981 period as against 8.65 per cent per annum in pre 1981 period. Capital input has increased at an annual rate of 12.00 per cent. Employment has increased at an annual rate of 4.94 per cent. On splitting the period, it is found that the rate of growth of employment has declined from 7.03 per cent per annum in pre eighties to 6.82 per cent per annum in the eighties onwards era.

Table 4.6(a) Growth Rates of Value Added, Capital and Labour in Manufacture of Textile Products Sector

Industry Code	Value Added			Capital			Labour		
	Entire Period	Period I	Period II	Entire Period	Period I	Period II	Entire Period	Period I	Period II
260	9.14	2.83	11.42	13.09	12.88	13.95	5.47	-0.01	8.03
261	4.97	-3.25	5.42	13.27	12.80	14.47	1.66	-1.70	4.86
262	1.46	-3.63	2.19	4.61	6.72	4.24	5.06	-0.08	-5.44
263	5.86	9.71	3.56	18.01	15.17	9.21	-1.47	5.86	-7.62
264	16.29	17.28	22.18	17.49	14.84	17.81	8.79	17.56	10.41
265	16.29	17.28	22.18	4.61	4.10	3.79	-9.10	17.56	10.41
266	18.9	4.65	12.37	16.48	15.03	20.07	12.80	4.26	9.94
267	3.56	3.24	6.93	12.98	14.49	11.64	0.75	-0.40	4.30
268	3.50	3.14	4.46	8.46	17.26	4.2	-4.20	3.27	-3.00
269	7.23	-0.36	12.89	12.77	10.05	9.74	3.43	-3.88	9.36
26	10.34	8.65	13.29	12.00	14.10	10.38	4.94	7.03	6.82

Computed

As far as the partial productivity performance [Table 4.6b] is concerned the second period presents a better picture. The growth in labour productivity recorded for the second period is 6.05 per cent per annum as against 1.58 per cent per annum in the pre eighties era. The rate of growth of capital productivity is -0.95 per cent per annum in the latter period as compared to -7.22 per cent per annum in the former period. There is a slowdown in the rate of growth of capital intensity in the period 1981-82 to 1992-93.

Table 4.6(b) Growth Rates of Labour Productivity, Capital productivity and Capital Intensity in Manufacture of Textile Products Sector

Industry Code	Labour Productivity			Capital Productivity			Capital Intensity		
	Entire Period	Period I	Period II	Entire Period	Period I	Period II	Entire Period	Period I	Period II
260	4.20	3.13	3.40	-3.50	-8.91	-2.23	4.87	11.29	2.59
261	3.04	-1.95	0.11	-7.32	-8.22	7.91	8.02	11.57	7.00
262	2.18	-8.14	7.92	-5.80	-9.70	-1.95	7.29	4.68	6.33
263	6.69	1.64	1.15	-10.29	-2.44	-5.16	-15.79	18.48	13.08
264	6.82	-0.68	10.65	-1.02	-6.06	-3.71	6.45	4.66	6.04
265	5.01	2.34	5.12	-2.01	-5.60	-3.46	7.75	5.33	7.92
266	5.33	7.09	7.28	-5.99	10.84	-2.58	7.34	9.53	4.23
267	4.53	-3.40	7.52	-6.35	-10.49	-2.22	9.18	10.74	7.21
268	6.29	-0.99	7.30	-6.42	-13.74	-2.26	12.13	10.41	15.75
269	0.14	-0.80	2.42	-9.72	-9.45	-12.99	11.50	9.84	14.69
26	5.14	1.58	6.05	-3.21	-7.22	-0.95	6.74	8.79	5.46

Computed

The performance of the three digit industries covered in this group is satisfactory. Five industries have labour productivity growth rate above five per cent per annum. These are (a) weaving carpets, rugs and other similar textile products (263); (b) all types of textile garments including wearing apparel (264); (c) rain coats, hats etc (265), (d) made up textile goods such as curtains, mosquito nets etc (266); and (e) coir and coir products (268). Capital productivity growth rate has become positive in threads, ropes and nets etc industry (261) in the post 1981 period.

Table 4.6(C) Growth Rates of Total Factor Productivity in Manufacture of Textile Products Sector

Industry Code	Industry	TFPG
260	Knitting Mills	0.189
261	Threads, ropes, nets etc	-0.091
262	Embroidery & making of crepes, laces and fringes	0.047
263	Weaving carpets, rugs & other similar textile products	0.243
264	All types of textile garments including wearing apparel	0.319
265	Rain coats, hats etc	-0.405
266	Made up textile goods such as curtains, mosquito nets etc	-0.361
267	Water proof textiles such as oil-cloth, tarpaulin etc	0.529
268	Coir and coir products	0.467
269	Other textiles like linoleum, padding, upholstering etc	-0.07
26 Entire Period	Textile Products	0.162
Period I		-0.886
Period II		0.006

Computed

Table 4.6(c) depicts growth rates of total factor productivity in textile products. This group shows a negative growth rate in pre 1981 period. There is a slight improvement in growth rate in the post 1981 period. For the entire period the growth rate is 0.162 per cent per annum. Water proof textiles (267) and coir products (268) show a comparatively higher growth rate than other industries in the group. Both these industries show a growth rate above seven per cent per annum in labour productivity during the period 1981-82 to 1992-93. This is also accompanied by a lower rate of decline in capital productivity in the second period. The increase in labour productivity in coir and coir products (268) is accompanied by an increase in capital intensity rate in the post 1981 period.

The picture that emerges for this sector is that output growth already high in 1981 records a further increase in post 1981 period. Both labour and capital inputs register a decline in growth rate in the period 1981-82 to 1992-93 as compared to the earlier period. Labour productivity shows a sharp increase in eighties onwards era. Capital productivity shows a lower rate of decline in the second period. A high growth rate of labour productivity, a slight improvement in capital productivity and total factor productivity rate indicates that the performance on productivity front is improving in the post 1981 period.

Wood and Wood Products, Furniture and Fixtures Sector

Output in this sector grows at a rate of 2.65 per cent per annum. The trend rate is negative for the first period, i.e., -1.90 per cent per annum and it is 3.28 per cent per annum in the second period. Capital registers a growth rate of 9.77 per cent per annum, the rate being more in period I in relation to period II. The employment growth has slowed down with a growth rate being -1.49 per cent in the period 1981-82 to 1992-93 as against 1.05 in the earlier period. The group, as a whole, experiences a negative trend rate of -0.84 per cent per annum in employment.

Table 4.7(a) Growth Rates of Value Added, Labour and Capital in Wood and Wood Products, Furniture and Fixtures Sector

Industry	Value Added			Capital			Labour		
Code	Entire Period	Period I	Period II	Entire Period	Period I	Period II	Entire Period	Period I	Period II
270	4.23	-0.82	5.82	11.19	15.44	10.96	2.17	4.55	1.77
271	0.44	1.57	0.26	7.11	9.51	2.91	-2.24	1.34	-5.04
272	-1.20	10.41	0.77	6.03	9.87	4.92	-3.43	-4.10	-3.83
273	4.65	3.48	7.14	0.37	8.01	13.52	1.77	5.10	2.32
274	2.27	-3.76	-3.17	8.50	11.40	4.16	-4.29	-2.85	-7.22
275	3.37	8.05	1.22	12.09	12.60	10.92	-2.51	12.87	-6.92
276	-0.35	-1.89	1.36	7.71	10.36	6.59	-2.96	-5.24	-2.71
277	4.38	1.97	-4.53	15.16	15.89	2.39	1.71	0.40	5.70
27	2.65	-1.90	3.28	9.77	12.74	8.04	-0.84	1.05	-1.49

Computed

Table 4.7(b) depicts growth rates of partial productivity and capital intensity. As far as the labour productivity is concerned, the post 1981 period presents a better picture with a growth rate of 4.83 per cent per annum as against -2.97 in period I. Capital intensity for the group increases at a rate of 7.58 per cent for the entire period. The eighties onwards period is also characterised by an improvement in capital productivity but it still has a negative growth rate. Sawing of wood industry (271) shows a comparatively higher growth in labour productivity than others in the group. Capital intensity growth rate is high in manufacture of wooden industrial goods (274) and other products of wood, bamboo and cane (277).

Table 4.7(b) Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity in Wood and Wood Products Sector

Industry	Labour Productivity			Capital Productivity			Capital Intensity		
Code	Entire Period	Period I	Period II	Entire Period	Period I	Period II	Entire Period	Period I	Period II
270	2.14	-5.29	3.95	-4.28	-4.09	-2.64	7.08	10.13	6.93
271	3.13	0.67	5.15	-6.23	-1.20	-2.56	6.59	5.75	4.87
272	2.81	4.50	4.12	-6.81	0.49	-4.63	4.43	5.90	5.75
273	2.67	-1.21	4.31	-6.88	-4.81	-5.62	8.34	6.94	6.77
274	2.27	-2.63	4.0	-9.9	-13.61	-7.67	10.31	15.19	10.31
275	-1.75	-4.56	1.28	-13.8	-11.86	-8.74	8.39	7.47	8.21
276	2.33	2.82	3.68	-7.49	-11.11	-4.90	6.32	9.32	5.19
277	2.97	2.12	8.05	-9.37	12.01	-6.78	11.69	11.68	3.12
27	3.52	-2.97	4.83	-6.49	-12.99	-4.40	7.58	8.99	6.80

Computed

Table 4.7(c) depicts growth rates of total factor productivity in this group. The growth rate is negative in the sub periods but the entire group exhibits an annual rate of growth of 0.15 per cent. Veneer, plywood and their products industry (270) shows a comparatively higher rate of growth in total productivity than others in the group. This industry is characterised by an improvement in value added and labour productivity growth rate in the second period as compared to the pre eighties period. Capital productivity also shows a decreased trend growth rate in post 1981 period.

Table 4.7(C) Growth Rates of Total Factor Productivity in Wood and Wood Products Furnitute and Fixtures Sector

Industry Code	Industry	TFPG
270	Veneer, Plywood and their products	0.386
271	Sawing of wood	-0.079
272	Wooden containers, and other wares made of cane, bamboo etc.	-0.642
273	Structural wooden goods, such as beams, parts etc	0.057
274	Other wooden industrial goods	-0.240
275	Cork and cork products	0.079
276	Wooden furniture and fixtures	0.021
277	Other products of wood, bamboo and cane	0.250
27 Entire period	Wood and Wood Products, Furniture and Fixtures.	0.15
period I		-0.462
Period II		-0.07

Computed

The overall analysis of this sector shows that value added which has a negative trend rate in the earlier period registers a rise and becomes positive in the latter period. Capital and labour input grew at a higher rate in the pre 1981 period. Labour productivity growth rate is negative in the first period while it is positive in the period, 1981-82 to 1992-93. Capital intensity rate registers a decline in the eighties onwards period. Capital productivity is negative but improves over time. Growth of total factor productivity is positive for the entire period, although it is very less. The second period shows a mild improvement in growth rate.

Paper and Paper Products and Printing, Publishing and Allied Industries Sector

Table 4.8 (a) Growth Rates of Value added, Capital and Labour in Paper and Paper products, Printing and Allied Industries Sector

Industry Code	Value Added			Capital			Labour		
	Entire Period	Period I	Period II	Entire Period	Period I	Period II	Entire Period	Period I	Period II
280	4.69	5.56	10.21	11.86	14.84	8.51	2.11	5.69	0.32
281	3.88	6.83	5.75	10.99	12.83	10.85	3.64	5.24	3.56
282	0.68	7.98	5.29	9.84	2.18	13.90	-0.53	-14.90	5.46
284	5.97	3.30	5.22	11.58	5.04	12.79	0.46	-0.45	0.43
285	1.14	3.03	-1.34	8.43	7.39	7.22	-1.20	0.52	-2.82
286	1.95	-10.44	-5.51	5.54	6.83	2.16	-1.42	-7.09	-6.54
287	-3.00	-0.73	-4.92	10.85	14.55	9.15	-3.59	-0.07	-6.25
288	2.65	3.23	-1.76	11.04	12.48	6.86	2.14	-1.18	0.31
289	2.87	3.39	3.7	11.27	11.83	9.97	0.50	0.76	0.89
28	3.90	1.75	7.61	11.21	12.56	8.78	0.94	1.87	-0.40

Computed

As seen from table (4.8a) the value added growth rate in this group is higher in the second period. The rate is 7.61 per cent per annum in period II while in the first period the growth rate is just 1.75 per cent. For this group employment shows a negative growth rate of -0.40 in the second period with overall growth rate being just 0.94 for the entire period. The growth rate of capital input has declined for the second period from 12.56 per cent to 8.78 per cent per annum.

Table 4.8(b) Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity in Paper and Paper Products, Publishing and Allied Industries Sector

Industry Code	Labour Productivity			Capital Productivity			Capital Intensity		
	Entire Period	Period I	Period II	Entire Period	Period I	Period II	Entire Period	Period I	Period II
280	3.37	-0.06	10.05	-6.41	-8.06	-1.57	7.16	7.56	3.85
281	0.44	1.07	2.17	-6.40	-5.3	4.61	5.68	3.87	6.61
282	-0.58	-4.94	-0.52	-9.59	-7.97	-7.55	9.99	16.49	4.92
284	4.56	2.84	4.76	-5.03	-1.65	-6.72	5.89	1.83	6.67
285	2.13	2.14	0.54	-6.73	-4.057	-7.99	9.95	1.08	9.10
286	-0.59	7.79	1.31	-7.10	-6.16	-7.27	4.06	6.38	7.01
287	0.76	0.11	1.57	-6.49	-5.34	-6.91	8.23	8.87	7.08
288	1.12	4.47	-1.72	-7.54	5.71	-5.05	7.18	6.42	4.14
289	2.45	-2.70	2.36	-7.54	-7.54	-5.74	8.17	10.67	5.99
28	2.93	-0.11	5.70	-6.57	-9.61	-4.00	7.24	8.20	5.13

Computed

Labour productivity performance has improved significantly in the second period with growth rate being 5.70 per cent per annum. The first period shows a negative trend growth rate of -0.11 per cent per annum. The trend rate in capital productivity is -4.00 per cent per annum in the second period as against -9.61 per cent per annum in the first period. Capital intensity growth rate for the entire groups is less for the second period.

Table 4.8 (c) Growth Rates of Total Factor Productivity in Paper and Paper Products and Printing, Publishing and Allied Industries Sector

Industry Code	Industry	TFPG
280	Pulp, paper and paper board including Newsprint	0.786
281	Containers of paper and paper board.	0.094
282	Paper board and other than paper articles	-0.22
284	Printing and publishing of newspaper	-0.243
285	Printing and publishing of periodicals and books	0.045
286	Currency notes, postage, stamps etc.	-0.142
287	Engraving, block marking etc.	0.003
285	Bookbinding	0.176
289	Printing and publishing.	0.067
28 Entire Period	Paper, Paper Products, Printing Publishing and Allied Industries.	0.083
Period I		-0.95
Period II		0.35

Computed

The estimate of annual total factor productivity growth rate [Table 4.8c] during the entire period is 0.083 per cent. Total factor productivity growth is higher during the post 1981 period. The estimate for the post 1981 period is 0.35 whereas that for the earlier period is -0.95 per cent per annum. A closer look at the industries in this group shows that Pulp, paper and paper board industry (280) grows at a rate of .786 per cent per annum. In this industry value added and labour productivity show above ten percent growth in the second period. Capital productivity which declines at a rate of -8.06 per cent per annum in pre 1981 period shows an improvement and is -1.57 per cent per annum in post 1981 period. All these factors point out that efficiency of this industry has improved.

Overall analysis of this group indicates that this sector is a growing sector as far as output is concerned. The increase in growth rate of value added is accompanied by decreased annual growth rates of labour and capital inputs. Labour efficiency has increased as is evident from increase in growth rate of labour productivity in the post 1981 period. Capital productivity, although negative for the entire period, shows an improvement in the period 1981-82 to 1992-93. Total factor productivity growth also shows an improvement in the post 1981 period. All these facts point out that this sector is a growing sector.

Leather and Leather Products and Fur Products Sector

Table 4.9 (a) presents the growth rates of factor inputs and value added. In this group, value added increases at a rate of 7.64 per cent per annum for the entire period. The growth is higher in the latter than in the former period. Capital input grows at a high rate of 14.9 per cent for the entire period, and employment grows at a rate of 5.47 per cent per annum. On splitting the period it is found that the rate of growth of employment is 8.10 per cent in the pre 1981 period and 6.29 per cent per annum in the post 1981 period.

Table 4.9(a) Growth Rates of Value Added, Capital and Labour in Leather and Leather Products and Fur Products Sector

Industry Code	Value Added			Capital			Labour		
	Entire Period	Period I	Period II	Entire Period	Period I	Period II	Entire Period	Period I	Period II
290	5.59	10.35	6.23	13.06	15.78	8.49	3.49	8.23	2.67
291	8.9	4.65	11.07	18.31	18.89	19.29	6.36	7.42	6.63
292	8.06	6.21	6.71	12.25	13.80	11.19	7.91	7.04	6.32
293	16.06	-7.72	7.57	16.50	19.63	12.50	7.91	-8.84	9.38
294	9.07	2.95	15.28	12.30	18.77	13.51	6.26	6.15	6.24
29	7.64	8.92	9.99	14.90	12.98	12.38	5.47	8.10	6.29

Computed

An analysis of trends of partial productivities [Table 4.9b] shows that labour productivity has increased at a higher rate in the period, 1981-82 to 1992-93. For the group as a whole the growth of labour productivity is 3.06 per cent. Capital productivity registers a fall throughout the period. The decline is more in period I. Capital intensity for the group is 7.90 for the entire period of analysis. As per the performance of industries in this group two industries show a high rate of growth in labour productivity. These are (a) leather consumer goods industry (293) and (b) other leather and fur products industry (294). Capital productivity is also positive for both these industries in period II.

Table 4.9(b) Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity in Leather and Leather Products and Fur Products Sector

Industry Code	Labour Productivity			Capital Productivity			Capital Intensity		
	Entire Period	Period I	Period II	Entire Period	Period I	Period II	Entire Period	Period I	Period II
290	2.07	1.00	3.28	-6.62	-7.26	-5.05	6.85	10.44	2.04
291	2.55	-2.09	3.84	-7.89	-8.98	-6.88	11.31	9.69	11.35
292	4.55	3.02	4.90	-2.79	-4.98	-1.21	7.89	8.21	7.26
293	7.52	5.54	8.12	-0.38	2.02	7.05	5.13	7.80	0.33
294	7.04	9.36	-2.25	-2.88	-8.96	1.56	5.26	7.69	5.87
29	3.06	0.77	3.32	-5.32	-7.14	-2.12	7.90	8.93	4.04

Computed

A summary of total factor productivity growth of leather and leather products is reported in Table 4.9(c). Productivity grows at a rate of 0.20 per cent per annum for the sample period for this sector. Total factor productivity growth shows an improvement in eighties onwards period. Total factor productivity growth which is negative in the first period becomes positive in the post 1981 period. Manufacture of wearing apparel of leather industry (292) and leather consumer goods industry (293) have comparitively higher total factor productivity growth than others in the group.

Table 4.9(c) Growth Rates of Total Factor Productivity in Leather and Leather Products and Fur Products Sector

Industry Code	Industry	TFPG
290	Tanning and finishing of leather	0.145
291	Leather foot wear	0.111
292	Wearing apparel	0.58
293	Leather consumer goods	0.52
294	Other leather and fur products	0.04
29 Entire Period	Leather and Leather Products and Fur Products.	0.20
Period I		-0.11
Period II		0.18

Computed

This sector is a growing sector as far as output is concerned. The output growth is higher in the eighties onwards period. Capital input records a high growth of 14.90 per cent per annum. There is a slight decline in employment growth rate in the period, 1981-82 to 1992-93. Labour productivity, capital productivity and total factor productivity show an improvement in the second period. Better productivity performance of leather consumer goods industry (293) and manufacture of wearing apparel of leather industry (292) in the eighties onwards phase could be attributed to an improvement in labour productivity and capital productivity in the second period. All this is indicative of the fact that this sector is a growing sector.

Rubber, Plastic, Petroleum and Coal Products Sector

This group experiences a high growth in value added and capital. There is an acceleration in the growth rate of value added in the second period, i.e., 11.84 per cent per annum in period II as compared to 3.49 in period I. Employment increases at an annual rate of 4.53 per cent, the increase is more pronounced in the first period. Capital grows at a rate of 13.02 per cent per annum for the entire period.

Table 4.10(a) Growth Rates of Value Added, Capital and Labour in Rubber, Plastic, Petroleum and Coal Products Sector

Industry Code	Value Added			Capital			Labour		
	Entire Period	Period I	Period II	Entire Period	Period I	Period II	Entire Period	Period I	Period II
300	7.89	1.90	6.19	13.55	8.17	11.95	3.66	4.26	3.41
301	11.04	1.72	13.78	17.85	12.06	9.23	3.53	2.31	7.99
302	4.53	5.03	7.72	11.28	16.13	11.26	1.17	3.46	1.11
303	11.45	9.70	17.38	17.16	11.59	17.47	6.48	6.09	6.79
304	10.16	1.07	18.10	14.39	15.45	11.35	5.35	8.35	8.35
305	6.75	6.01	8.12	11.52	9.84	6.57	3.16	21.45	4.06
307	1.51	-2.85	6.42	5.43	14.01	8.34	2.81	21.67	1.38
30	8.12	3.49	11.84	13.02	16.99	12.30	4.53	6.74	4.05

Computed

Table 4.10(b) presents growth rate of partial productivities and capital intensity. There is an acceleration in rate of growth of labour productivity in the second period, the rate being 7.48 per cent per annum as against -3.04 per cent in the earlier period. Capital productivity growth rate is -4.33 per cent per annum. This growth rate is -0.31 per cent in period II as against -11.54 per cent per annum in period I Capital intensity growth rate also registers a decline in the second period of analysis.

Table 4.10(b) Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity in Rubber, Plastic, Petroleum and Coal Products Sector

Industry Code	Labour Productivity			Capital Productivity			Capital Intensity		
	Entire Period	Period I	Period II	Entire Period	Period I	Period II	Entire Period	Period I	Period II
300	4.04	-3.09	2.75	-4.98	-7.20	-5.13	8.20	14.53	6.59
301	5.80	-2.03	13.06	-5.77	-5.97	-4.21	10.87	5.51	13.30
302	2.97	0.30	6.18	-6.06	-6.27	-3.18	5.47	6.32	6.52
303	4.59	2.99	9.27	-4.87	-5.54	-0.07	6.38	9.21	5.60
304	4.95	6.48	10.03	-3.69	-9.42	6.06	7.32	8.23	4.89
305	4.06	0.18	5.21	-3.01	-2.18	-1.71	6.14	7.62	0.74
306	7.51	7.64	7.43	-2.06	-0.76	0.56	1.52	6.64	2.27
307	-2.48	1.54	4.05	-3.72	-8.95	-1.75	-0.56	-3.93	4.04
30	3.44	-3.04	7.48	-4.33	-11.54	-0.31	5.78	8.66	4.81

Computed

Total factor Productivity Growth of this sector is depicted in table 4.10(c). An analysis of results of total factor productivity growth reflects the poor performance of this sector in period I. Productivity declines at an annual rate of 2.95 per cent per year in the pre eighties period. However, the rate of decline is less in the second period.

Table 4.10(c) Growth Rates of Total Factor Productivity in Rubber, Plastic, Petroleum and Coal Products Sector

Industry Code	Industry	TFPG
300	Tyres and Tubes	-0.013
301	Rubber footwear	-1.702
302	Other rubber products	-0.105
303	Other Plastic products	0.169
304	Petroleum refineries	0.182
305	Other products of petroleum	0.142
306	Coal tar from Cake oven	0.153
307	Other coal by-products	0.485
30 Entire Period	Rubber, Plastic, Petroleum and Coal Products	0.007
Period I		-2.95
Period II		-0.43

Computed

An overall analysis of this group shows that the sector has performed badly in the period 1973-74 to 1980-81. In this period, the rate of growth of output is less. Labour productivity, Capital productivity and total factor productivity show a negative growth rate in pre 1981 period. However, the performance is slightly better in the period, 1981-82 to 1992-93. Value added grows at a higher rate. Growth rate of labour productivity is 7.48 and the rate of decline in average product of capital is slower during the second period. There is an improvement in value added and labour productivity in the post 1981 period in all the industries in this sector. Rubber foot wear industry (301) shows improvement in value added and labour productivity in period II, but still it has a negative growth rate of -1.7 per cent per annum in total factor productivity. This industry records an appreciable increase in capital intensity rate in the latter period so the improvement in labour productivity in this industry may be because of capital deepening and not because of improvement in productivity performance. Capital productivity in this industry decreases at a rate -5.77 per cent per annum for the entire period. Other coal by products industry (307) shows better performance on productivity front. Another industry which needs mention in this group is petroleum refineries (304). This industry has a high rate of growth of value added and labour productivity in the post 1981 period. Capital productivity improves and becomes positive in the post 1981 period. The industry also shows better performance than others in the group in terms of total factor productivity.

Chemicals and Chemical Products Sector

Value added for this group has increased at an annual rate of 5.66 per cent for the entire period. It accelerated to 8.05 per cent in the second period from 4.13 per cent per annum in the earlier period. Paints and varnishes (312), explosives, ammunition and fire works (318) and other chemical products (319) depict above 10 per cent growth rate in value added in period II. The rate of growth of capital input and labour input is less in the second period. Capital grows at a rate of 9.20 per cent in period II as against 13.93 per cent in period I and labour grows at a rate of 2.99 per cent in post 1981 period as against 6.31 per cent in pre 1981 period.

Table 4.11(a) Growth Rates of Value Added, Capital and Labour in Chemicals and Chemical Products Sector

Industry Code	Value Added			Capital			Labour		
	Entire Period	Period I	Period II	Entire Period	Period I	Period II	Entire Period	Period I	Period II
310	2.84	0.31	6.38	12.91	15.58	10.50	3.34	4.01	2.35
311	7.42	7.61	4.56	9.30	11.98	7.73	2.78	5.66	2.75
312	6.67	5.10	12.88	9.72	11.60	9.05	2.17	3.20	2.99
313	6.48	5.51	8.14	10.75	13.37	10.23	2.65	2.94	2.70
314	8.56	10.43	9.22	11.24	12.08	9.87	5.36	9.66	3.66
316	4.63	10.44	4.49	10.33	15.51	10.26	-1.47	5.90	-5.93
317	2.27	-1.12	3.85	9.22	10.98	5.57	3.97	9.35	4.61
318	7.34	9.02	11.19	11.61	5.94	12.79	6.28	7.21	6.28
319	8.62	9.77	10.62	10.05	11.22	13.84	1.19	5.89	-0.98
31	5.66	4.13	8.05	10.35	13.93	9.20	2.99	6.31	2.99

Computed

Labour productivity [Table 4.11b] for the entire period grows at a rate of 2.61 per cent per annum. There is an acceleration in the growth rate from -3.46 per cent in period I to 5.83 per cent in period II. Capital productivity declines at an annual rate of -4.26 per cent for the entire period, the decline being -1.05 per cent in the second period as against -8.60 in pre eighties. Capital intensity for the entire group is higher in the first period.

Table 4.11(b) Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity in Chemicals and Chemical Products Sector

Industry Code	Labour Productivity			Capital Productivity			Capital Intensity		
	Entire Period	Period I	Period II	Entire Period	Period I	Period II	Entire Period	Period I	Period II
310	-0.59	-5.11	4.12	-8.91	-8.02	-3.73	5.85	4.49	5.06
3.11	4.57	1.02	1.89	-1.73	-6.93	-2.94	2.87	7.19	0.42
312	4.20	1.28	9.66	-2.78	-6.14	3.52	4.32	5.56	3.67
313	3.95	0.15	6.68	-3.86	-5.46	-1.91	4.65	3.74	5.14
314	3.37	10.09	6.01	-2.41	6.21	-0.58	5.32	7.00	5.96
316	5.87	4.31	10.77	-5.17	-1.45	-5.24	9.17	3.78	13.89
317	-1.56	-9.46	-0.52	-6.36	-10.45	-1.61	10.83	10.93	0.64
318	1.13	1.12	4.77	-3.82	-2.79	1.42	4.78	4.54	3.88
319	6.57	2.27	10.56	-1.30	3.62	-2.82	-4.21	-3.04	7.69
31	2.61	-3.46	5.83	-4.26	-8.60	-1.05	4.57	5.99	4.14

Computed

As per the individual industries in the group the rate of growth in labour productivity is above five percent per annum in two industries for the entire period. Paints and varnishes (312); turpentine, synthetic fibres, plastic materials and synthetic fibres (316) and other chemical products including photo chemicals, films and paper (319) show a growth rate of above nine per cent in period II. Capital productivity becomes positive for the second period in paints and varnishes (312) and explosives etc (318). Capital intensity has declined in most of the industries in the second period as compared to that in the first one.

Table 4.11(c) Growth Rates of Total Factor Productivity in Chemicals and Chemical Products Sector

Industry Code	Industry	TFPG
310	Basic industrial organic and inorganic chemicals and gases	0.297
311	Fertilizers and pesticides	0.002
312	Paints and varnishes	0.492
313	Drugs and medicines	0.361
314	Cosmetics, hair dressings, tooth pastes, soap and synthetic detergents	0.422
316	Turpentine, synthetic resins, plastic materials and synthetic fibres	0.079
317	Matches	-0.473
318	Explosives, ammunition and fireworks	0.368
319	Other chemical products including photo chemicals, films and papers)	0.077
31 Entire Period	Chemicals and Chemical Products.	0.23
Period I		-0.92
Period II		0.28

Computed

Productivity growth [Table 4.11c] declines at a rate of -0.92 per cent per annum in the pre eighties period for the chemicals and chemical products sector. There is an improvement in the growth rate in the 1981 onwards period. For the entire period the productivity growth is 0.23 per cent per annum. Industries showing comparatively higher growth rates in total factor productivity are (a) paints and varnishes (312); (b) drugs and medicines (313) and (c) explosives; ammunition and fire works (318). The increase in value added in these industries in the second period is accompanied by improvement in labour productivity and a lower decline in capital productivity growth rate. Cosmetics (314) and matches industries (317) have shown unsatisfactory performance on the productivity front. In case of cosmetic industry the value added registers a decline in the second period. This industry shows better performance in partial productivities in period I. The matches industry (317) on the other hand shows a negative trend in labour as well as capital productivity in both the periods as well as for the entire period of analysis.

Overall analysis of this sector shows that the performance has improved in the period 1981-82 to 1992-93. Labour productivity as well as total factor productivity register an increase in the second period. The decline in rate of growth of capital productivity is less in the post 1981 period. The industries: (a) paints and varnishes (312); (b) drugs and medicines (313); and (c) explosives, ammunition and fire works (318) have shown satisfactory performance in partial as well as overall productivity. So this sector is a growing sector of the economy.

Non Metallic Mineral Products Sector

This sector shows a high growth rate of value added for the entire period. Output growth is 12.48 per cent per annum for the entire period of analysis. In the second period the rate of growth is 15.92 per cent per annum against 6.97 per cent in the first period. Capital input growth is 14.66 per cent per annum for the entire period. Employment growth has increased at a rate of 4.86 per cent per annum for the same period.

Table 4.12(a) Growth Rates of Value Added, Capital and Labour in Non Metallic Mineral Products

Industry Code	Value Added			Capital			Labour		
	Entire Period	Period I	Period II	Entire Period	Period I	Period II	Entire Period	Period I	Period II
320	7.78	6.87	8.43	12.74	11.22	12.27	5.08	5.91	-4.35
321	12.14	8.04	16.47	6.59	0.29	13.12	-0.34	0.42	-0.97
322	5.56	4.24	8.02	10.88	13.03	16.60	4.57	10.76	6.38
323	4.94	6.37	3.12	11.48	7.02	12.35	3.01	3.20	-1.57
324	14.93	4.96	19.07	16.63	11.43	18.58	5.57	3.06	6.31
325	-2.05	5.88	1.29	9.69	9.02	6.00	4.01	-5.64	6.70
326	8.72	15.96	13.93	17.20	15.08	16.49	3.65	5.57	3.82
327	8.28	7.94	9.33	11.75	15.17	10.43	4.11	4.95	3.94
328	1.72	-0.18	6.54	9.73	8.66	8.84	-0.24	4.65	-1.95
32	12.48	6.97	15.92	14.66	11.13	15.88	4.86	3.39	3.89

Computed

In terms of partial productivity measures, [Table 4.12b] the most notable development in this sector is that the capital productivity becomes positive in the second period. As capital intensity records a stronger acceleration in the second period as compared to the earlier period, there is understandably a strong acceleration in the growth of labour productivity. This sector shows a distinctly better performance with respect to both labour and capital productivity in the second period. The labour productivity growth is above ten percent in the second period whereas it was just 3.46 per cent in pre 1981 period.

Table 4.12(b) Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity in Non Metallic Mineral Products Sector

Industry Code	Labour Productivity			Capital Productivity			Capital Intensity		
	Entire Period	Period I	Period II	Entire Period	Period I	Period II	Entire Period	Period I	Period II
320	3.39	2.36	7.01	-4.39	-3.94	-3.41	-6.76	-5.20	9.22
321	6.51	0.47	12.85	-4.94	-7.17	-2.87	8.30	6.30	11.40
322	5.21	2.27	6.21	2.62	-2.24	2.01	4.30	4.03	4.01
323	3.96	2.83	4.54	-5.87	-0.61	-8.21	3.32	4.45	9.54
324	6.56	2.30	6.19	-1.45	-5.82	0.42	2.98	6.78	7.74
325	3.37	6.41	8.05	-6.72	-3.88	-4.45	8.95	11.49	7.35
326	5.04	0.79	9.38	-7.24	-7.92	-2.22	9.76	7.94	7.49
327	4.03	2.37	5.14	-3.11	-6.26	-1.01	4.63	6.22	3.13
328	1.62	-2.24	8.07	-7.30	-8.13	-2.11	8.52	6.16	7.27
32	9.34	3.46	10.31	-1.89	-3.75	0.05	8.26	5.64	9.12

Computed

As per the performance of individual industries in this group four industries show a growth rate above five per cent per annum in labour productivity for the entire period and eight industries show growth rate above five per cent in the second period. Capital productivity has declined at a much lesser pace in the second period. Earthen ware and pottery (322) and cement, lime and plaster industry (324) record a positive growth rate in capital productivity in the second period. The industries showing above eight per cent per annum growth in labour productivity in the second period are; (a) glass and glass products (321); (b) mica products (325); (c) structural stone goods; stone dressing and stone crushing and stone ware (326) and (d) asbestos, cement and other cement products (328). Most of the industries in this sector show an increase in capital intensity rate in period II.

Table 4.12(c) Growth Rates of Total Factor Productivity in Non Metallic Mineral Products Sector

Industry Code	Industry	TFPG
320	Structural clay products	0.077
321	Glass and glass products	0.215
322	Earthen ware and earthen pottery	0.298
323	Chinaware and porcelain ware	0.012
324	Cement, lime and plaster	0.368
325	Mica products	0.090
326	Structural stone goods, stone crushing and stoneware	0.111
327	Earthern and plaster statues	-0.003

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328	Asbestos, cement and other cement products	0.259
32 Entire Period Period I Period II	Non Metallic Mineral Products	0.21 -0.92 0.55

Computed

Non metallic mineral products group shows a growth rate of 0.21 per cent per annum in total factor productivity growth [Table 4.12c]. A decline in growth rate in the pre-eighties is followed by a positive growth rate in total factor productivity in the eighties onwards phase. Three industries showing higher growth than others in the group in productivity are (a) cement, lime and plaster (324), (b) asbestos, cement and other cement products (328) and (c) earthen ware and pottery (327).

The analysis of group as a whole highlights the fact that the eighties onwards period is marked by a significant acceleration in the growth of value added. Capital input growth is high for the entire period. As capital intensity records an increase over the eighties onwards period, there is also a strong acceleration in labour productivity. Capital productivity records a rise and becomes positive in the second period. The better performance of cement, lime and plaster (324) and earthen ware and earthen pottery (322) could be attributed to positive rates of growth of productivity of capital in the second period of analysis. The group as a whole has performed better in terms of partial as well as total productivity in the eighties onwards phase.

Basic Metals and Alloys Sector

This sector contains Iron and steel industry which occupies important position in the country. Value added in this sector, as a whole, has grown at a rate of 4.7 per cent per annum, the rate being 5.96 per cent per annum in the second period as against 2.49 per cent in period I. The group is capital intensive with growth in capital at a rate of 10.9 per cent per annum for the entire period. The rate of growth of employment decreases to -2.0 per cent per annum in the second period from 4.10 per cent per annum in period I. For the sector as a whole the employment growth rate is 0.95 per cent per annum.

Table 4.13(a) Growth Rates of Value Added, Capital and Labour in Basic Metals and Alloys Sector

Industry Code	Value Added			Capital			Labour		
	Entire Period	Period I	Period II	Entire Period	Period I	Period II	Entire Period	Period I	Period II
330	5.68	3.79	6.34	11.78	16.85	9.73	2.86	5.56	1.41
331	-2.01	1.97	-3.33	8.12	9.92	7.23	-3.78	2.16	-10.50
332	7.93	7.41	10.99	14.35	12.17	13.69	7.75	6.46	10.19
333	-1.98	-2.52	2.66	4.51	5.56	5.14	-0.002	2.04	0.71
334	1.13	7.21	-0.33	10.01	11.91	7.86	-0.43	6.80	-4.42
335	8.53	0.76	10.83	10.02	10.33	12.13	3.67	4.22	3.15
336	8.53	0.76	10.83	13.10	10.33	12.13	7.48	4.33	3.87
339	0.58	3.44	0.13	5.15	3.43	4.65	-2.67	-3.41	-1.79
33	4.70	2.49	5.96	10.90	14.55	9.62	0.95	4.10	-2.00

Computed

The indices of partial productivities and capital intensity are shown in Table 4.13(b). The performance of the sector as a whole has improved in the post 1981 period. Capital productivity continues its declining trend although the rate of decline is less in the second period. Rate of growth of capital intensity in the group is 7.94 per cent per annum for the entire period. There is a slight decline in capital intensity in the second period as compared to that in the first period.

Table 4.13(b) Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity in Basic Metals and Alloys Sector

Industry	Labour Productivity			Capital Productivity			Capital Intensity		
Code	Entire Period	Period I	Period II	Entire Period	Period I	Period II	Entire Period	Period I	Period II
330	3.14	-1.55	5.80	-5.45	-7.15	-3.09	7.72	11.15	7.39
331	1.58	-0.48	1.78	-8.37	-7.22	-8.51	10.16	8.12	10.72
332	0.12	0.26	7.45	-5.62	-4.25	-2.39	-3.33	1.94	0.79
333	-2.96	-6.14	0.85	-6.20	7.67	-2.38	0.98	-1.62	-2.45
334	1.67	1.08	3.71	-8.07	-4.19	-7.60	9.06	2.01	10.83
335	4.85	-3.27	8.94	-1.35	-8.63	-0.71	5.15	8.00	5.96
336	3.91	2.21	5.00	-2.42	-4.51	-2.26	6.11	7.20	7.06
339	3.05	8.58	2.14	-4.35	-0.11	-4.32	6.02	8.31	5.34
33	3.84	-1.57	8.42	-5.59	-10.53	-3.35	7.94	10.17	9.01

Computed

As per the performance of industries in this group, the iron and steel industry (330), the hallmark of the heavy industries strategy of Indian industrialisation, shows poor productivity performance in the first period in terms of labour productivity but the performance has improved in the second period with growth rate being above 5 per cent per annum. Capital productivity continues its downward trend although the decline is less in the post 1981 period. Capital intensity growth rate also declines in the second period. Ferro-alloys (332) and aluminium industry (335) show growth rate above five per cent in labour productivity in period II.

Table 4.13(c) Growth Rates of Total Factor Productivity in Basic Metals and Alloys Sector

Industry Code	Industry	TFPG
330	Iron and Steel Industry	0.071
331	Casting and forging: iron and steel	-0.423
332	Ferro Alloys	0.002
333	Copper	0.115
334	Brass	0.147
335	Aluminium	0.414
336	Zinc	0.198
339	Other non ferrous metals	-0.147
33 Entire Period	Basic Metals and Alloys	0.072
Period I		-0.22
Period II		-0.24

Computed

Considering the period as a whole the annual growth rate of total factor productivity [Table 4.13c] shows a mild positive trend. However, the group as a whole shows a negative rate of growth in productivity in both the periods. Iron and steel industry a major industry in this group has a low TFPG of 0.071 per cent per annum. Aluminium industry (335) shows better performance than that of other industries in the group.

An analysis of this group reveals a rise in rate of growth of output in the eighties onwards period. The surge in value added is accompanied by a decrease in growth of intermediate inputs in the second period. Capital productivity rate of growth is negative for the entire period. The rate of capital intensity growth turns out to be quite high, i.e., 7.94 per cent per annum for the group as a whole. Labour productivity improves in the second period. The inescapable conclusion is that the labour productivity has improved mainly because of the process of capital deepening. As per the performance of three digit industries in this group aluminium industry (335) shows better performance than others on productivity front. In this industry labour productivity and capital productivity show an improvement in period II.

Metal Products and Parts Sector

Value added has grown at the rate of 2.52 per cent per annum, and capital and labour have grown at the rate of 10.04 and 0.80 per cent per annum respectively for the entire period. The growth rates of value added, capital and employment show a decline in the eighties onwards period as compared to that in the first period, as can be seen from table 4.14(a). Value added has grown at a rate of 3.86 per cent per annum in period I as against 2.63 per cent in period II. Capital input has grown at a rate of 11.32 per cent per annum in pre 1981 period as against 9.35 per cent in the latter period. Labour input has grown at a rate of 1.95 per cent in pre 1981 period while the growth rate is 1.04 per cent in the post 1981 period.

Table 4.14(a) Growth Rates of Value added, Capital and Labour in Metal Products and Parts Sector

Industry	Value Added			Capital			Labour		
Code	Entire Period	Period I	Period II	Entire Period	Period I	Period II	Entire Period	Period I	Period II
340	2.44	2.15	1.18	9.46	9.09	9.04	0.46	0.6	-0.75
341	9.16	17.26	7.99	15.68	16.23	17.16	6.67	12.83	7.43
342	3.05	5.11	-1.31	8.35	7.31	7.07	-2.74	0.32	-5.52
343	0.56	2.69	0.54	8.32	11.38	6.63	-1.12	2.19	-1.77
344	6.38	-3.62	5.95	14.38	14.79	17.27	1.11	-1.75	2.14
345	0.20	0.88	0.61	8.96	12.85	6.35	-0.87	-0.20	-1.46
349	4.86	3.94	6.51	13.25	13.64	11.64	2.25	-0.53	5.82
34	2.52	3.86	2.63	10.04	11.32	9.35	0.80	1.95	1.04

Computed

As seen from table 4.14b this group, as a whole, has not performed well in terms of partial productivities. Labour productivity growth rate is just 1.69 per cent for the entire period, furthermore, the growth rate registers a fall in the second period. Capital productivity shows a negative trend rate of -6.83 per cent per annum for the group. Capital intensity shows a marginal decline in the second period. As per the individual performance of industries in this group the picture is not very good. All the industries show high capital intensity rate and negative capital productivity rate. All this shows that high growth rate of capital input has not led to increase in value added and labour productivity.

Table 4.14(b) Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity in Metal Products and Parts Sector

Industry Code	Labour Productivity			Capital Productivity			Capital Intensity		
	Entire Period	Period I	Period II	Entire Period	Period I	Period II	Entire Period	Period I	Period II
340	1.90	1.55	1.62	-6.43	-6.35	-7.21	6.10	7.47	9.62
341	2.26	4.39	0.13	-5.69	-1.65	-7.83	11.15	2.65	3.86
342	-0.45	5.37	-5.78	-8.52	-2.05	-8.22	9.18	6.69	7.63
343	1.77	0.64	2.18	-7.16	-7.78	-5.71	7.39	7.44	5.91
344	5.13	-1.74	3.40	-6.98	10.04	-9.64	9.46	10.88	9.20
345	1.39	1.10	1.91	-8.04	-10.61	-5.40	7.25	11.44	4.35
349	2.35	3.47	0.77	-7.4	-8.52	-4.59	8.48	11.06	4.16
34	1.69	1.83	1.57	-6.83	-6.74	-6.14	5.88	7.00	6.06

Computed

Table 4.14(c) depicts total factor productivity growth in this sector. This sector records an extremely mild growth in total factor productivity. Rate of growth of productivity is 0.08 per cent per annum in pre 1981 period as against 0.06 per cent in period II. The growth rate is positive for both the periods but it is very low. Poor performance on productivity front of structural metal products (341), metallic furniture and fixtures (342) and plating and polishing of metal products (344) could be due to negative growth in capital productivity in the second period.

Table 4.14(c) Growth Rates of Total Factor Productivity in Metal Products and Parts Sector

Industry Code	Industry	TFPG
340	Fabricated metal products	0.208
341	Structural metal products	-0.024
342	Metallic furniture and fixtures	-0.728
343	Hand tools and hardware	0.130
344	Plating & polishing of metal products	-0.334
345	Metal utensils and cutlery	0.164
349	Other metal products	0.087
34 Entire Period	Metal Products and Parts	0.026
Period I		0.08
Period II		0.06

Computed

An overall analysis of this sector shows that value added and labour productivity grow at a very slow pace and infact the eighties onward era records a decline in both. There is a rapid fall in capital productivity growth for the entire period. Total factor productivity grows at a similar rate in both the periods, but the rate of growth is mild. Even with a ten per cent increase in annual rate of capital, this sector fails to record any appreciable rise in value added and productivity.

Machinery, Machine Tools and Parts Sector

Value added in this sector has grown at an annual rate of 4.37 per cent. An analysis of sub periods reveals the fact that the rate of increase in value added is somewhat higher in period 1973-74 to 1980-81 than during the period 1981-82 to 1992-93.

Table 4.15(a) Growth Rates of Value Added, Capital and Labour in Machinery, Machine Tools and Parts Sector

Industry Code	Value Added			Capital			Labour		
	Entire Period	Period I	Period II	Entire Period	Period I	Period II	Entire Period	Period I	Period II
350	6.53	10.92	5.19	9.05	13.21	7.09	1.73	8.29	-1.15
351	5.64	5.87	4.46	9.98	10.79	10.25	1.29	-2.35	1.39
352	5.04	2.63	2.33	10.26	11.51	7.62	0.63	-1.46	-1.95
353	3.83	7.63	4.39	10.71	12.64	8.59	-0.78	-1.67	-2.31
354	5.46	4.47	4.70	7.61	10.85	7.89	1.51	4.64	0.65
355	7.85	7.92	9.62	12.85	12.84	15.63	2.61	3.14	3.87
356	8.05	7.97	7.28	12.94	13.88	12.16	3.28	5.36	2.62
357	4.69	6.71	-0.50	9.06	11.12	7.52	0.19	3.90	-1.93
358	2.58	2.06	1.40	10.03	13.79	10.14	-3.85	-0.42	-8.00
359	7.54	5.57	8.01	11.04	9.70	11.47	2.32	4.36	-0.06
(35)	4.37	5.10	4.82	10.24	11.87	9.26	1.59	3.71	-0.28

Computed

Employment growth rate for the sample period is 1.59 per cent per annum. The employment growth rate has decelerated in the second period. As against the annual rate of growth of 3.71 per cent in the earlier period, the growth rate is just -0.28 per cent in the latter period. Despite a high growth of capital at a rate of 10.24 per cent, value added does not show any significant increase.

Table 4.15(b) Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity in Machinery, Machine Tools and Parts Sector

Industry Code	Labour Productivity			Capital Productivity			Capital Intensity		
	Entire Period	Period I	Period II	Entire Period	Period I	Period II	Entire Period	Period I	Period II
350	4.27	2.39	4.74	-2.30	-2.03	-1.78	2.11	1.72	1.37
351	3.44	7.05	1.88	-3.94	-4.44	-5.24	4.74	10.46	3.68
352	3.94	2.92	3.78	-4.73	-7.97	-4.90	5.70	8.58	5.27
353	4.52	4.86	6.13	-6.23	-4.44	-3.87	8.61	7.68	7.41
354	3.67	1.05	3.67	-2.00	5.75	-2.96	3.87	3.68	4.23
355	4.72	4.03	5.40	-4.43	-4.36	-5.20	5.31	6.18	4.85
356	4.09	1.61	4.07	-4.32	-5.18	-4.33	5.54	5.57	5.39
357	3.81	2.19	0.61	-4.01	-3.99	-7.45	4.98	4.85	4.74
358	5.22	0.49	8.78	-6.77	-10.31	-7.92	10.46	8.32	14.97
359	4.22	-0.65	7.01	-3.15	-3.75	-3.10	5.53	4.71	7.13
35	2.73	1.31	2.33	-5.82	-6.04	-5.88	5.28	6.06	4.87

Computed

An analysis of partial productivity [Table 4.15b] shows that labour productivity has increased at an annual rate of 2.73 per cent for the sector as a whole. The growth rate is higher in the post 1981 period. Capital productivity shows a negative trend growth rate for the entire period as well as for both the sub periods. Capital intensity grows at a rate of 5.28 per cent per annum for the entire period of analysis.

Table 4.15(c) Growth Rates of Total Factor Productivity in Machinery, Machine Tools and Parts Sector

Industry Code	Industry	TFPG
350	Agricultural machinery and equipment	0.071
351	Heavy machinery and equipment used for construction and mining	-0.058
352	Prime movers (boilers & diesel engines)	0.032
353	Machinery for food and textile industries	0.063
354	Other industrial machinery	0.041
355	Refrigerators, air-conditioners and fire fighting equipment	-0.015
356	Non electrical machinery and accessories	0.028
357	Machine tools and their accessories	-0.147
358	Office machinery	0.048
359	Other non electrical machinery & equipment	0.115
35 Entire Period	Machinery, Machine Tools and Parts	0.011
Period I		-0.018
Period II		-0.14

Computed

For this sector as a whole, productivity grows at a rate of 0.011 per cent per annum for the entire period. On splitting the periods, it is found that the growth rate is negative for both the periods, the rate of fall being slightly high in the later period. The sector, as a whole, has not shown satisfactory performance as is evident from analysis of three digit industries covered in this group. Most of the industries show either a negative growth rate or a mild positive growth rate.

The picture that emerges for the group is that there is a moderate rise in value added and labour productivity. The labour productivity growth rate is high in two industries in the second period. These are (i) office machinery (358); and (ii) other non-electrical machinery and equipment (359). The improvement in labour productivity in these industries could be a consequence of increase in capital intensity rate in the post 1981 period. Average rates of productivity of capital show a high negative trend for the sample period. Even total factor productivity growth rates are negative for both the periods. All these indicators point to the fact that this sector shows a sluggish performance.

Electrical Machinery Apparatus, Appliances, Supplies and Parts Sector

This group, as a whole, shows a high growth in value added in the first period, i.e., 9.93 per cent per annum but the growth rate is lower for the second period (5.70). Employment for the sector, as a whole, shows a growth rate of 1.94 per cent per annum with the rate being less for the second period. Capital input has a high growth rate of 10.58 per cent per annum and here also the growth rate is low in the second period.

Table 4.16 (a) Growth Rates of Value Added, Capital and Labour in Electrical Machinery, Appliances, Supplies and Parts Sector

Industry Code	Value Added			Capital			Labour		
	Entire Period	Period I	Period II	Entire Period	Period I	Period II	Entire Period	Period I	Period II
360	6.03	3.22	6.72	8.06	9.62	7.60	1.51	1.69	1.85
361	9.04	10.00	9.36	11.19	9.34	11.10	2.17	3.37	1.43
362	5.98	5.37	4.37	7.99	8.68	8.44	-0.66	-0.17	-1.67
363	9.60	4.95	10.06	11.95	11.48	11.76	0.26	-0.99	-2.00
366	11.73	5.17	4.23	18.37	4.75	9.21	5.13	5.87	9.54
36	6.55	9.93	5.70	10.58	11.93	9.48	1.94	3.47	1.25

Computed

Table 4.16(b) presents the indices of labour productivity capital productivity and capital intensity. Labour productivity for the entire period depicts a growth rate of 4.52 per cent per annum, the growth rate being less for the second period. The slower growth in labour productivity in the second period could be the consequence of slower growth of value added in the second period. Capital productivity shows a negative trend for the sector, as a whole, with the trend increasing at a higher rate in second period. Capital intensity rate of growth for the sector shows a declining trend in the second period.

As far as the performance of industries in this group is concerned wires and cables (361) and electrical lamps, switches, fans, insulators, conductors and entertainment, professional communication and other electronic equipment (363) show a higher increase in annual rate of output and labour productivity in the post eighties period as compared to that in the earlier period. In case of wires and cables (361) the annual increase in labour productivity in the second period is 8.12 per cent as against 5.88 per cent in the earlier period, but this industry is characterised by a higher growth in output in the pre eighties era.

Table 4.16 (b) Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity in Electrical Machinery, Appliances, Supplies and Parts Sector

Industry Code	Labour Productivity			Capital Productivity			Capital Intensity		
	Entire Period	Period I	Period II	Entire Period	Period I	Period II	Entire Period	Period I	Period II
360	4.06	0.79	4.49	-1.88	-5.83	-0.82	2.85	4.95	1.34
361	6.81	5.88	8.12	-1.93	0.56	-1.57	6.68	4.48	7.31
362	6.31	4.42	5.42	-1.87	-3.05	-3.75	6.68	7.88	7.18
363	7.89	2.52	9.98	-2.10	-5.85	-1.52	7.67	7.11	7.93
366	3.16	2.05	1.54	-5.61	-7.82	-4.56	9.51	2.81	5.44
36	4.52	6.23	4.39	-3.64	-1.79	-3.45	5.84	7.41	4.48

Computed

Growth rates of total factor productivity are presented in Table 4.16(c). Three industries covered in this sector show a negative rate of total factor productivity growth The growth rate is -0.12 per cent per annum for the sector for the entire period. There is no significant variation in total factor productivity growth in the sub periods and it is negative for both the sub periods.

Table4.16(c) Growth Rates of Total Factor Productivity in Electrical Machinery, Appliances, Supplies and Parts Sector

Industry Code	Industry	TFPG
360	Electrical motors, generators, transformers, electromagnetic clutches	0.152
361	Wires and cables	-0.070
362	Dry and wet batteries	-0.071
363	Lamps, switches, fans, insulators, conductors, entertainment, professional, communication and other electronic equipment.	0.106
366	Electronic computers, control instruments	-0.864
36 Entire Period	Electrical Machinery, Appliances, Supplies and Parts	-0.12
Period I		-0.02
Period II		-0.03

Computed

An analysis of results of this sector shows a decline in value added, capital and employment in the eighties onwards period Capital productivity already negative becomes more negative in the period 1981-82 to 1992-93. Labour productivity growth rate also registers a decline. All this is indicative of the fact that this sector has shown poor productivity performance.

Manufacture of Transport Equipment and Parts Sector

Tabel 4.17(a) presents the growth rates in value added, capital and labour respectively. The sector experiences a rapid growth in value added and capital stock for the entire period. Employment increases at a moderate rate of 1.66 per cent per annum and infact it declines in the second period. The growth in value added is higher in post 1981 period as compared to that in the earlier period.

Table 4.17(a) Growth Rates of Value Added, Capital and Labour in Transport Equipment and Parts Sector

Industry Code	Value Added			Capital			Labour		
	Entire Period	Period I	Period II	Entire Period	Period I	Period II	Entire Period	Period I	Period II
370	-2.27	5.74	-6.92	6.08	15.82	0.18	-3.58	6.45	7.54
371	1.32	12.16	-3.43	13.13	13.91	1.18	-0.06	7.93	-6.08
372	8.73	4.26	12.73	10.26	6.46	10.69	0.67	0.52	-2.54
373	8.01	-1.03	5.17	16.73	18.23	16.76	13.89	-2.07	3.12
374	2.34	4.52	-3.28	13.84	16.82	8.53	-0.92	4.33	-6.50
375	12.37	-3.14	12.64	11.16	11.24	12.37	8.33	11.82	2.54
376	5.16	0.83	6.53	10.22	9.24	10.29	2.69	0.82	2.54
378	4.18	5.21	9.66	17.72	17.01	19.57	12.04	3.52	4.47
379	8.99	4.16	16.93	14.42	11.35	16.73	5.81	3.38	7.19
37	9.61	8.49	9.66	11.71	9.94	8.03	1.66	3.37	-0.29

Computed

In terms of partial productivity measures, [Table 4.17b] the most notable development in this sector is that capital productivity is no longer declining in the second period. Capital intensity has increased at a rate of 6.74 per cent for the entire period. Capital intensity shows a higher growth in the first period. Labour productivity shows a growth of 7.82 per cent per annum for the entire period. Labour productivity rate registers an increase in the second period.

Table 4.17(b) Growth Rates of Labour productivity, Capital Productivity and Capital Intensity in Transport Equipment and Parts Sector

Industry	Labour Productivity			Capital Productivity			Capital Intensity		
Code	Entire Period	Period I	Period II	Entire Period	Period I	Period II	Entire Period	Period I	Period II
370	2.45	4.10	0.87	-7.88	-8.69	-7.10	9.81	10.72	9.67
371	1.17	9.95	3.21	-10.43	-10.51	-4.56	9.94	9.04	5.43
372	6.81	0.43	14.76	-2.30	4.88	1.84	6.06	3.04	8.52
373	6.38	6.89	9.97	-3.73	-2.28	1.95	6.73	4.21	5.32
374	3.30	-0.01	-3.60	-5.10	-5.89	-5.89	5.43	4.01	4.38
375	3.78	1.42	3.83	-6.47	-7.78	-4.03	5.32	3.95	4.42
376	2.79	0.01	4.08	-4.58	-7.78	-4.03	5.32	3.95	4.42
378	4.31	3.26	4.01	-1.88	-2.11	-0.52	6.21	6.01	6.23
379	3.05	3.04	4.30	-4.75	-6.45	0.20	5.65	4.99	-0.37
37	7.82	4.97	8.98	-1.88	-9.55	1.51	6.74	8.59	5.00

Computed

Manufacture of railway wagons and coaches and parts (372) and other railroad equipment (373) show better partial productivity performance in period II. Labour productivity growth rate is above nine per cent per annum in these industries in the 1981 onwards period. Capital productivity has improved and has become positive in the second period. On the other hand industries like ship building and repairing (370) and manufacture of motor vehicles and parts (374) show a high negative growth rate in capital productivity throughout the period.

Table 4.17(c) Growth Rates of Total Factor Productivity in Transport Equipment and Parts Sector

Industry Code	Industry	TFPG
370	Ship building	0.167
371	Locomotives and Parts	0.242
372	Railway wagons and coaches and parts	0.451
373	Other railroad equipment	0.059
374	Motor vehicles and parts	-0.002
375	Motor cycles and scooters and parts	0.148
376	Bicycles, cycle rickshaws and parts	0.045
378	Bullock carts, hand carts etc.	-0.005
379	Other transport equipment and parts	0.218
37 Entire Period	Transport Equipment and Parts	0.32
Period I		-0.13
Period. II		0.38

Computed

An analysis of total factor productivity growth of this sector indicates an improvement in the post 1981 period. The overall rate of growth for the group as a whole is 0.32 per cent per annum. The increase in total factor productivity from -0.13 per cent in the earlier period to 0.38 per cent in the latter period reflects an improvement in the performance of this sector. Railway wagons, coaches and parts (372) shows comparitively higher productivity growth than others in the group. Better performance of manufacture of railway wagons and coaches and parts industry could be attributed to a high rate of growth of value added and labour productivity and to a positive trend in capital productivity in the second period of analysis.

An analysis of the sector shows that this is a progressing group. Value added, labour productivity, capital productivity and total factor productivity show an improvement in the post 1981 period. Another important feature of this group is that capital productivity growth rate is positive in the 1981 onwards period.

Other Manufacturing Industries Sector

This sector shows high growth rate of value added and capital as depicted in table 4.18(a) for the entire period. The growth rate of value added is higher in the second period. The rate of growth is 11.62 per cent in period II as against 9.38 per cent in period I. Employment has grown at a rate of 2.52 per cent per annum, the rate being higher for the period 1981-82 to 1992-93. Capital grows at a rate of 12.17 per cent per annum for the entire period, the rate of growth is higher in the second period of analysis.

Table 4.18(a) Growth Rates of Value added, Capital and Labour in Other Manufacturing Industries Sector

Industry Code	Value Added			Capital			Labour		
	Entire Period	Period I	Period II	Entire Period	Period I	Period II	Entire Period	Period I	Period II
380	6.63	5.63	7.79	9.27	7.77	9.91	1.02	1.42	0.51
381	9.42	10.84	6.01	10.21	9.18	12.14	1.53	-3.15	4.94
382	14.33	16.92	12.58	13.37	15.95	12.00	5.76	10.18	5.05
383	7.76	6.24	9.26	9.31	10.37	8.82	6.64	-7.07	9.53
385	10.88	12.68	9.23	15.01	15.44	12.18	1.29	5.69	-0.53
386	9.92	9.38	11.62	12.17	10.69	10.61	2.52	1.16	4.46
387	11.39	5.07	11.72	10.79	13.49	10.01	-0.05	-0.03	1.08
389	10.26	-1.72	19.02	9.89	6.98	11.87	1.04	-6.69	5.89
38	9.92	9.38	11.62	12.17	10.69	12.61	2.52	1.16	4.46

Computed

Table 4.2 (b) depicts trends in partial productivities and capital intensity growth rates. Labour productivity in this sector has increased at a rate of 7.22 per cent per annum. The growth rate is slightly lower in the second period as compared to that in the earlier period. Capital productivity has declined at a rate of -2.01 per cent per annum for the entire period. The decline is less in the second period. Capital intensity shows a growth rate of 3.84 per cent per annum for period II as against 6.78 in period I. Most of the industries in this sector show a high growth rate in value added and capital input.

Table 4.18(b) Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity in Other Manufacturing Industries Sector

Industry Code	Labour Productivity			Capital Productivity			Capital Intensity		
	Entire Period	Period I	Period II	Entire Period	Period I	Period II	Entire Period	Period I	Period II
380	5.06	3.38	6.16	-2.42	-1.98	-2.01	14.01	2.68	7.31
381	7.49	9.92	0.92	-5.85	-2.06	-2.48	10.98	5.61	10.59
382	7.71	5.52	7.12	-1.75	-1.69	-2.10	6.67	6.36	5.34
385	9.26	5.81	9.99	-3.58	-2.39	-2.64	2.19	6.34	7.58
386	7.25	6.21	8.19	-3.56	-1.41	-1.06	4.21	5.26	4.21
387	10.94	10.47	10.00	1.53	-7.42	2.55	5.99	8.05	5.10
389	9.32	4.97	12.54	-0.34	-8.14	6.39	5.36	10.01	-3.77
38	7.22	8.16	6.80	-2.01	-2.06	-0.88	6.66	6.78	3.84

Computed

Most of the three digit industries in the group also show high growth rates in labour productivity for the entire period. Capital productivity shows an improvement in the post 1981 period. Stationery articles industry (387); and other miscellaneous products industry (389) show a positive trend in capital productivity in the post 1981 period. Capital intensity is high in the earlier period in all industries except in medical and scientific equipment (380), photographic and optical goods (381) and sports and athletic goods (385).

Table 4.18(c) Growth Rates of Total Factor Productivity in Other Manufacturing Industries Sector

Industry Code	Industry	TFPG
380	Medical and Scientific	0.011
381	Photographic and optical goods	-0.596
382	Watches and clocks	-0.074
383	Jewellery and related goods	-0.051
385	Sports and athletic goods	-0.015
386	Musical instruments	0.091
387	Stationery articles	0.183
389	Other miscellaneous products	0.134
38 Entire Period	Other Manufacturing Industries	0.04
Period I		0.015
Period II		0.13

Computed

Total factor productivity growth rates of this sector are reported in table 4.18(c). This sector shows a mild increase in productivity growth for the period under consideration. The performance in the post 1981 period is slightly better than in the pre 1981 period. The industries like stationery articles (387) and other miscellaneous products (389) show comparatively higher productivity growth than others in the group. An analysis of these industries shows that in Stationery articles and other miscellaneous products industries, high growth rate in labour productivity in the second period is accompanied by positive rate of growth in capital productivity. On the other hand, photographic and optical goods (381) show a high negative growth rate of -0.596. In case of photographic and optical goods (381), the rates of growth of output and labour productivity are higher in the earlier period and for this industry, productivity of capital falls at a rate of -5.85 per cent per annum for the entire period. Even with a high capital intensity rate of 10.59 per cent in the post 1981 period, labour productivity in this industry grows at a rate of 0.92 per cent per annum.

An overall analysis of results of this sector indicates that despite an increase in growth rates of value added, capital and labour over the period, this sector has not performed well on the productivity front. The sector as a whole registers a mild increase of 0.04 per cent per annum in total factor productivity growth. The slight improvement in performance on productivity front in the post 1981 period could be attributed to improvement in productivity of capital in this period.

Repair Services Sector

Table 4.19(a) presents growth rates in value added, capital and employment. Value added for the sector grows at a rate of 1.07 per cent for the entire period with the growth rate being more in the first period. Capital for the entire period has grown at 6.50 per cent. The rate of growth of capital is higher in pre 1981 period. Employment grows at a rate of 4.77 per cent per annum for the entire period. The rate of growth is higher in the latter period under analysis.

Table 4.19 (a) Growth Rates of Value Added, Capital and Labour in Repair Services Sector

Industry Code	Value Added			Capital			Labour		
	Entire Period	Period I	Period II	Entire Period	Period I	Period II	Entire Period	Period I	Period II
971	5.2	1.868	1.21	7.23	7.16	8.10	4.65	8.63	8.98
972	4.1	4.5	1.60	6.28	6.27	3.37	4.92	3.61	8.42
973	11.15	1.53	2.34	14.09	9.93	7.72	3.87	2.84	2.29
974	3.2	3.4	3.36	8.73	8.24	8.61	10.8	4.85	6.58
975	1.42	2.65	5.98	2.2	3.10	9.7	9.91	0.50	9.83
97	1.07	6.97	3.40	6.50	10.43	8.94	4.77	3.09	5.43

Computed

Table 4.19(b) presents trends in partial productivities and capital intensity growth rates in the repair services group. With the exception of repair of footwear industry (971), other industries in the group show improvement in annual growth rate of labour productivity in the second period of analysis. The picture is not so good in terms of capital productivity. The productivity of capital is negative in both the periods in all the industries in this group. For the sector, as a whole, capital productivity declines at a rate of -3.28 per cent per annum. Capital intensity in period II registers an increase. It is 11.17 per cent in post 1981 period as against 10.05 per cent per annum in pre 1981 period.

Table 4.19(b) Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity in Repair Services Sector

Industry Code	Labour Productivity			Capital Productivity			Capital Intensity		
	Entire Period	Period I	Period II	Entire Period	Period I	Period II	Entire Period	Period I	Period II
971	5.41	10.63	3.34	-5.06	-1.0	-0.18	5.14	5.42	4.01
972	6.79	6.31	7.90	-2.21	-1.05	-3.56	4.76	4.91	3.01
973	8.64	2.15	8.10	-2.57	0.03	-2.06	7.71	8.71	7.79
974	6.12	3.01	8.07	-3.31	-4.26	-2.21	3.71	3.11	4.21
975	9.06	-3.37	10.01	-3.61	-4.72	-2.78	10.45	13.87	12.63
97	6.13	3.79	7.91	-3.28	-3.13	-3.21	8.87	10.05	11.17

Computed

Table 4.19(c) Growth Rates of Total Factor Productivity in Repair Services Sector

Industry Code	Industry	TFPG
971	Repair of Footwear	0.02
972	Electrical Repair Shops	0.04
973	Repair of Motor vehicles	-0.23
974	Repair of watches etc	0.07
970	Other Repair	0.35
97 Entire Period	Repair Services	-0.07
Period I		0.16
Period II		-0.53

Computed

Total factor productivity growth [Table 4.19(c)] of repair group is negative for the entire period. The group as a whole has higher productivity in the pre 1981 period as compared to post 1981 period when total factor productivity growth becomes negative. Other repair industry shows a higher productivity growth than that of others in the group.

An analysis of this sector depicts that rate of growth of value added is higher during the pre eighties period. Employment growth rate which is positive in the pre eighties becomes negative in the eighties onwards period. Capital input also grows at a higher rate in the first period. High growth of output-labour ratio in the post 1981 period could be due to higher growth of capital labour ratio, i.e., at a rate of 11.17 per cent during the second period of analysis. Capital productivity is negative for the entire period as well as for both the periods for all the industries. Total productivity growth is higher in the pre 1981 period than in the post 1981 period.

Electricity, Gas, Water Supply and Cold Storage Sectors

Table 4.20(a) presents growth rates in value added, labour and capital inputs in electricity (400); gas (410); water supply (420) and cold storage (741) industries. Electricity and cold storage sectors show high growth rates in value added for the entire period. All sectors report a high growth of capital input for the entire period. Post 1981 period records a decline in growth rate of employment in electricity, water supply and cold storage sectors.

Table 4.20(a) Growth Rates of Value Added, Capital and Labour in Electricity, Gas, Water Supply and Cold Storage Sectors

Industry Code	Value Added			Capital			Labour		
	Entire Period	Period I	Period II	Entire Period	Period I	Period II	Entire Period	Period I	Period II
400	11.29	12.43	8.45	9.03	11.07	7.85	3.24	6.30	1.21
410	4.41	5.44	4.74	11.63	6.98	15.78	1.81	-5.49	6.81
420	4.86	-6.34	10.29	7.27	8.00	7.21	3.67	3.86	2.94
741	8.98	4.74	9.84	13.45	15.42	9.77	8.00	13.04	3.30

Computed

Growth rates in partial productivities and capital intensity are given in table 4.20(b) Labour productivity in electricity sector grows at a rate of 7.79 per cent per annum for the entire period, and at a rate of 10.31 per cent per annum in post 1981 period. All other sectors also record a higher growth in labour productivity in post 1981 period. Electricity sector records a positive growth in capital productivity throughout the period, with the growth rate declining in the second period. All sectors record a positive growth rate in capital productivity in the second period of analysis. Capital intensity is high in gas and steam sectors. Capital intensity growth rate is negative for water works and supply sector for the entire period and for the post 1981 period.

Table 4.20(b) Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity in Electricity, Gas, Water Supply and Cold Storage Sectors

Industry Code	Labour Productivity			Capital Productivity			Capital Intensity		
	Entire Period	Period I	Period II	Entire Period	Period I	Period II	Entire Period	Period I	Period II
400	7.79	6.02	10.31	2.09	1.55	0.56	1.02	0.25	1.94
410	5.20	4.21	6.26	-2.31	-5.05	1.20	8.26	8.23	7.25
420	1.15	-9.82	7.13	-2.25	-3.26	2.52	-0.37	0.96	-1.08
741	0.87	6.36	7.36	-4.52	-9.25	0.53	3.58	7.34	1.38

Computed

Table 4.20(c) Growth Rates of Total Factor Productivity in Electricity, Gas, Water Supply and Cold Storage Sectors

Industry Code	Industry	TFPG		
		Entire Period	Period I	Period II
400	Electricity	0.124	0.007	-0.13
410	Gas and Steam	0.474	-0.516	0.80
420	Water works and supply	1.194	2.02	0.55
741	Cold Storage	0.415	-0.39	0.688

Computed

An analysis of trends of total factor productivity growth of these sectors indicates that overall productivity of water works and supply is above 1 per cent per annum. This sector has recorded a high productivity growth in pre 1981 period while the growth rate has comparitively slowed down in the post 1981 period. Electricity generation, and transmission and distribution of electrical energy also shows a slowdown in growth rate of total factor productivity in the second period. A review of results of this sector reveals a slow rise in value added and capital productivity in the second period. In other two sectors, i.e., Gas and steam and Cold storage sector, period II marks an improvement over period I on the total productivity front. A common feature of both the groups is that there is a marked improvement in capital productivity in the post 1981 period. So these sectors are progressing sectors.

4.3 CAPITAL-OUTPUT RATIOS

In this part, the study examines the trends in aggregate capital- output ratios, as also the sector wise pattern of capital-output ratios and their trends. In dynamisation of growth models, capital output ratio has played an important role. While Harrod Domar model of growth assumed it to be constant. Solow (1956) believes that under Neoclassical conditions of variable proportions and constant returns to scale, capital output and labour will tend to grow at the same rate. In case capital grows faster than labour, causing a rise in capital output ratio and capital labour ratio, the rate of output per worker declines. This leads to a decrease in the rate of savings which means capital-output ratio remains constant. However, Lutz (1961) is skeptical about the empirical evidence as well as theoretical justification of constancy of capital output ratios. According to this study, the variability of factor proportions consists in changes in industry mix and if capital increase is faster than labour, capital will grow not only in 'breadth' but also in 'depth'. In the recent past historically argued constancy of capital coefficients has been questioned. Empirical evidence does not support the constancy of capital coefficients. Capital coefficient has a tendency to move with per capita income [Kuznets, 1961]. Even different stages of industrial development have a bearing on capital coefficients. As the economy moves from lower to higher stages of industrial development, the efficiency and productivity of capital stock in use increases which causes a decline in capital coefficients. At maturity capital coefficients have a tendency to rise. Expansion and diversification of an industrially poor economy has a tendency to increase capital coefficients [Snagha, 1960].

In the short run when new capital equipment cannot be acquired and installed output is increased by employing more labour and by using existing capital more intensively. On the other hand, in the long run new equipment can be installed to raise output. The effect of capital coefficients depends on capacity utilisation, rate of capital accumulation, technology mix, product mix and finally the scale of operations.

4.3.1 Capital Coefficients at Aggregate Level

A capital coefficient is the ratio between the capital stock and the output produced by it. For the period under consideration the capital coefficients in gross terms (ratio of gross fixed capital to gross value of output) and in net terms (ratio of net capital to net output) for aggregate manufacturing are closer to one another in average terms. But coefficient of variation depicts that gross capital coefficients are more stable overtime than net coefficients. Coefficients based on value added are highly unstable because of volatility of working capital, which mainly constitutes inventories. Capital coefficients based on it are unstable over- time.

Table B1 : Capital-Output Relations in the Indian Manufacturing, 1973-74 to 1992-93.

Year	GFCAP : GVOUT	NFCAP : NVOUT	GFCAP : GVADD	NFCAP : NVADD	WCAP : GVOUT	WCAP: NVOUT
1973-74	0.630992	0.612980	2.685335	2.146869	0.252687	0.263030
1974-75	0.509366	0.491729	2.186134	1.795733	0.239925	0.247870
1975-76	0.456974	0.441994	2.136976	1.740825	0.195280	0.201724
1976-77	0.471963	0.457024	2.200817	1.800886	0.193551	0.199818
1977-78	0.506511	0.492140	2.424757	1.985939	0.182960	0.188851
1978-79	0.499045	0.484940	2.316270	1.884416	0.174620	0.180638
1979-80	0.488836	0.474485	2.486267	2.027287	0.189646	0.195579
1980-81	0.519077	0.504417	2.658056	2.176839	0.216234	0.222825
1981-82	0.476687	0.461728	2.412897	1.961552	0.194175	0.200310
1982-83	0.479016	0.465136	2.477623	2.035717	0.179822	0.185118
1983-84	0.528137	0.512297	2.453204	1.963640	0.187976	0.195031
1984-85	0.530003	0.513277	2.678767	2.090455	0.200929	0.208927
1985-86	0.509968	0.493231	2.633636	2.063612	0.164480	0.170733
1986-87	0.513361	0.497551	2.672932	2.115422	0.155722	0.161358
1987-88	0.522875	0.504788	2.841468	2.156023	0.170063	0.177261
1988-89	0.495983	0.477720	2.639944	2.027347	0.140439	0.146085
1989-90	0.476186	0.457686	2.532367	1.952547	0.139503	0.144948
1990-91	0.504709	0.487500	2.650820	2.062344	0.149331	0.155099
1991-92	0.518444	0.501433	2.829192	2.181423	0.141226	0.146790
1992-93	0.534364	0.517431	2.764619	2.139223	0.161087	0.167647
CV	6.885712	6.990341	8.009107	7.131559	16.681135	16.586236

4.3.2 Sectoral Analysis

Sectoral level time series of gross capital coefficients with adjusted data are presented in table B2. Coefficient of variation has been computed for manufacturing. It shows that capital coefficients are relatively stable for manufacturing industries. Inter industry variations are quite high, e.g., in 1992-93 food products (20) has capital coefficients as low as 0.44203 per unit of output and electicity generation and distribution(40) has as high as 4.67325 per unit of output.

Table B2 Capital Coefficients 1973-74 to 1982-83

NIC Code	YEAR									
	73-74	74-75	75-76	76-77	77-78	78-79	79-80	80-81	81-82	82-83
20	0.30273	0.28717	0.27183	0.28827	0.26934	0.23701	0.31979	0.44400	0.37835	0.32374
22	0.26097	0.29914	0.36483	0.31434	0.30035	0.31609	0.35933	0.39998	0.36742	0.36161
23	0.48577	0.49941	0.52365	0.50269	0.53014	0.52578	0.59728	0.65711	0.73082	0.81306
24	0.62856	0.65379	0.59319	0.62405	0.61929	0.62698	0.59977	0.62972	0.58836	0.65986
25	0.36726	0.52106	0.41393	0.37976	0.38195	0.44959	0.45073	0.46091	0.47133	0.54281
26	0.15007	0.18766	0.20939	0.19235	0.19361	0.22813	0.27848	0.26756	0.33193	0.32958
27	0.32206	0.44231	0.46045	0.44936	0.45995	0.47529	0.49698	0.56940	0.64802	0.70126
28	0.90420	1.01466	1.10591	1.07491	1.06690	1.12032	1.17992	1.27844	1.26123	1.44694
29	0.13232	0.16019	0.18675	0.16392	0.20203	0.20743	0.23073	0.32212	0.30054	0.32732
30	1.02004	1.15281	1.20140	1.08768	1.03328	1.01686	1.09950	1.22814	1.16124	1.11636
31	0.52969	0.39552	0.39616	0.44302	0.41266	0.50820	0.48715	0.43775	0.41900	0.39138
32	0.91327	1.03883	1.05111	1.00116	0.92134	1.05788	1.15485	1.22019	1.25307	1.24074
33	1.34009	1.29020	1.47242	1.46492	1.50242	1.38573	1.02256	1.48451	1.50235	1.48880
34	0.41850	0.47360	0.51389	0.50371	0.49829	0.52506	0.50934	0.58868	0.57129	0.66468
35	0.58404	0.59396	0.73305	0.65958	0.66294	0.67696	0.73447	0.70778	0.74613	0.75637
36	0.61109	0.78783	0.73797	0.66080	0.65673	0.65439	0.65207	0.60419	0.62607	0.58378
37	0.55238	0.64459	0.70963	0.68355	0.72038	0.98701	1.01512	1.01273	0.98530	0.98777
38	0.74340	0.95527	0.85326	0.74361	0.74025	0.71074	0.72599	0.70423	0.77756	0.67545
40	10.37544	10.41558	8.08808	7.30171	7.53173	6.51873	7.57931	7.59087	6.29611	5.99230
41	1.60394	1.58930	1.55723	1.63185	1.93674	2.44923	1.70357	2.20390	2.04006	2.46895
42	0.87859	2.74417	2.62911	1.80967	2.04219	2.34544	2.57906	2.53761	2.15710	2.39838
74	3.22425	3.79874	2.57395	2.83134	2.54086	2.43585	2.20934	2.81433	2.67698	2.71189
97	0.55955	0.54995	0.43477	0.46030	0.43384	0.38568	0.54897	0.53351	0.49695	0.44688
ALL	1.17776	1.14837	1.11113	1.08409	1.08214	1.05125	1.11059	1.27772	1.20519	1.16227
CV mfg only	54.35	51.90	53.76	54.01	53.61	50.72	45.64	48.83	48.29	48.77

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Table B2 Capital Coefficients 1983-84 to 1992-93

	YEAR									
NIC Code	83-84	84-85	85-86	86-87	87-88	88-89	89-90	90-91	91-92	92-93
20	0.37273	0.38989	0.39440	0.42444	0.38441	0.39266	0.38038	0.52320	0.42329	0.44203
22	0.33947	0.35851	0.44460	0.45117	0.52814	0.59933	0.45983	0.45931	0.47573	0.51081
23	0.79301	0.83925	0.87469	0.89392	0.95488	0.94129	0.88159	0.91569	0.95333	0.95819
24	0.72031	0.71270	0.67331	0.68395	0.71974	0.73213	0.75221	0.83016	0.85504	0.88166
25	0.72534	0.70379	0.59085	0.64436	0.83334	0.95024	0.62435	0.71556	0.75780	0.76176
26	0.39681	0.39365	0.39069	0.37715	0.42207	0.41529	0.32081	0.33287	0.33187	0.32398
27	0.80821	0.77095	0.91050	0.94942	0.92047	0.75279	0.80313	1.74213	0.79450	1.43528
28	1.59710	1.51761	1.64556	1.58979	1.80068	1.85331	1.66143	1.69276	1.82349	2.04544
29	0.36629	0.32799	0.35680	0.39322	0.32298	0.36884	0.35003	0.41011	0.41816	0.42278
30	1.14182	1.11593	1.14064	1.29985	1.29080	1.19810	1.01234	1.19278	1.07691	1.09053
31	0.48565	0.48107	0.44464	0.75048	0.80205	0.81176	0.96229	1.08247	1.04341	0.87182
32	1.43197	1.38569	1.48696	1.64078	1.72084	1.67548	1.65987	1.81721	1.74005	1.88569
33	1.71785	1.72839	1.90339	1.79749	1.82397	1.70889	2.00401	2.11417	2.21427	2.12807
34	0.77574	0.76120	0.82801	0.89605	0.79093	0.82399	0.78586	0.90253	0.82665	0.93940
35	0.80733	0.81364	0.81696	0.88439	0.83122	0.89721	0.81188	0.82279	0.93790	1.00861
36	0.66094	0.64203	0.65343	0.68885	0.61847	0.64053	0.63328	0.71718	0.87961	1.03565
37	1.02321	1.04607	1.12356	1.09009	1.09794	0.98849	0.97083	1.07545	1.13126	1.04551
38	0.66579	0.64423	0.51792	0.69371	0.55799	0.59799	0.48554	0.45131	0.45583	0.40760
40	5.11615	5.94093	5.75140	4.84424	4.94039	5.16241	4.99203	5.06907	5.07472	4.67325
41	2.12016	3.41451	1.14932	1.46391	0.99026	1.72608	3.17898	3.85183	2.16597	1.89161
42	1.76053	1.73309	2.07798	1.73241	1.80433	1.87778	1.83305	1.78253	1.66412	1.52549
74	3.12492	2.95075	2.56830	3.24372	3.54678	2.75852	2.97971	3.01045	3.37152	1.65454
97	0.79112	0.80589	0.81050	0.73754	0.75495	0.69709	1.04279	1.76766	2.13797	2.35575
ALL	1.24836	1.27616	1.26335	1.26922	1.28360	1.26500	1.23353	1.26935	1.37122	1.37726
CV mfg only	48.95	48.52	52.61	47.05	50.07	47.51	53.49	52.44	52.77	52.83

The results presented here are what may be termed as exploratory in nature. To arrive at policy implication with a sound confidence an exercise on large scale with a strong data base is called for. To sum up it may be stated that an open end study in the input-output framework is required to analyse capital coefficients.

CHAPTER-V

DETERMINANTS OF PRODUCTIVITY

After analysing the trend in productivity it is significant to enquire what factors govern the temporal, spatial and cross sectional changes in industrial productivity. For this, one has to analyse the important determinants of productivity and how these determinants interact with one another. Can these determinants furnish some plausible reasons to explain the existence of inter unit, inter-industrial differences in industrial productivity? A critical study and appraisal of such factors will help us in analysing the conditions which retard and stimulate productivity, and also in discovering the nature and character of relationship that exists between different determinants of productivity. A study of determinants of productivity helps in analysing which variables influence productivity the most and should be varied in order to have an immediate effect on productivity .

For correct interpretation of the productivity data and for the formulation of definite, coordinated and unified business policies, it is essential to know what influences do the individual determinants exercise on overall productivity. But the factors affecting productivity are so numerous, complex and inextricably interwoven that the task of evaluating the influence of each individual factor on overall productivity of individual units is beset with almost insuperable difficulties. Such a large variety of factors affect productivity that it is difficult to say whether increased productivity is the result of more efficient utilisation of plant and machinery or of more intensive efforts of the workers and management or of the application of the process of production . Generally speaking, although long term advances in industrial productivity usually stem from the steady application of science and technology to the productive process and from increased efficiency and skill of workers and management but other factors such as the degree of plant utilisation, steady flow of material and components, size and stability of production, rationalisation and standardization of work and material layout and location of plant, and degree of integration are by no means less important. Indeed, under the complex production system, the influence of the individual factors is often blurred in the overall picture and no rough and ready method is available by which these complex and interrelated influences could be separated and their influence weighed or measured in quantitative terms.

So a multiplicity of factors governs the rise and fall in industrial productivity. Mehta (1955) observes that the factors affecting productivity are so numerous, complex and inter related that it is difficult to arrange them in any logical or systematic sequence. Indeed Balakrishna's (1958) description of productivity as an elusive concept that does not lend itself either to clear cut definition or easy computation, would seem to be real.

The objective of this chapter is to find out the relationship between growth in total factor productivity and growth in other variables like rate of growth of output, capital-labour ratio, rate of growth of investment, scale variable, rate of growth of factories and total emoluments. It is hypothesised that productivity is dependent on these variables.

Rate of growth of output

Rate of growth of output is an important determinant of productivity as productivity is measured as a ratio of output to input. So, higher rate of growth of output should lead to higher labour productivity of the industry. The movements in labour productivity have normally a specific relationship with movements in output. Verdoorn (1949) examined the empirical relationship by estimating the equation of the form :

$$P=\alpha+\beta Q \qquad \ldots\ldots\ldots\ldots(5.1)$$

Where P is the Productivity growth and Q is the output growth and α and β are parameters. The equation (5.1) was later popularised as Verdoorn's law. He observed a constant long run relationship between output growth and productivity growth. Kennedy (1971) observed a strong correlation coefficient between output growth and productivity growth for Irish manufacturing industry for the period (1946-66). Reddaway and Smith (1960) also noticed a close relationship between the rate of growth of output and productivity growth for 14 British manufacturing groups. Katz (1969) observed a strong positive correlation between TFP growth and output growth for Argentine manufacturing. Goldar (1986) has also examined the determinants of productivity in Indian manufacturing sector for the period 1960-70 and found that one per cent higher growth in output is associated with 0.4 per cent higher growth in TFP. Swamy (1993) examines the relationship between growth rates in TFP and output in Andhra Pradesh manufacturing industries for the period 1961-82. The results of the analysis indicate the validity of Verdoorn's law of productivity growth. Ahluwalia (1991) estimates the relationship between growth in value added and TFPG. The growth in value added has a positive and statistically significant impact on productivity growth. The elasticity of total factor productivity with respect to value added is 0.37. Rao (1996) examines correlations between TFP growth and output growth for 19 year period 1973-74 to 1992-93. The elasticity of productivity growth with respect to output growth in aggregate manufacturing is 5.1 for the private large sector, 5.7 for the public and 4.8 for aggregate manufacturing, so Verdoorn's law holds for organised Indian manufacturing as a whole over the entire period.

Capital Intensity

Capital Intensity is the capital-labour ratio of the industry. The most immediate factor affecting output per worker is the amount of machinery available. It is quite evident that the worker helped by machine will produce more than the workers operating with little or no machinery. The need to employ more or less machinery is determined by a number of factors such as size of the plant, the nature and character of products, the size of the market, the state of technological advancement, the availability of capital and human resources and the possibility of substituting one by the other. The quality, size (type, efficiency, etc) of the machinery, as well as the application of modern technique in general is of equal importance.

Most of the empirical studies undertaken in Great Britain and United States seem to suggest that the amount of machinery, its quality, its rate of replacement and factors determining its use will materially affect output per worker. Rostas (1958), in comparative study of productivity in British and American industries, observes that the higher rate of increase in horsepower per worker in United States runs parallel with the higher rate of increase in output per worker in the United States. The average increase in horsepower per worker per annum amounted to 0.075 h.p. in the 1924-30 period in the United Kingdom and to 0.150 h.p. per annum in the 1925-39 period in U.S. Simultaneously, the productivity increases were at a compound rate of 2.3 in U.K. and at the compound rate of 3.3 in U.S. during 1924-35 and 1924-37 periods respectively. In U.S., several empirical studies undertaken by U.S. Bureau of Labour Statistics, the National Bureau of Economic Research, the National Industrial Conference Board show that rapid increases in the output per man hour in American industry are associated with the technical improvements and their application to productive processes. Although, it is difficult to measure quantitatively the degree of relationship between technical change and productivity, yet numerous empirical studies bear ample testimony to the fact that the technological advances have made significant contribution towards the rapid rise in industrial productivity. Higher capital intensity involves more embodied technical progress and more scope for learning by doing. Empirical studies on the technology-productivity nexus carried out on American industries by Terlechky (1974), Scherer (1982,1983), Griliches (1984) and others have shown that technological advancement is a major source of productivity improvement. Similar conclusions have been reached in the studies of Odagiri (1985) for Japanese industries and Cuneo and Maisessse (1984) for

French industries.

Investment

Composition of capital affects productivity. Investment is taken as the change in the capital stock. Investment figures have been obtained using the formula :

$$I_t=(B_t-B_{t-1}+D_t)/R \qquad \text{..............(5.2)}$$

where B is the book value of fixed capital, D is the depreciation and R is an appropriate deflator for fixed capital. For R wholesale price index of machinery (base 1981-82=100) has been used.

Growth in number of factories

The next variable is growth in number of factories over the period. Ahluwalia's (1991) study reveals that the growth of factories in an industry is negatively related to total factor productivity growth. This probably reflects an adverse impact on productivity growth of the phenomenon of fragmentation stemming from the policies of protection of the small scale sector.

Scale variable

Scale variable (SC) is measured as the capital stock per factory (an average of two points of time during the period). Ahluwalia's (1991) scale variable, 'capital stock per factory' is an average of the value for two points (1959-60 and 1975-76) during the period (1959-60 to 1979-80). The estimated regression coefficient for scale variable is positive but not statistically significant in

Ahluwalia's study.

Wages and productivity

Total factor productivity also depends on the efficiency of labour. The ability of worker, the willingness, and the system of wage-payment influence the efficiency of labour. The worker's attitude and behaviour are influenced partly by the system and partly by his morale, feeling of responsibility, general outlook to life and trade union practices and attitudes. The system of wage payments undoubtedly exerts an important influence on the worker's urge to produce more. The regression coefficient estimated by Mehta, (1980) is small. Only 25 per cent of changes in output per person can be explained by the earnings per head. Many studies have found that for short periods, earnings and productivity are more closely correlated. Kendrick, in a study for U.S.A., estimated correlation coefficient to be 0.26 for the period 1899 to 1937 and in a study for the period 1929 to 1937 correlation coefficient is 0.44. Katz (1967) in the study for Argentina for the period 1946-1995 estimated correlation coefficient to be 0.50.

The relationship of productivity growth with all the aforementioned variables can be represented by an equation of the form :

$$Y=f(X_1, X_2, X_3, X_4, X_5, X_6) \qquad \ldots\ldots\ldots\ldots(5.3)$$

Where X_1 is output growth;

X_2 is capital intensity;

X_3 is investment;

X_4 is growth in number of factories;

X_5 is scale variable and

X_6 is total emoluments.

The present study uses ordinary least square regression and step wise regressions to fit in the above mentioned model. The time period for the analysis is 1974-75 to 1992-93. The dependent variable is total factor productivity growth. Total factor productivity is a comprehensive measure of productive efficiency. In this chapter an effort is made to explain the factors affecting total factor productivity growth. The variables used in the model are discussed below :

1. Output Growth Rate

This is measured by the growth rate of output at constant prices. There are a number of reasons why we should expect a positive association between growth in output and growth in productivity. The faster an industry grows, the more the opportunity it has to explore the benefits of an expanding level of operations. The expansion allows the industry to explore the economies of scale. Thus, an increase in inputs leads to a higher increase in output. In situations where there is excess capacity, the expansion in scale of operations allows the utilization of this capacity and thus increases efficiency of the factors. Besides the effect of economies of scale and better utilisation of capacity, there is also the effect of learning by doing on productivity performance. Adoption and adaptation of new technologies takes time. In the course of absorption of technology, learning by doing has a positive influence on productivity growth. Arrow (1962) points out that learning is a result of experience, arising out of attempts to solve a problem and therefore, cumulative investment, a measure of experience, will determine the rate of improvement in quality of machine and hence, productivity. Here Arrow refers to the learning on the part of engineers, machine designers and managers. But this would be true for labour force in general.

2. Capital Intensity

Capital intensity is the capital-labour ratio. Capital is the fixed capital employed and labour is the given by the number of employees. It is apparent that a worker helped by a machine will produce more than the worker operating with little or no machinery. High capital intensity involves more embodied technical progress and more scope for learning by doing.

3. Investment

Variations in the composition of capital, its relative intensity, age and kind also affect productivity. The growth of capital depends on investment. Investment is the change in capital stock and is calculated by :

$$I_t = (B_t - B_{t-1} + D_t)/R_t$$

Where B is the book value of fixed capital, D is the depreciation and R is appropriate deflator. For R, wholesale price index of machinery (base 1981-82=100) has been used.

Productivity in the economy can be increased by increasing the use of capital goods, machinery and equipment.

4. Growth in Number of Factories

The source of data for this variable is Annual Survey of Industries. This variable captures the effect of increase in the number of factories during the period of study.

5. Scale Variable

Scale variable is the average of capital stock per factory taken for two points 1973-74 and 1987-88 during the period. The basic source of data is Annual Survey of Industries.

6. Total Emoluments

Wages and salaries and incentives to the workers influence the workers' ability and efficiency. The system of wage payments has an important influence on the workers' urge to produce more. The source of data for this variable is Annual Survey of Industries.

5.1 AGGREGATIVE ANALYSIS

Entire Manufacturing

Regression results of the entire manufacturing sector are depicted by the equation:

$$Y = 0.019X_1^* + 2.558X_2^* - 0.11X_3 + 0.051X_4^* - 1.50X_5 + 0.059X_6$$

$$t = (3.80) \quad (3.325) \quad (0.289) \quad (5.50) \quad (1.59) \quad (0.07)$$

$$R^2 = 0.62$$

Total factor productivity is positively related to output growth, capital labour ratio, growth in number of factories and total emoluments and is negatively related to scale variable and investment. Output, capital-labour ratio and growth in number of factories are statistically significant at 5 per cent level. The model explains 62 per cent of variations in total factor productivity.

Stepwise regression has picked up output growth and capital labour ratio as important determinants of productivity.

$$
\begin{aligned}
Y &= 0.043X_1 + 0.25X_2 \\
t &= (4.30) \qquad (2.74) \\
R^2 &= 0.52
\end{aligned}
$$

The explanatory power of the model is 52 per cent.

5.2 SECTORWISE ANALYSIS

Food Products Sector

The empirical results for the food products sector are:

$$
\begin{aligned}
Y &= 0.42X_1^* - 5.4X_2^* + 0.49X_3 + 0.11X_4^* - 0.79X_5 + 0.18X_6 \\
t &= (2.35) \quad (2.67) \quad (0.59) \quad (4.23) \quad (0.85) \quad (0.67) \\
R^2 &= 0.59
\end{aligned}
$$

Total factor productivity is positively related to output growth, investment, growth in number of factories and total emoluments. Total factor productivity is negatively related to capital labour ratio and scale variable. Regression coefficients for output growth, capital intensity and growth in number of factories are significant at 5 per cent level. Out of total variation in total factor productivity 56 per cent is explained by the model.

The analysis of stepwise regression depicts a positive and significant relationship between total factor productivity and output growth . The value of R^2 is 0.51.

$$Y = 0.695\,X_1$$
$$t = (3.22)$$
$$R^2 = 0.51$$

Beverages Sector

The empirical results for this sector are:

$$Y = 0.016X_1^{*} - 0.31X_2 - 0.17X_3^{*} + 0.10X_4^{*} + 7.44X_5^{*} - 0.42X_6$$
$$t = (2.66) \quad (0.30) \quad (2.53) \quad (2.12) \quad (2.23) \quad (0.74)$$
$$R^2 = 0.71$$

Total factor productivity is positively related to output, growth in number of factories and scale variable and is negatively related to investment, capital intensity and total emoluments. Regression coefficients for output, investment, growth in number of factories and scale variable are significant at 5 per cent level. The model explains 71 per cent variations in total factor productivity.

The results of stepwise regression indicate a positive and significant relation between total factor productivity and growth in output. The value of R^2 is 0.50.

$$Y = 0.91X_1$$
$$t = (2.22)$$
$$R^2 = 0.50.$$

Cotton Textiles

The results of this sector are:

$$Y = 2.005X_1^* - 9.80X_2 + 0.022X_3^* + 0.91X_4^* + 0.80X_5^* + 0.003X_6^*$$
$$t = (2.08) \quad (1.69) \quad (3.60) \quad (2.31) \quad (2.25) \quad (1.96)$$
$$R^2 = 0.61$$

Total factor productivity is positively related to output, investment, growth in number of factories, scale variable and total emoluments. It is negatively related to capital intensity. Regression coefficients for output, investment, growth in number of factories, scale variable and total emoluments are statistically significant at 5 per cent level. Out of total variation 61 per cent is explained by the model.

The results of stepwise regression show a positive and significant relationship between total factor productivity and output growth. The value of R^2 is 0.57

$$Y = 0.017X1$$
$$t = (4.81)$$
$$R^2 = 0.57$$

Wool, Silk and Other Textiles

The results for this sector are:

$$Y = 0.14X_1^* - 7.06X_2 - 0.17X_3^* + 0.31X_4^* + 0.61X_5^* + 0.08X_6^*$$
$$t = (4.82) \quad (0.859) \quad (8.95) \quad (2.38) \quad (3.05) \quad (4.44)$$
$$R^2 = 0.94$$

The model explains 94 per cent of total variation in total factor productivity. Total factor productivity is positively related to output, growth in number of factories, scale variable and total emoluments. It is negatively related to investment and capital labour ratio. Regression coefficients for all variables except for capital labour ratio are statistically significant at 5 per cent level.

Stepwise regression depicts a positive and significant relationship between output and total factor productivity. The model explains 56 per cent of variations in growth.

$$Y = 0.132X_1$$
$$t = (2.69)$$
$$R^2 = 0.56$$

Jute textiles

The explained variation of the model is 59 per cent. The regression equation is :

$$Y = 0.465X_1^* + 0.39X_2^* + 0.077X_3^* + 0.15X_4^* + 0.21X_5^* + 0.021X_6^*$$
$$t = (1.99) \quad (2.76) \quad (1.97) \quad (2.27) \quad (2.625) \quad (2.469)$$
$$R^2 = 0.59$$

All variables in this model are positively related to total factor productivity. Another important feature is that all coefficients are statistically significant at 5 per cent level.

The results of stepwise regression show a positive and significant relationship between total factor productivity and investment. The value of coefficient of determination is 0.62.

$$Y = 0.062X_3$$
$$t = (4.13)$$
$$R^2 = 0.62$$

Textile Products

The regression equation for this sector is

$$Y = 0.067X_1^* + 5.98X_2^* + 0.29X_3^* + 0.23X_4 - 0.060X_5 + 0.60X_6$$
$$t = (2.16) \quad (1.98) \quad (3.67) \quad (1.35) \quad (0.54) \quad (1.07)$$
$$R^2 = 0.99$$

Output, capital-labour ratio, investment, growth in number of factories and total emoluments are positively related to total factor productivity. Scale variable is negatively related to total factor productivity. Regression coefficients for output, investment and capital intensity are statistically significant at 5 per cent level of significance. The explanatory variation of the model is 99 per cent.

Stepwise regression analysis has selected investment and scale variable to be significant determinants of total factor productivity. Productivity is positively related to investment and is negatively related to scale variable.

$$Y = 0.63X_3 - 0.25X_5$$
$$t = (4.21) \quad (2.74)$$
$$R^2 = 0.62$$

The model explains 62 per cent variations in total factor productivity.

Wood and Wood Products

Regression equation for wood and wood products is :

$$Y = 0.0237X_1^{*}+2.51X_2 - 0.06X_3^{*} + 0.020X_4^{*} + 1.18X_5 + 0.80X_6^{*}$$
$$t = (3.38) \quad (0.91) \quad (2.50) \quad (2.33) \quad (0.56) \quad (2.96)$$
$$R^2 = 0.52$$

Total factor productivity growth is positively related to output growth, capital labour ratio, growth in number of factories, scale variable and total emoluments and is negatively related to investment. Output, investment, number of factories and total emoluments depict regression coefficients to be statistically significant at five per cent level. The model explains 52 per cent of variations in total factor productivity.

Stepwise regression analysis has picked up the output as a dominant explanatory variable of total factor productivity. But with R^2 = 49 per cent only the relation does not prove to be a sound one.

$$Y = 0.012X_1$$
$$t = (3.333)$$
$$R^2 = 0.49$$

Paper and Paper Products

The results for paper and paper products sector are;

$$Y = 0.3X_1^* + 2.62X_2 - 0.009X_3 - 0.052X_4 - 0.51X_5^* + 0.31X_6^*$$
$$t = (2.73) \quad (1.20) \quad (1.50) \quad (0.98) \quad (2.05) \quad (5.16)$$
$$R^2 = 0.53$$

The model depicts a positive relationship of total factor productivity with output growth, capital-labour ratio and total emoluments. Scale variable, investment and growth in number of factories are negatively related to total factor productivity. The model explains 53 per cent variation. Regression coefficients for output, scale variable and total emoluments are statistically significant at 5 per cent level.

The results of stepwise regression depict that output growth is a significant determinant of total factor productivity.

$$Y = 0.010X_1$$
$$t = 2.54$$
$$R^2 = 0.51$$

Coefficient of determination turns out to be 51 per cent.

Leather and Leather Products

Regression equation for leather and leather products sector is ;

$$Y = 0.049X_1^* - 5.51X_2 - 0.153X_3 + 0.202X_4^* + 1.19X_5^* + 0.238X_6^*$$
$$t = (2.04) \quad (0.38) \quad (1.53) \quad (2.69) \quad (2.55) \quad (2.90)$$
$$R^2 = 0.89$$

Total factor productivity is positively related with output, growth in number of factories, scale variable and total emoluments. The variables capital intensity, and investment enter with a negative sign in the regression. The regression coefficients of output, scale variable, growth in number of factories and total emoluments are statistically significant at 5 per cent level of confidence.

Stepwise regression analysis proves that output and growth in number of factories variables are only significant determinants of total factor productivity. But the R^2 value is only 0.45.

$$Y = 0.016X_1 + 0.27X_4$$
$$t = (3.25)\ (2.50)$$
$$R^2 = 0.45$$

Rubber, Rubber Products, Coal and Petroleum

Regression equation for rubber, rubber products, coal and petroleum sector is;

$$Y = 0.287X_1^* + 13.94X_2^* - 0.241X_3^* - 0.38X_4^* - 1.48X_5^* + 0.087X_6^*$$
$$t = (3.64)\quad (4.13)\quad (2.82)\quad (1.95)\quad (3.73)\quad (3.78)$$
$$R^2 = 0.63$$

Total factor productivity is positively associated with output, capital-labour ratio and total emoluments. The regression depicts that total factor productivity is negatively associated with investment, scale variable and growth in number of factories. The model explains 63 per cent of the variations in the dependent variable. The regression coefficients are statistically significant for all the indepedent variable.

The stepwise regression depicts a positive and significant relation between total factor productivity and output growth.

$$Y = 0.77X_1$$
$$t = 3.34$$
$$R^2 = 0.40$$

Chemicals and Chemical Products

Regression equation for chemical and chemical products sector is ;

$$Y = 0.102X_1^* + 1.41X_2 + 0.16X_3 + 0.20X_4 - 0.19X_5 + 0.63X_6^*$$
$$t = (2.03) \quad (0.42) \quad (0.246) \quad (1.66) \quad (0.85) \quad (3.43)$$
$$R^2 = 0.84$$

Ordinary least square regression model underscores the fact that total factor productivity is positively related to output growth, capital intensity, investment, growth in number of factories and total emoluments. Scale variable shows a negative relationship with total factor productivity. Regression coefficients for output growth and total emoluments are significant at 5 per cent level. The model explains 84 per cent of the variations in total factor productivity.

The significant determinants picked by stepwise regression are output and capital-labour ratio.

$$Y = 0.051X_1 + 0.022X_2$$
$$t = (4.25) \quad (2.82)$$
$$R^2 = 0.64$$

Coefficient of determination turns out to be 64 per cent.

Non Metallic Mineral Products

The regression equation for this sector is:

Y	= $0.157X_1$	$+1.77X_2$ +	$0.084X_3^*$	$+0.199X_4^*$ -	$3.44X_5$ +	$0.41X_6^*$	
t	= (0.993)	(0.56)	(3.64)	(7.653)	(1.638)	(4.382)	
R^2	= 0.70						

The regression indicates that total factor productivity is positively associated with all the independent variables except with the scale variable. The regression coefficients are significant for investment growth in number of factories and total emoluments. The value of R^2 is 0.70. The model explains 70 per cent of variations in total factor productivity

Stepwise regression has picked up output as the determinant of total factor productivity. The value of R^2 is 0.64.

$$Y = 0.029X_1$$
$$t = 2.999$$
$$R^2 = 0.64$$

Basic Metals and Alloys

The regression equation for this sector is:

Y	= $0.011X_1$	$-.85X_2$ +	$0.14X_3^*$ +	$0.16X_4$ +	$0.78X_5^*$ -	$0.154X_6^*$
t	= (0.85)	(1.07)	(2.18)	(1.67)	(2.28)	(2.09)
R^2	= 0.53					

In the basic metals sector total factor productivity is positively associated with output, investment, number of factories and scale variable. It is negatively associated with capital-labour ratio and total emoluments. Regression coefficients are statistically significant for investment, scale variable and total emoluments. Stepwise regression analysis failed to select the dominant independent variable.

Metal Products and Parts

The regression for metal products and parts sector is :

$$
\begin{array}{lllllll}
Y & = 0.11X_1^{*} - 3.66X_2^{*} & + 0.0247X_3^{*} & + 0.079X_4 & + 0.24X_5 & + & 0.053X_6^{*} \\
t & = (3.43) & (2.795) & (.224) & (2.46) & (0.57) & (4.07) \\
R^2 & = 0.57 & & & & &
\end{array}
$$

Total factor productivity is positively related to output, investment, growth in number of factories, scale variable and total emoluments. It is negatively associated with capital-labour ratio. Regression coefficients are statistically significant for all the independent variables except for investment and scale variable. The model explains 57 per cent of the total variations in total factor productivity.

Stepwise regression selects output and capital-labour ratio as important determinants of productivity.

$$
\begin{array}{lll}
Y & = .040X_1 & - \ 1.25X_2 \\
t & = (5.79) & (3.90) \\
R^2 & = 0.59 &
\end{array}
$$

Coefficient of determination turns out to be 59 per cent.

Machinery, Machine tools and Parts

The regression equation for machinery, machine tools and part sector is :

$$Y = 0.76X_1^* + 7.09X_2 + 0.016X_3 + 0.19X_4^* - 0.004X_5 + 0.036X_6^*$$
$$t = (2.17) \quad (0.946) \quad (.183) \quad (5.58) \quad (0.8) \quad (4.736)$$
$$R^2 = 0.62$$

Total factor productivity is directly related with all the variables except the scale variable. Regression coefficients are statistically significant for output, growth in number of factories and total emoluments. The model explains 62 per cent of the variations in total factor productivity.

Stepwise regression model depicts number of factories to be the most important and significant determinant of total factor productivity.

$$Y = 0.18X_4$$
$$t = 3.95$$
$$R^2 = 0.51$$

In the finally slected model 51 per cent of variation in total factor productivity is explained by growth in number of factories alone.

Electrical Machinery, Appliances, Supplies and Parts

The regression equation for electrical machinery, appliances, suppliers and parts sector is:

$$Y = 0.94X_1^{*} + 6.09X_2 + 0.62X_3 + 0.10X_4^{*} + 1.26X_5^{*} + 0.51X_6^{*}$$
$$t = 1.99 \quad 0.79 \quad 1.05 \quad 4.010 \quad 1.97 \quad 8.22$$
$$R^2 = 0.63$$

The model depicts a positive relation between total factor productivity and all the independent variables. Regression coefficient for output, growth in number of factories, scale variable and total emoluments are statistically significant at 5 per cent level. The model explains 63 per cent of variations in total factor productivity growth.

Rate of growth of output emerges to be the most important determinant of total factor productivity in stepwise regression model. Explanatory power of total factor productivity variable (R^2) comes to be 53 per cent.

$$Y = 0.10X_1$$
$$t = 2.77$$
$$R^2 = 0.53$$

Transport Equipment and Parts

The regression equation for transport equipment and parts sector is :

$$Y = 0.1094X_1^{*} - 8.95X_2 + 0.45X_3 + 0.37X_4^{*} - 0.19X_5 + 0.16X_6^{*}$$
$$t = (1.98) \quad (0.934) \quad (0.725) \quad (2.242) \quad (0.7) \quad (3.07)$$
$$R^2 = .57$$

Total factor productivity is positively related to output growth, investment, growth in number of factories, and total emoluments. It is negatively associated with capital-labour ratio and scale variable. Independent variables like output, number of factories and total emoluments are characterised by statistically significant regression coefficient. The model explains 57 per cent of the variations in total factor productivity.

The analysis of stepwise regression has selected output to be the only determinant of productivity.

$$Y = 0.026$$
$$t = 4.33$$
$$R^2 = 0.49$$

Other Manufacturing Industries

Regression equation for other manufacturing industries is :

$$\begin{array}{lllllll} Y & = 0.27X_1^* + & 1.29X_2 - & 0.21X_3 + & 0.477X_4^* + & 0.11X_5 + & 0.13X_6 \\ t & = (1.985) & (0.744) & (1.57) & (6.04) & (0.410) & (0.216) \\ R^2 & = 0.56 & & & & & \end{array}$$

Total factor productivity growth is positively related to all the independent variables except investment. Regression coefficients for output and number of factories are statistically significant at 5 per cent level. The model explains 56 per cent of the variations in total factor productivity.

Repair Group

For the repair group regression equation is :

$$Y = 1.12X_1^* + 0.48X_2 + 0.042X_3 + 0.122X_4^* + 0.075X_5 + 0.11X_6^*$$
$$t = 2.55 \quad 1.113 \quad 0.56 \quad 2.03 \quad 0.72 \quad 3.92$$
$$R^2 = 0.50$$

Total factor productivity is directly related with all the independent variables but regression coefficients are significant for output, number of factories and total emoluments. The model explains 50 per cent of the variations in total factor productivity.

Stepwise regression has selected output growth, capital-labour ratio and total emoluments as the determinants of productivity.

$$Y = 0.12X_1 + 0.12X_2 + 0.24X_6$$
$$t = (3.24) \quad (2.40) \quad (2.14)$$
$$R^2 = 0.54$$

Electricity

Regression results for the electricity sector are as follows :

$$Y = 0.10X_1^* + 7.29X_2^* + 0.005X_3 + 1.6X_4^* - 0.62X_5^* + 0.37X_6^*$$
$$t = (2.08) \quad (3.12) \quad (0.357) \quad (1.97) \quad (3.26) \quad (3.42)$$
$$R^2 = 0.64$$

Total factor productivity has a positive association with all the independent variables except with that of scale variable. Regression coefficients are significant for all the variables except for investment. The model explains 64 per cent of the variations in total factor productivity.

Stepwise regression analysis highlights the fact that output and capital-labour ratio are the most important determinants of total factor productivity. Coefficient of determination turns out to be 57 per cent.

$$Y = 0.11X_1 + 0.17X_2$$
$$t = 4.23 \quad 2.46$$
$$R^2 = 0.57$$

Gas and Steam

Regression results for gas and steam sector are as follows :

$$Y = 0.09X_1^* + 1.12X_2^* - 0.033X_3^* + 0.740X_4^* - 0.34X_5 - 0.045X_6$$
$$t = (3.91) \quad (3.85) \quad (2.06) \quad (2.36) \quad (1.62) \quad (1.35)$$
$$R^2 = 0.99$$

Total factor productivity is positively related with output growth, capital intensity and growth in number of factories. It is negatively associated with investment, scale variable and total emoluments. Regression coefficients of output growth, capital-labour ratio, investment and growth in number of factories are statistically significant at 5 per cent level. The model explains 99 per cent of variations in total factor productivity.

Stepwise regression highlights the fact that output variable and capital-labour ratio are the most important determinants of total factor productivity.

$$Y = 0.11X_1 + 0.96X_2$$
$$t = (2.75) \quad (2.23)$$
$$R^2 = 0.99$$

Water Works and Supply

Regression results for water works and supply sector are as follows :

$$Y = 0.20X_1^* + 5.09X_2^* + 0.20X_3^* - 0.13X_4 + 0.45X_5 + 1.10X_6^*$$
$$t = (2.41) \quad (3.71) \quad (2.40) \quad (0.57) \quad (0.540) \quad (2.90)$$
$$R^2 = 0.92$$

The results of regression depict a positive and significant relationship of total factor productivity with output, capital-labour ratio, investment and total emoluments. Growth in number of factories is negatively related to total factor productivity. The model explains 92 per cent of the variations in total factor productivity.

Stepwise regression has picked up output and investment as important determinants of total factor productivity. The explained variation of the model is 66 per cent.

$$Y = 0.029X_1 + 0.39X_3$$
$$t = (5.80) \quad (3.98)$$
$$R^2 = 0.66$$

Cold Storage

Regression equation for cold storage sector is as follows :

$$Y = 0.011X_1^* + 2.20X_2^* - 0.012X_3^* + 0.27X_4^* + 1.33X_5^* + 0.13X_6$$
$$t = (2.62) \quad (3.34) \quad (2.72) \quad (4.28) \quad (2.52) \quad (1.51)$$
$$R^2 = 0.88$$

Total factor productivity is positively related with all independent variables except for investment. All variables except total emoluments are statistically significant at 5 per cent level. The model explains 88 per cent of the variations in total factor productivity.

Stepwise regression depicts that output growth and capital labour ratio are the most important determinants of total factor productivity. The explanatory variation of the model is 0.58 per cent.

$$Y = 0.423X_1 + 1.31X_2$$
$$t = (3.95) \quad (2.43)$$
$$R^2 = 0.58$$

As already stated, the main objective of this chapter has been to enquire into the determinants of productivity growth. The regression results show that the coefficients for output growth variable are positive and statistically significant in all the industries. A significant positive relationship between output growth and total factor productivity growth has been observed in a number of earlier studies. Verdoorn (1949) has identified a positive relationship between growth in labour productivity and the growth in output as early as in 1949. Kaldor (1967) also maintained that it was most prominent in manufacturing and largely reflected scale economies. Kendrick (1961, 1973) and others have pointed out that productivity growth and output growth are interrelated. Just as productivity growth can be seen as an effect of output growth because of differential scale economies and technological progress that it creates, output growth may also be seen as a consequence of productivity growth because of the lowering of costs and prices that the latter leads to and the increase in demand that fall in prices themselves leads to. So a strong positive relation between output growth and productivity growth (both labour productivity and total factor productivity) is well established in the empirical literature. The findings of this study, that a significant positive relationship between output growth and productivity growth exists, is in agreement with the findings of earlier studies. A positive relationship has been observed between total emoluments and total factor productivity in most of the industries. Motivation is basic to all human behaviour and thus it leads to productivity improvement. Productivity depends on financial incentives provided to workers and other employees. This includes the methods of paying wages and salaries, rewards and incentive plans. The regression coefficients for total emoluments are significant for most of the industries. The capital intensity variable is defined as the ratio of gross fixed assets at replacement cost at constant prices to the number of employees for each industry. The regression coefficient of capital intensity are positive and significant for the entire manufacturing sector and for electricity, water supply, cold storage, jute and rubber and rubber products sectors. In most of the sectors the capital intensity coefficients are not significant and are negative in certain sectors. Considering that higher capital intensity involves more embodied technical progress and more scope for learning the negative effect of this coefficient could be the result of certain factors not included here which are highly correlated with capital labour ratio and have negative impact on productivity. Hence, above average capital input per worker does not necessarily increase output per worker. Some manufacturing industries report higher productivity with relatively low capital intensity. The growth of factories and investment are positively related to total factor productivity in most of the industries. The results of regression depict a significant relationship between total factor productivity and growth in number of factories. This result is not in consonance with that of Ahluwalia's (1991). Regression coefficients of investment are significant in jute textile, chemical and chemical products, non metallic mineral products, basic metals and alloys, metal products and parts and electricity. Scale variable is capital stock per factory which is an average of value at 1973-74 and 1987-88. Scale variable enters in many industries with a negative sign. This could be due to its relationship with other variables included in the model.

CHAPTER-VI

CONCLUSIONS

As already stated the study aims at giving a precise and clear cut concept of productivity, measurement of factor productivity and problems involved in measuring various inputs and output, industry wise and sector wise trends in labour productivity, capital productivity and total factor productivity, trends in aggregate manufacturing sector and other sectors, and trends in capital-output ratios and analysis of factors influencing productivity.

In the first part of this study the focus has been on the conceptualisation of productivity and review of earlier studies on productivity. This treatise then discusses the different methodologies adopted in the Indian set up to determine factor productivities. Productivity can be measured using conventional indices like labour and capital productivity but a comprehensive estimate of efficient resource utilisation can only be gained from total factor productivity growth (TFPG), as the latter includes alongwith labour and capital efficiency, the impact of technological progress and the impact of human resource development, e.g., learning by doing, increased skill acquisition etc. The study then analyses the trends in productivity, both at the aggregate level as well as at the disaggregate, at two digit and three digit level. An attempt has been made to examine the growth rates of inputs (labour and capital) and output (value added). A detailed analysis has been done for the entire period as well as for the two sub periods, period I, 1973-74 to 1980-81 and period II, 1981-82 to 1992-93.

Liberalisation wave in India started with the industrial policy of 1980. Infact, the liberalisation and export promotion which have been the hallmark of the Indian economy in the Nineties, were initiated a decade ago. The preoccupation with efficiency improvement in the early 80's is reflected in the year 1982 which was declared the year of productivity. Further, Rajiv Gandhi's government brought about a sea change in terms of liberalisation of licensing policy in favour of large business houses, particularly in terms of freeing them from provisions of Monopolies and Restrictive trade practices Act (MRTP) and Foreign Exchange Regulation Act (FERA). New economic policy of 1991 was a further step towards economic liberalisation. The main aim of the new policy is to unshackle the Indian Industrial economy from the cobwebs of unnecessary bureaucratic control to introduce liberalisation with a view to integrate the economy with the world economy, to remove restrictions on direct foreign investment as also to free the domestic entrepreneur from the restrictions of Monopolies and Restrictive Trade Practices Act. So the eighties onwards period is a period when there is a wave of liberalisation. It is with this view that this study tries to examine the trends in productivities in the two sub periods to see whether there has been any improvement in productivity in the post 1981 period as compared to the earlier period. Finally an attempt has been made to isolate the determinants of productivity growth in Indian manufacturing . The major findings of the study are highlighted in this chapter. An attempt has been made to summarize the evidence at aggregate level and then to discuss the evidence at two digit and three digit level.

At the aggregate level, the overall long term growth of 11.91 per cent per annum in output in manufacturing over the period 1973-74 to 1992-93 is associated with a massive growth of capital which is 10.64 per cent per annum and a moderate growth (1.05 per cent) of employment. The growth in value added increased from 8.06 per cent per annum in period I to 12.22 per cent per annum in period II. However, this increase in growth of value added is not accompanied by an increase in employment, but rather there is a fall in rate of growth of employment in the post 1981 period. Labour productivity for the entire period has increased at an annual rate of 6.13 per cent, whereas the productivity of capital has decreased at an annual rate of 3.28 per cent per annum. This is accompanied by a 6.87 per cent rise in capital intensity. On splitting the period, it is found that the rate of increase in labour productivity is somewhat higher during the period 1981-82 to 1992-93 than in the earlier period, and the rate of decline in capital productivity is slower during the eighties onwards period as compared to that in the earlier decade. Capital intensity registers a slightly higher growth in the latter period as compared to the former period. Estimates for total factor productivity growth for aggregate manufacturing during the period is 0.54 per cent per annum. As compared to the pre eighties period, total factor productivity growth is higher during the period 1981-82 to 1992-93. An important feature of the improvement in total factor productivity growth in the latter period is that it largely reflects improvement in labour productivity. Moreover, the decline in capital productivity rate in period II is not as high as in period I.

industries. The estimates for total factor productivity growth rates for different sectors are generally quite low during the period 1973-74 to 1992-93 with value ranging form 0.011 to 1.19 per cent per annum. The sectors that are characterised by higher productivity growth rates than others during the period under investigation are:

(a) water works and supply,

(b) gas and steam generation and distribution through pipes,

(c) cold storage,

(d) transport equipment and parts,

(e) non metallic mineral products and

(f) chemicals and chemical products.

With the exception of water works and supply all other sectors have a negative growth in total factor productivity in period 1973-74 to 1980-81. Total factor productivity growth rate shows an improvement in the post 1981 period in all except water works and supply where total factor productivity growth is positive in both the periods but it shows a decline in period II as compared to in period I. In all these sectors, there is an improvement in labour and capital productivity in the eighties onwards era. Another important feature common to these sectors is that with the exception of chemicals and chemical products all sectors record a positive growth rate in productivity of capital in the second period of analysis. But even in chemicals and chemical products the rate of decline in period II is just -1.05 as against -8.60 in period I.

The sectors showing moderate growth in total factor productivity are :

a) leather and leather products and substitutes of leather,

b) textile products,

c) wood and wood products and furniture and fixtures,

d) electricity generation and distribution and

e) food products

On splitting the period it has been found that total factor productivity growth has improved in the second period in the four sectors: (a) food products, (b) textile products, (c) leather and leather products and substitutes of leather and (d) wood and wood products, furniture and fixtures. Electricity generation and distribution sector reports a higher growth rate of total factor productivity in the earlier period. This sector records a higher positive growth rate in capital productivity in period I as compared to that in the latter period. Labour productivity growth rate shows an improvement in all the sectors. The rate of decline in capital productivity is lower in the second period. Again the fact which emerges is that it is high time to improve productivity of capital.

The sectors with relatively low total factor productivity growth rate are:

(a) paper and paper products,

(b) beverage, tobacco and tobacco products,

(c) wool, silk and man-made textile fibres,

(d) basic metals and alloys,

(e) metal products and parts,

(f) machinery and equipment,

(g) rubber, plastic, petroleum and coal products and

(h) other manufacturing industries.

In all the sectors except in metal products and parts and in machinery and equipment value added shows an increase in the second period. Except in the two sectors viz (a) basic metals and alloys and (b) other manufacturing industries, labour productivity shows an improvement in all the sectors in post 1981 period. A common characteristic of all these sectors is that the capital productivity shows a decline in the entire period as well as in both the sub periods. Beverages, tobacco and tobacco products and rubber, plastic, petroleum and coal products sectors register a high decline in total factor productivity at a rate of -2.23 and -2.94 per cent per annum in the first period of analysis. Both these sectors also record a decline in labour and capital productivity in the period 1973-74 to 1980-81. Total factor productivity growth rate improves in the second period in the following five sectors in the latter period : (a) beverages, tobacco and tobacco products, (b) paper and paper products, (c) rubber, plastic, petroleum and coal products, (d) machinery and equipment and (e) other manufacturing industries.

There are four sectors which show a negative rate of growth in total factor productivity. Cotton textiles, one of the oldest and most important sector shows a sluggish performance. The other sectors are:

(a) jute and mesta textiles,

(b) electrical machinery, apparatus, appliances and parts and

(c) repair group.

A common characteristic of all these sectors is that the decline in capital productivity is at a faster rate in eighties onwards period as against the pre eighties period. Labour productivity growth rate is higher in the earlier period of analysis in all except in repair services sector. The improvement in productivity of labour in this sector could be because of the increase in capital intensity rate. All these sectors are characterised by higher annual growth rates in value added and total factor productivity in the pre eighties period. Again, the results indicate that the poor performance on productivity front is because of the unsatisfactory productivity of capital. A sincere effort is needed to improve capital productivity. The decline in partial productivity has its implications on the performance of overall productivity. Another point which needs to be mentioned here is that the performance on the productivity front is better not in the modern sophisticated and mechanised mill sector but rather in spinning and handloom sector.

Among the different sectors, the non metallic mineral products sector registers the highest growth in value added (12.48 per cents per annum) followed by electricity (11.29 per cent per annum), textile products (10.34 per cent per annum), other manufacturing products (9.92 per cent per annum) and transport equipment and parts (9.61 per cent per annum). Sectors having lower rates of growth in value added are: (a) cotton textiles (3.26 per cent per annum); (b) metal products and parts (2.52 per cent per annum) and (c) Jute textiles (-2.98 per cent per annum).

The highest growth in labour employment is found in cold storage (8.00 per cent per annum) followed by leather products (5.47 per cent per annum), textile products (4.94 per cent per annum), beverages (4.68 per cent per annum) and rubber, plastics and petroleum products (4.52 per cent per annum). A slowdown has been witnessed in growth rate of employment in most of the sectors in the eighties onwards period. The sectors showing negative rate of growth of employment for the period under analysis are : (a) jute textile and (b) wood and wood products. Highest growth in capital employed has been registered by: leather products (14.90 per cent) followed by (a) non metallic mineral products (14.66 per cent), (b) wool, silk and synthetic fibre (14.59), (c) cold storage (13.45 per cent) and (d) rubber, coal and petroleum products (13.02 per cent).

All sectors show an increase in output to labour ratio. The fastest growth in this ratio is for non metallic mineral products followed by (a) transport equipment and parts, (b) electricity generation and distribution and (c) other manufacturing products.

Solow index of total factor productivity has also been calculated to investigate the sectorwise analysis of manufacturing industries.

According to this fast growing sectors are : (a) non metallic mineral products (b) gas and steam generation (c) other manufacturing industries (d) water works and supply (e) food products and (f) transport equipment. The two most important sectors, i.e., cotton textiles and basic metals and alloys show a high negative rate of growth in Solow index of total factor productivity. Other sectors showing low rate of growth of total factor productivity are : (a) jute and mesta textiles, (b) paper and paper products, (c) basic metals and alloys, (d) metal products and parts and (e) leather and leather products and substitutes of leather.

For the period under consideration the capital coefficents in gross terms (ratio of gross fixed capital to gross value of output) and in net terms (ratio of net capital to net output) for aggregate manufacturing are closer to one another in average terms. But coefficient of variation depicts that gross capital coefficients are more stable over time than net coefficients. Coefficients based on value added are highly unstable because of volatility of working capital, which mainly constitutes inventories. Capital coefficients based on it are unstable over time. Sectoral level time series of gross capital coefficients show that capital coefficients are relatively stable for manufacturing industries. Inter industry variations are quite high, e.g., in 1992-93 food products (20) has capital coefficients as low as 0.44203 per unit of output and electricity generation and distribution (40) has as high as 4.67325 per unit of output.

After analysing the trends in productivity an effort has been made to study the important determinants of productivity. A study of determinants of productivity helps in analysing the variables which influence productivity the most. The present study uses the regression analysis for the period 1974-75 to 1992-93. The regression equation has total factor productivity as the dependent variable. The explanatory variables include output, capital intensity, investment, growth in number of factories, scale capital and total emoluments.

The regression results show that the coefficients for output growth variable are positive and statistically significant in all the industries. A significant positive relationship between output growth and total factor productivity growth has been observed in a number of earlier studies. Verdoorn (1949) has identified a positive relationship between growth in labour productivity and the growth in output as early as in 1949. Kaldor (1967) has also maintained that it was the most prominent in manufacturing and largely reflected scale economies. A strong positive relation between output growth and productivity growth (both labour productivity and total factor productivity) is well established in the empirical literature. The finding of this study, that a significant positive relationship between output growth and productivity growth exists, is in agreement with the findings of earlier studies. A positive relationship has been observed between total emoluments and total factor productivity in most of the industries. Motivation is basic to all human behaviour and thus it leads to productivity improvement. Productivity depends on financial incentives provided to workers and other employees. This includes the methods of paying wages and salaries, rewards and incentive plans. The regression coefficients for total emoluments are significant for most of the industries. The capital intensity variable is defined as the ratio of gross fixed assets at replacement cost at constant prices to the number of employees for each industry. The regression coefficients of capital intensity are positive and significant for the entire manufacturing sector and for electricity, water supply, cold storage, jute and rubber and rubber products sectors. In most of the sectors the capital intensity coefficients are not significant and are negative in certain sectors. Considering the fact that higher capital intensity involves more embodied technical progress and more scope for learning the negative effect of this coefficient could be the result of certain factors not included here which are highly correlated with capital labour ratio and have negative impact on productivity. So, above average capital input per worker does not necessarily increase output per worker. Some manufacturing industries report higher productivity with relatively low capital intensity. The growth of factories and investment are positively related to total factor productivity in most of the industries. The results of regression depict a significant relationship between total factor productivity and growth in a number of factories. This result is not in consonance with that of Ahluwalia's (1991). Regression coefficients of investment are significant in jute textile, chemicals and chemical products, non metallic mineral products, basic metals and alloys, metal products and parts and electricity. Scale variable is capital stock per factory which is an average of value at 1973-74 and 1987-88. Scale variable enters in many industries with a negative sign. This could be due to its relationship with other variables included in the model.

Detailed analysis for pre eighties and eighties onwards era brings out the fact that the performance in terms of partial productivity and total factor productivity has improved in the post 1981 period in most of the sectors as well as for the aggregate manufacturing industries. Labour productivity growth rate has increased in the latter period for most of the sectors as well as for the individual industries. Among the sectors, water works and supply, gas generation and distribution, cold storage, transport equipment and parts, non metallic mineral products and chemicals and chemical products register high rate of growth of total factor productivity. The eighties onwards period reflects improvement in labour productivity measured in terms of output per worker. The period is also marked by an increase in value added in most of the industries. Moreover, the decline in capital productivity in the earlier period is sharper than in the latter period. Total factor productivity also shows some improvement in this period in most of the sectors. So although the rates of productivity growth are very low yet there is a hope that productivity has a potential to improve.

The analysis of the performance of the manufacturing sector draws attention to the low output-capital ratios. It is a matter of grave concern since it reflects low efficiency in the utilisation of capital. Efforts have to be made to increase operational efficiency with a view to sustain a higher level of industrial output in future, without necessitating a corresponding rise in capital investment. At an all India level there is an urgent need to improve productivity of capital. Low capital productivity within industries has accounted for low levels of total factor productivity. The barriers impeding capital productivity need to be investigated at the state, industry and enterprise levels.

The limitations of the present study originate mainly from the database and methodology used. Estimates of output and input in the present study are not free from certain biases. As stated earlier there are conceptual problems in the measurement of capital and they are very difficult to overcome. The standard methodology used in this study also has certain limitations. The measure of total factor productivity growth used in this study is derived from a Translog production function under the assumptions of competitive equilibrium (where the factors are paid the value of their respective marginal products) and constant returns to scale. These assumptions have been frequently questioned in literature.

To sum up, this attempt on productivity analysis is, what may be called academic in nature. A detailed study fortified by a big enterprise level database is the need of the time if some policy implications are to be drawn with a greater confidence.

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Appendix-I

Translog Index of Total Factor Productivity.

Year	Industry Code							
	20	22	23	24	25	26	27	28
73-74	100	100	100	100	100	100	100	100
74-75	97.2	109.2	98.3	97.2	106.8	95.6	100.2	105.2
75-76	97.3	102.2	91.5	98.5	105.8	103.2	92.5	102.0
76-77	98.5	97.2	94.4	98.4	95.2	107.3	92.7	95.4
77-78	97.3	96.0	104.0	97.1	109.3	98.1	99.9	96.4
78-79	100.9	100.1	109.9	101.3	100.6	88.9	98.2	96.3
79-80	92.4	100.1	105.9	99.7	89.0	90.5	94.8	98.3
80-81	92.7	81.6	94.2	97.1	111.8	96.4	94.9	95.8
81-82	98.7	92.1	93.0	99.8	108.5	112.6	100.8	95.7
82-83	107.4	101.9	95.8	98.9	91.9	104.8	102.2	93.5
83-84	107.3	113.7	101.9	98.8	93.1	93.2	102.4	94.8
84-85	100.8	105.7	101.2	101.0	105.7	91.3	100.5	104.6
85-86	98.1	90.0	97.9	101.5	103.5	97.8	94.6	99.7
86-87	103.0	99.0	100.5	101.2	103.3	109.3	98.7	98.3
87-88	102.4	100.6	97.0	97.0	103.6	107.0	101.8	103.6
88-89	104.1	101.3	96.3	96.4	100.8	99.5	111.3	102.1
89-90	101.0	101.4	102.6	104.8	66.1	99.7	96.3	106.6
90-91	92.6	94.6	102.6	106.3	78.5	99.0	89.2	107.7
91-92	98.2	103.2	96.4	94.1	107.5	103.5	103.3	102.9
92-93	101.1	103.2	95.9	93.4	94.1	104.7	98.8	97.5

Contd...

Appendix-I

Translog Index of Total Factor Productivity.

Year	Industry Code							
	29	30	31	32	33	34	35	36
73-74	100	100	100	100	100	100	100	100
74-75	96.0	104.4	100.5	95.0	100.7	98.2	97.9	100.5
75-76	92.6	100.9	95.4	96.6	93.7	95.6	97.1	101.0
76-77	101.4	125.9	96.0	103.4	94.3	98.2	101.3	100.5
77-78	102.5	98.3	101.3	104.7	98.0	101.0	99.9	101.1
78-79	95.5	62.2	99.8	101.0	98.5	99.0	98.0	99.2
79-80	96.2	92.3	94.0	96.6	98.3	99.1	97.3	98.2
80-81	97.1	97.2	91.4	95.7	102.0	98.4	98.0	102.1
81-82	97.3	98.5	97.2	97.0	98.3	96.4	100.7	97.6
82-83	98.1	106.4	100.7	108.6	94.6	96.9	99.6	96.7
83-84	102.8	95.9	102.8	104.7	96.6	99.9	100.3	100.3
84-85	103.5	95.1	101.1	97.8	96.3	99.9	102.8	100.6
85-86	95.9	114.3	97.5	99.9	102.8	99.9	99.8	98.1
86-87	94.9	106.9	97.5	93.3	101.7	97.1	97.0	96.6
87-88	94.0	95.3	99.7	95.5	99.4	100.1	99.0	101.8
88-89	102.2	96.8	101.6	101.3	110.0	102.5	96.5	101.0
89-90	99.8	99.0	98.9	104.0	105.6	94.9	97.4	99.5
90-91	105.2	104.9	101.5	110.0	97.9	92.9	100.1	100.7
91-92	102.9	94.0	106.8	102.9	89.9	101.0	100.1	98.7
92-93	95.8	95.5	100.1	109.6	95.2	99.5	99.1	94.3

Contd...

Appendix-I

Translog Index of Total Factor Productivity.

Year	Industry Code							
	37	38	97	40	41	42	74	Total
73-74	100	100	100	100	100	100	100	100
74-75	97.2	97.4	97.0	94.5	113.4	62.3	96.3	90.6
75-76	97.2	100.1	97.2	98.7	99.0	56.7	99.5	99.8
76-77	104.0	108.5	102.9	106.4	68.4	117.8	96.2	97.5
77-78	103.5	103.7	105.4	103.3	85.0	111.0	91.4	102.5
78-79	98.7	97.2	103.4	104.6	97.8	81.9	98.1	104.6
79-80	96.2	98.5	98.4	99.2	96.2	94.2	96.8	103.6
80-81	98.6	101.3	97.9	95.5	103.0	102.9	96.3	98.4
81-82	104.1	99.2	99.9	107.0	99.0	105.0	101.6	135.3
82-83	105.6	101.9	103.0	106.6	112.9	91.8	98.4	105.3
83-84	101.8	103.7	105.3	105.0	97.9	94.3	94.0	106.5
84-85	99.0	99.8	103.1	98.1	83.0	108.2	98.6	104.2
85-86	98.5	100.4	98.4	93.8	83.1	98.5	102.6	101.3
86-87	100.6	97.8	100.6	105.3	87.9	97.8	98.8	101.9
87-88	101.0	101.7	105.2	101.3	88.8	104.9	96.3	102.5
88-89	98.5	99.1	102.8	97.2	86.9	124.8	99.1	102.9
89-90	103.7	100.0	105.4	106.2	90.3	102.7	104.8	105.8
90-91	107.9	101.6	94.7	101.5	93.8	73.0	107.1	106.4
91-92	102.1	102.7	90.6	98.2	105.1	100.1	103.9	103.3
92-93	111.4	103.1	100.7	108.3	116.7	111.5	105.2	103.4

Appendix II

Rate of Growth of Solow Index of Total Factor Productivity.

Industry Code	Industry	TFPG
20	Food Products	0.97
22	Beverage, Tobacco and Tobacco Products	-1.41
23	Cotton Textiles	-3.15
24	Wool, Silk and other Textiles	0.71
25	Jute Textiles	-4.65
26	Textile Products	-1.65
27	Wood and Wood Products, Furniture and Fixtures	-1.27
28	Paper and Paper Products, Printing and Publishing	-4.82
29	Leather and Leather Products	-2.57
30	Rubber, Coal and Petroleum Products	-1.17
31	Chemicals and Chemical Products	-0.75
32	Non Metalic Mineral Products	1.87
33	Basic Metal and Alloys	-3.86
34	Metal Products and Parts	-3.31
35	Machinery, Machine tools and Parts	-0.73
36	Electrical Machinery	-0.42
37	Transport Equipment and Parts	0.79
38	Other Manufacturing Industries	1.15
97	Repair Group	-1.17
40	Electricity Supply and Distributes	-1.64
41	Water Supply and Distribution	-1.06
42	Gas and Steam Generation and Distributes	1.17
74	Cold Storage	0.33
	Total Manufacturing	-0.69

Appendix-III

Solow Index of Total Factor Productivity.

Year	Industry code							
	20	22	23	24	25	26	27	28
73-74	100	100	100	100	100	100	100	100
74-75	67.1	118.8	92.8	86.5	123.6	90.0	98.0	112.8
75-76	76.5	96.1	60.6	90.8	111.64	108.1	61.6	109.6
76-77	62.6	107.3	63.3	77.7	96.4	109.1	65.2	103.4
77-78	54.2	88.8	71.4	71.5	133.2	100.2	65.6	94.8
78-79	67.5	83.7	92.2	76.3	49.8	97.9	63.4	90.8
79-80	57.3	92.6	90.9	78.1	53.0	53.8	49.4	88.2
80-81	36.9	95.3	63.6	66.1	73.6	68.1	46.4	69.7
81-82	43.4	74.6	55.8	69.5	68.9	75.9	50.6	74.3
82-83	56.4	78.9	51.7	60.5	48.7	78.3	55.3	48.3
83-84	71.5	81.9	61.9	60.8	46.7	54.9	59.5	51.3
84-85	62.8	76.8	55.9	61.4	59.4	46.2	51.5	59.9
85-86	67.1	84.5	57.2	64.7	52.2	47.2	46.4	49.9
86-87	74.4	84.4	58.6	63.6	64.4	60.3	52.3	48.1
87-88	78.0	89.6	50.1	54.7	56.8	56.9	52.9	50.5
88-89	91.4	77.8	49.1	51.8	65.2	58.0	76.1	60.8
89-90	91.5	96.5	56.1	62.4	60.3	54.8	70.1	79.6
90-91	70.6	101.8	55.4	63.8	54.7	53.7	68.9	88.5
91-92	88.3	95.8	47.4	45.1	56.3	61.3	80.1	88.4
92-93	90.3	88.5	44.7	45.1	70.3	64.3	79.1	83.6

Contd...

Appendix-III

Solow Index of Total Factor Productivity.

Year	Industry Code							
	29	30	31	32	33	34	35	36
73-74	100	100	100	100	100	100	100	100
74-75	87.5	103.8	103	79.0	102.4	93.0	88.2	103.7
75-76	80.9	108.6	72.3	80.7	70.9	78.8	89.6	102.9
76-77	93.0	165.9	75.8	85.6	76.3	80.2	100.9	102.7
77-78	83.4	158.2	76.6	96.2	62.5	80.3	89.8	105.8
78-79	79.4	122.1	72.5	85.6	68.3	74.7	96.6	95.8
79-80	76.0	128.3	57.3	81.9	57.8	75.0	76.2	97.9
80-81	68.4	117.4	50.1	71.3	54.2	71.1	78.8	107.5
81-82	67.0	117.4	49.8	71.8	59.5	64.9	79.3	85.8
82-83	64.2	92.4	50.4	100.2	51.7	61.7	81.8	87.7
83-84	70.1	109.2	54.3	86.9	47.5	60.2	87.4	83.1
84-85	70.4	112.8	50.2	92.4	46.6	54.2	88.8	87.4
85-86	54.8	102.7	46.6	83.9	53.5	50.7	91.2	73.5
86-87	50.0	109.4	43.2	63.7	46.8	43.2	89.9	72.8
87-88	57.1	104.9	45.2	64.6	51.4	57.9	88.1	77.4
88-89	56.8	116.6	46.7	68.0	67.6	56.6	77.0	74.9
89-90	57.5	118.4	39.9	75.0	67.9	46.9	82.5	74.7
90-91	65.0	124.3	46.5	93.4	65.9	41.3	80.5	76.7
91-92	63.8	121.1	53.3	65.3	64.2	46.6	81.1	70.3
92-93	51.4	122.3	41.7	93.5	63.4	43.6	79.1	56.2

Contd...

Appendix-III

Solow Index of Total Factor Productivity.

Year	Industry Code							
	37	38	97	40	41	42	74	Total
73-74	100	100	100	100	100	100	100	100
74-75	91.4	86.5	86.5	76.0	146.0	98.8	76.5	95.7
75-76	80.8	101.6	87.0	95.7	127.9	97.1	141.0	74.6
76-77	91.9	128.0	96.9	100.8	124.7	102.3	99.7	83.9
77-78	84.5	110.8	108.5	112.8	135.2	131.1	90.7	80.0
78-79	83.0	108.8	111.7	133.8	68.8	95.2	100.2	77.9
79-80	77.5	103.2	61.8	99.8	76.8	93.4	97.3	92.4
80-81	83.4	116.4	74.9	99.7	83.8	98.8	97.0	95.0
81-82	90.3	93.8	75.3	129.0	74.7	105.9	98.2	94.6
82-83	97.7	119.1	86.5	132.3	101.9	90.2	96.1	87.8
83-84	93.3	118.0	96.8	161.3	97.6	74.0	90.1	88.3
84-85	90.6	123.1	101.4	103.6	98.5	61.1	101.3	80.6
85-86	80.4	80.5	89.6	119.6	57.5	71.7	104.5	79.4
86-87	85.5	120.6	10.31	145.2	69.6	71.7	99.8	76.5
87-88	81.0	145.3	113.4	127.6	91.6	80.1	96.2	75.9
88-89	79.5	109.9	117.8	140.8	83.8	131.9	101.3	75.7
89-90	90.3	127.6	127.4	185.0	112.6	118.9	106.8	80.7
90-91	105.7	110.5	92.4	112.7	152.2	88.7	110.3	81.7
91-92	98.6	133.0	91.3	96.0	86.01	98.6	101.2	88.1
92-93	140.5	140.6	94.3	161.6	130.2	104.7	104.3	71.7