3.1 INTRODUCTION

The review of literature, in general, guides the researchers for getting better understanding of methodology used, limitations of various available estimation procedures and data base, and lucid interpretation and reconciliation of the conflicting results. Besides this, the review of empirical studies explores the avenues for future and present research efforts unexpected results, the researcher can take the advantage of knowledge of other researchers simply through the medium of their published works (Sunil Kumar, 2001).

This chapter presents a brief review of selected studies about the topic and consists of two sections. In section 3.2 a review of literature relating to the studies on production functions, returns to scale and elasticity of substitution in the manufacturing industries. The section 3.3 is devoted to present a brief review on Partial and Total factor productivity analysis.

3.2 STUDIES ON PRODUCTION FUNCTIONS, RETURNS TO SCALE AND ELASTICITY OF SUBSTITUTION:

A production function is a highly abstract concept that has been developed to deal with the technological aspect of the theory of production. It is an embodiment of the technology which yields maximum output from the given set of inputs or specifies the way in which the inputs co-operate with each other to produce given level of output. Therefore, a production function can represent through its parameters the efficiency of technology, technologically determined economies of scale, the capital intensity of technology and the ease with which factors can be substituted for each other.
Survey of literature relating to empirical economical investigations of estimation of production functions of Indian industries have been constantly attempted by many authors for macro and micro units of production, and they followed some criteria for classification of studies for a better enlightenment. These studies were mainly aimed at analysing the contributory factors of output growth, returns to scale, partial and total productivity indices, technical progress, elasticity of substitution etc. The production function studies can be distinguished with respect to their objectives and the type of production function used.

The literature reveals that most of the studies relating to industrial disparities in India paid negligible attention to elasticity of substitution and the influence of technical change on the variations in growth of manufacturing sector in India.

The elasticity of substitution is the ease with which the factors of production can be substituted for each other. This concept was developed by J.R. Hicks. The elasticity of substitution is the ratio of the percentage change in the ratio of inputs to the percentage change in the marginal rate of technical substitution when the inputs are changed in such a way as to hold output constant. It is a pure number and it is an important tool to determine the pattern of resource use in any productive system. Besides this, it is very useful in determining the form of the production function.

Murthy and Sastry (1957) estimated cross section data-based Cobb-Douglas production function for the Indian industrial sector as a whole as well as for some selected industry product groups for the years 1951-52. They concluded that, sum of the coefficients of labour and capital were different from ensuring constant returns to scale.
Diwan and Gujarati (1968) estimated Constant Elasticity of Substitution (CES) production function in 28 Indian industries using time series data for the period 1946-58. Out of 28 industries two industries have an elasticity of substitution equal to or greater than one, remaining 26 industries have an elasticity of substitution less than one. Among these 26 industries, four industries have an elasticity of substitution greater than 0.5 but less than one. Hence they conclude that the elasticity of substitution is quite low.

Venkataswamy (1968) estimated the elasticity of substitution for 28 Indian industries for the period 1948-1967. He tested the hypothesis that the elasticity of substitution is equal to unity and he observed that out of 28 industries, in 21 industries the hypothesis could not be rejected.

Sankar (1970) estimated the Constant Elasticity of Substitution production function for 15 manufacturing industries covering the period 1953-58 and finds evidence of economies of scale. It has been found that the elasticity of substitution was significantly different from zero in five out of 15 cases and close to zero for one. Among the industries analysed, the elasticity of substitution between capital and labour was unity for Indian sugar industry. He also found the presence of increasing returns to scale in a number of industries.

Benerjee (1971) made an attempt to analyse the productivity growth and factor substitution in Indian manufacturing industry for the period 1946-64. The Cobb-Douglas and Constant Elasticity of Substitution production functions have been fitted for the Indian manufacturing industry and he also estimated TFP indices
to capture the trend of technical progress and to estimate the coefficient of elasticity of substitution. He conclude that the performance of the manufacturing sector had been rather sluggish over the study period. There was no sign of technical progress in the Indian manufacturing sector. The elasticity of substitution between capital and labour was not found to be significantly different from unity implying considerable substitution possibilities. The study, on the whole, observed that capital deepening is the major influence behind the increase in production of Indian manufacturing sector.

Kazi (1972) examined the possibilities of capital-labour substitution in the CES production function framework across the regions in Indian industries. He utilised the time series of cross-section data for 1960, 1961 and 1962. In most of the cases, the author observed that the elasticity of substitution between capital-labour lies between zero and unity.

Dadi and Hashim (1973) also arrived at constant returns to scale in Indian industries. Narasimham and Fabrycy (1974) gave estimates of returns to scale for 28 Indian industries for the period 1946-1958 using three different functions – Cobb-Douglas production function Constant Elasticity of Substitution and Homothetic Isoquant and showed constant returns to scale in all 28 industries, individually and together.

Benerjee (1973) examined the elasticity of substitution for five major Indian industries viz., Cotton and Jute textiles (1946-1963), Sugar (1946-62), Paper (1946-1958), and Bicycle (1946-1958) by five different variants of SMAC relationship. He
has been observed that the hypothesis of zero elasticity of substitution implying fixed input coefficients was rejected conclusively for all industries. In none of the cases, however, the hypothesis of unitary elasticity of substitution was conclusively rejected.

Mehta (1974) fitted Cobb-Douglas and Constant Elasticity of Substitution production functions for Indian Sugar industry on the basis of time series data for the period 1953-1965. He observed that there exist constant returns to scale for sugar industry and there was no evidence for neutral technical progress for the industry. The elasticity of substitution between capital and labour was low which was significantly different from unity as well as zero. He also estimated the total factor productivity growth for sugar industry which has been declined over the period under study.

Barthwal (1975) fitted three forms of production functions viz., Variable Elasticity of Substitution, Constant Elasticity of Substitution and Cobb-Douglas production functions for Indian Paper industry for the period 1948-1965. He observed that the Cobb-Douglas production function is the good fit for Indian paper industry and he also observed that there exist very negligible technological progress in Indian paper industry.

Bhasin and Seth (1977) made an attempt to analyse the elasticity of substitution, returns to scale and technological change in 27 industries of Indian manufacturing sector by using ASI and CMI for the period 1953-65 by fitting C-D and CES production functions. The estimates of C-D function indicates that capital
elasticity is higher than labour elasticity and there are wide inter industry differences in input elasticities. The sum of two exponents showed that the Indian manufacturing sector experiencing decreasing returns to scale. On the other hand the estimates of CES production function indicates that the elasticity of substitution is significantly different from unity and the value is uniformly above unity. The pattern of technological change in the Indian manufacturing sector was observed to be non-neutral and it was labour augmenting.

Acharya and Nair (1978) estimated the Cobb-Douglas production function for the Indian cement industry for the period 1959-1971. They estimated the elasticity of substitution between capital and labour by using standard SMAC relationship. The estimates of C-D production function reveals that the Indian cement industry experiencing increasing returns to scale, implying that the industry can reap higher returns by expansion. The magnitude of elasticity of substitution was found to be 0.86 and it is not significantly different from unity at 5 per cent level of significant. The Solow factor productivity indices showed no monotonic trend.

Mehta (1980) made an attempt to estimate the elasticity of substitution by using C-D production function and CES production function for 27 Indian industries for the period 1953-1965. The results reveal that most industries exhibited the constant returns to scale.

Bhasin and Seth (1980) fitted C-D and CES production function for 27 Indian manufacturing industries. They used both cross section and Time series data to estimate the production function. They include time trend in the estimation of C-D
production function and the exponents of capital and labour indicated negative sign for some of the product groups. The estimates of returns to scale also showed negative tendencies in some of the product groups.

Kazi (1980) estimated the elasticity of substitution for two and three digit Indian manufacturing sector for 1973, 1974 and 1975. He has been fitted both the VES and CES production function for the comparison purpose. The estimates of elasticity of substitution were obtained from the VES production function and the result reveals that the elasticity of substitution was variable among industries. The estimates of elasticity of substitution suggested that the lesser possibilities of labour-capital substitution for eight out of nine industries for 1974 and 1975 respectively. Thus he infer that the application of C-D and CES production function has been rejected.

Sharanjit Singh Dhillon (1983) made an attempt to analyse the factor substitution in manufacturing sector of Karnataka for the period 1968-69 to 1977-78. In order to decide the form of the production function in the manufacturing sector of Karnataka state he estimates the elasticity of substitution with the aid of ACMS function. The regression fit of the equation indicated that the C-D production function seems to be suitable for manufacturing sector of Karnataka. The elasticity of substitution is found to be not significantly different from unity.

Babu and Vani (1983) made an attempt to estimate the elasticity of substitution by using CES production function for the Indian manufacturing sector for the two periods 1949-1958 and 1959-1966. The study reveals that there was a
shift in the production function over the period 1949-1966 and the elasticity of substitution of labour and capital has also varied from 0.42 in 1949-58 to high of 0.96 in 1959-1966. The increase in the elasticity of substitution made easy to substitute capital for labour at each labour-capital ratio. The study conclude that substitution possibilities differ in two periods and hence the assumption of unitary substitution which is same for both periods was not found to be valid in Indian manufacturing sector.

Lakshmana Rao (1985) made an attempt to study economic development of Andhra Pradesh with particular emphasis thorough an examination of the structure, growth and performance of the manufacturing sector of Andhra Pradesh for the two decades 1960’s and 1970’s. The results reveal that the C-D production function fits well to the Andhra Pradesh manufacturing sector. There is statistical evidence to support the hypothesis that the manufacturing sector is subject to increasing returns to scale.

Rajalakshmi (1985) fitted C-D, CES and VES production functions for Electrical machinery industry group in three states viz., Maharashtra, West Bengal and Karnataka for the period 1961-1975. The study has been found that the electrical machinery industry group operates under constant returns to scale in all the three states. The estimates of elasticity of substitution through VES production function showed high year to year fluctuation in Maharashtra. The study conclude that, since the estimates of elasticity of substitution from ACMS specification were not statistically significant from unity, the C-D production function seems to be a best fit for that particular industry.
Kadak (1986) estimated the elasticity of substitution from various forms of CES production functions in the Indian manufacturing sector by using ASI data for the period 1960-1971. The study observed that the elasticity of substitution is significantly different from zero and one in many industries. Also, the magnitude of elasticity of substitution was less than one because of the inflexible production structure of Indian factory sector.

Soni and Jani (1987) made an attempt to analyse the technical progress and magnitude of elasticity of substitution for industrial sector of Gujarat as compared to the same for All India as a whole for the period 1960-1961 to 1980-1981. They have fitted VES production function (given by Lu and Fletcher) and they found that the technical progress was highly significant. The result implied that the technological parameters for the industrial sector of Gujarat state were found to be nearly four times as that of All India. The estimated elasticity of substitution through VES production function is fluctuating over the entire period. The average elasticity of substitution for the industrial sector of Gujarat state was found to be low (0.38) compare to All India as a whole (0.61). On the basis of results obtained they conclude that the technological progress became much more effective for the industrial innovations.

Bhatia (1990) estimated the productivity in the Indian manufacturing sector and for the comparison purpose he also estimated the productivity in USA and UK. The comparative study reveals that the role of technology was traced in trends of capital used per person and its effects on the factor productivity in the production
process and come to the conclusion that in Indian manufacturing sector productivity after 1975 grew at a rate faster than in the UK and USA.

Gowda (1991) estimated the elasticity of substitution for Indian factory sector by using CES production function for both cross section and time series data. On the basis of results obtained for cross section data the elasticity of substitution is interestingly identical for both the years 1960 and 1977. It has been also observed that coefficients of elasticity of substitution estimated were greater than unity and statistically significant. For the time series estimates the elasticity of substitution is high for majority of the industries.

P.V. Sarma and Y.V. Appa Rao (1991) made an attempt to estimate the nature of elasticity of substitution, returns to scale in Indian Cement industry for the period 1959-1982. To examine the elasticity of substitution they estimated VES, CES and C-D production function for Indian cement industry. They infer that the elasticity of substitution is found to be constant in Indian Cement industry and Cobb-Douglas production function was found to be a good fit. The estimated values of returns to scale reveal that it is found to be constant during 1959-82. Further, output is more responsive to a unit increase in capital input.

C. Mani and E. Satyanarayana (1991) made an attempt to analyse the technical progress for sugar industry in a backward region with special reference to Chittoor Cooperative Sugar Limited. They have tried various forms of production functions viz., VES, CES and C-D production functions for that particular industry and they conclude that C-D production function seems to be a suitable presentation
of production function in this industry. The study revealed that the industry operating under constant returns to scale and they found that labour was found to be relatively more important factor than capital, based on their output elasticities, and their marginal factor productivities. The study also reveal that the Chittoor Cooperative Sugar Limited have zero neutral technical progress.

S. Indrakanth and Muppalla Sambasiva Rao (1993) examined the degree of factor substitution and Returns to scale in the selected manufacturing industry group of Andhra Pradesh for the period 1973-74 to 1984-85. (Food, Beverages, Cotton textiles, Basic metals and alloys, Electrical machinery and Electricity industry groups). This study employed both C-D and CES production function for the selected industry groups. The main finding of the study is that extent of factor substitutability is significantly different from zero in the selected manufacturing industry group of Andhra Pradesh. The elasticity of substitution is around unity in four industries and 0.3 in the remaining two industries. They also observed that the Beverages and Electrical machinery industries are operating under increasing returns to scale, Food and Electricity industry groups are operating under decreasing returns to scale and Cotton textiles and Basic metals industry groups are operating under constant returns to scale.

Singh and Ajit (1995) have tried different production functions for Indian industries by using ASI data for the period 1974-1990. They used both conventional production function specifications, namely, C-D, CES and Translog as well as new production function introduced by Bairam (1989). They observed that among the production functions, the C-D and Bairam production functions suited compare to
CES and Translog production functions. The study concludes that most of the Indian manufacturing industries are experiencing decreasing returns to scale.

Dr. Sajal Chattopadhyay and Dipasis Bhadra (1998) made an attempt to examine the returns to scale and elasticity of substitution in Indian manufacturing industries for the years 1980-81, 1981-82, and 1982-83 for 22 two-digit industries in West Bengal. The study emphasized that the elasticity of substitution is high and significant between capital and labor that vary considerably across the industries. They observed that the value of substitution parameter is negative for the Jute industry in West Bengal and they conclude that elasticity of substitution is significantly different from zero and the returns to scale parameter is greater than unity.

Sanjib Pohit (2002) have examined whether the estimated elasticity of substitution between labor and capital vary from year to year or not. He tried various forms of production functions to find which type of production function is suitable for Indian manufacturing sector for the years 1988-89 and 1989-90. They observed that the Variable Elasticity of Substitution production function is more appropriate for various industry groups in the Indian manufacturing sector. The estimates of distribution parameter derived from VES hypothesis and that of from CES function suggest that ‘δ’ is a variable across the industries.

3.3 STUDIES ON TOTAL AND PARTIAL FACTOR PRODUCTIVITIES
In this section, we made an attempt to review the empirical studies related to the concept of partial and total factor productivity in the Indian manufacturing industries.
S.S. Mehta (1980) examined the trends in partial and total factor productivities of 27 industries between 1953 and 1965. Both partial and total factor productivity indices show considerable diversity in movements, with considerable range of dispersion. The total factor productivity index measured both geometrically and arithmetically has not increased significantly in 13 industries. This shows that the overall efficiency has not increased, rather it has decreased. Most partial productivity indices also shown declining trends.

Arya (1981) measured total factor productivity indices by using Solow index for the period 1951-70 in Indian Cement industry. The study observed that the upward shift in the production function was neutral. For the period 1951-60, out of 2 percent increase in labour productivity 3.04 per cent was due to technical change and 5.04 percent due to capital intensity. While for 1961-70, 2.8 per cent increase in labour productivity was due to technical change and remaining 1.6 per cent was due to intensive use of capital. For the study period as whole the rate of technical progress was 0.25 per cent and out of 4.1 percent annual increase in labour productivity, 0.25 per cent has been attributed to technical change and the remaining 3.85 per cent to increased use of capital.

Sharanjit Singh Dhillon (1983) attempted to study the productivity trends and factor substitutability in manufacturing sector of Karnataka for the period 1968-69 to 1977-78. He also made an attempt to identify the factors affecting total productivity by using log linear and semi-log form. It was found that the total productivity increases till 1969-70 and after 1969-70 the total productivity declined continuously by 12.85 per cent in the remaining period. The annual trend rate of growth is -1.48
per cent, significant at 5% level. As many industries in Karnataka are state undertakings, the managerial staff may not be having the much required skill for running these industries and this may be another possible cause in the decline of productivity.

V. Lakshamana Rao (1985) made an attempt to relate trends in managerial resources to trends in productivity in the case of 10 industries for the period (1960-69) through regression analysis in manufacturing sector of Andhra Pradesh. On the whole he infer that the Managerial resources had systematic but mild influence on the productivity ratios.

Kodak (1986) analysed the productivity trends and technological changes in the Indian manufacturing sector for the period 1960-1971. The study observed that the capital productivity has been found to be declined and the total factor productivity indices obtained by Solow and Kendrick indicates the absence of technical change in most of the Indian industries. The analysis concludes that the total factor productivity reflected the sluggish performance of Indian manufacturing sector.

N.G. Pendse, L.M.S. Baghel and S.K. Chaubey (1996) provided the analysis of productivity trends and technological change in Vanaspati Ghee Industry in the state of Madhya Pradesh for the period 1973-74 to 1988-89. The analysis reveals that the industry experiencing capital deepening process. Trends in partial ratios confirm the fact that the positive and high labour productivity is not as a result of improvement in efficiency of labour but because of high doses of capital. Further
they conclude that though the industry is observing a technological change but the inverse relation of labour with output is a point where every one should think.

Goldar (1986a) analysed the growth of TFP in Indian industries during the period 1951-1979. The estimates of productivity for the two periods 1951-65 and 1959-1979 brought out that TFP growth in Indian manufacturing under 1951-1979 has been rather sluggish and relative contribution of TFP growth to output growth quite small. Productivity in small scale industries showed not much more better than that of large scale sector. The results of analysis of productivity trends at disaggregated level showed the inter-industrial differences in productivity growth.

Chatterjee (1988) analysed the factors affecting labour productivity and has given policy measures to improve the performance in productivity by using diversified sources of data for Indian economy. He suggests that there was some disguised unemployment in industrial sector. Also inter-sectoral allocation of labour is not a critical decision and stress should be on reallocation of capital.

Bhatia (1990) examined the changes in productivity during 1965-1985 in the manufacturing sector of India in comparison to the US and UK through Solow and Kendrick indices of total factor productivity. His results indicated that during 1980-85, the productivity in Indian manufacturing is steeply raised subsequently even faster than that in US and UK. But during 1965-1975 the trends in productivity observed to have declined. The overall performance of Indian manufacturing sector was very low during the period because of low level of capital-labour ratio, low level of technology and socio-demographical conditions.
Ahluwalia (1991) made an attempt to analyse the TFPG performance of Indian manufacturing sector at disaggregated level for the period 1959-60 to 1985-86. Her study reveal that the analysis of Translog index of TFPG brought out the poor performance up to the end of the seventies. In first half of the eighties the TFPG was reflected by improvements in labour productivity. Capital productivity showed neither an increase nor decrease.

Singh and Kumar (1992) examined the changes in total factor productivity growth and factor substitution in Indian manufacturing (both small scale and large scale sector) for the period 1973-74 to 1984-85. The analysis of growth rates of Solow, Kendrick and Translog indices of TFP reveals that the capital productivity has declined in both small and large scale sector whereas the labour productivity has increased in both the sectors. He concludes that both large and small scale sectors have been experiencing the phenomenon of capital deepening.

Anita Kumari (1993) made an attempt to analyse the productivity trends at the group level of public sector enterprises for 11 groups of manufacturing industries for the period 1971-72 to 1987-88. She estimated TFP by using Kendrick, Solow and Divisia methods and also partial factor productivities have been measured for various public sector groups over time. The analysis of productivity trends reveals marked inter-industrial differences in productivity growth.

Balakrishna and Pushpangadan (1994) examined the total factor productivity growth and technical efficiency for 17 two digit industry groups by employing the methodologies of Corn and Well et al (1990). The major advantage of this
methodology is that, it does not assume constant returns to scale and perfect competition in the factor market. The major findings is that TFPG seems to have improved in a large number of industries and across most of the states during 1985-86 through 1992-93. Several states in which the organized industrial sector experienced a positive TFPG during 1976-77 to 1992-93.

Pradhan and Barik (1998) examined the TFPG in aggregate Indian manufacturing sector and eight most polluting industries viz., chemical and chemical products, structural clay, iron and steel, non-ferrous metals, pottery and earthenware, glass and pulp and paper for the period 1963-64 to 1992-93. The empirical results revealed that total factor productivity growth was negative during 1963-71 and 1982-92. The TFP growth registered a positive trend during the period 1972-81.

Subas. C. Kumar (2000) made an attempt to examine the trend of total and partial factor productivity in the leather industry and two of its major sectors, tanning and footwear for the period 1974-75 to 1992-93. He measured the TFP indices on the basis of Solow, Kendrick and Divisia. The results reveal that there exist inter-sectoral differences in productivity trend. TFP in tanning sector have been rising insignificantly. TFP in footwear sector have been declining significantly according to all three indices. In case of sectors as well as the industry, the partial labour productivity and capital intensity have been rising. Partial capital productivity on the other hand has been declining.

Jeemol Unni, N. Lalitha and Uma Rani (2001) examined the trends in growth and efficiency in the utilisation of resources in the manufacturing industry before and
after the introduction of economic reforms. The period of study is divided into three sub-periods, 1975-85, 1985-1990 and 1990-1995. The study reveals that at the All India level, the TFP growth was high in the pre-reforms period and it was declined during reforms period particularly in the unorganised sector. However, it was observed that in the reforms period, there was a sharp increase in capital intensity in both organised and unorganised sector at the national level.

Soumyendra Kishore Datta (2001-2002) analysed the productivity trends in the Indian cotton mill industry for the period 1966-1990. He used three alternative measures of TFP indices viz., Kendrick, Solow and Translog to analyse the trends in productivity. His study reveals that the growth rate of TFP is about 3 per cent over the relevant period. The results showed the positive trend in movement of labour productivity indices in cotton mill sector.

Rakesh Kumar (2002) made an attempt to analyse the efficiency and technology undercurrents in Indian textile industry during the period 1973-1994. His study reveals that the industry failed to optimise gains in terms of efficiency as well as productivity parameters and continues to work in the scenario of decreasing returns associated with given technology plateaus. He observed negative growth in total factor productivity for both Solow and Kendrick TFP indices and he concluded that productivity level and growth in the industry did not play any considerable role.

Tarlok Singh (2002) examined the total factor productivity for a sample set of ten industries in Indian manufacturing sector for the period 1973-74 to 1993-94. The selected ten industries constitute a combined share of around seventy per cent in the
total real domestic product originating from the manufacturing. His study reveals that during the overall period 1973-94, the trend growth rate of TFP witnessed improvements in all industries except for the basic metals industries in which the TFP witnessed a declining trend. The highest growth in TFP is observed in the case of the Food products industry.

Deb Kusum Das (2004) examined the productivity performance of Indian manufacturing under varying trade regimes. The analysis focuses on the overall period 1980-2000 and four sub-periods to reflect the shifts in trade policy regime. In his study he computed TFP growth rates for 75 three digit industries and three use-based industry groups for the four phases of trade reforms and the overall period 1980-2000. The results reveal that the TFP growth rates for individual industries are either negative or ranging between 0 to 2. The comparison among the four sub-periods shows that TFP growth in the 1990's is found to be lower than in the 1980's for all the three use-based industries, TFP growth in the second half of the 1990's (1996-2000) is lower than in the first half (1991-1995).