Production Conditions and Total Factor Productivity in the Cotton Textile Mills' Sector : An Inter-State Analysis : 1974-75 To 1981-82

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MASTER OF PHILOSOPHY

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DECLARATION

This dissertation titled 'Production Conditions And Total Factor Productivity In The Cotton Textile Mills' Sector: An Interstate Analysis: 1974-75 to 1981-82' being submitted to the School of Social Sciences, Jawaharlal Nehru University, by Jatinder Singh, in partial fulfilment of the requirements of the degree of Master of Philosophy, is entirely his own work and has not been considered for the award of any other degree either at this or any other University. We recommend that the dissertation be forwarded to the examiners for evaluation.

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CHAPTER-1

STURCTURE AND PROGRESS OF THE TEXTILE INDUSTRY IN INDIA

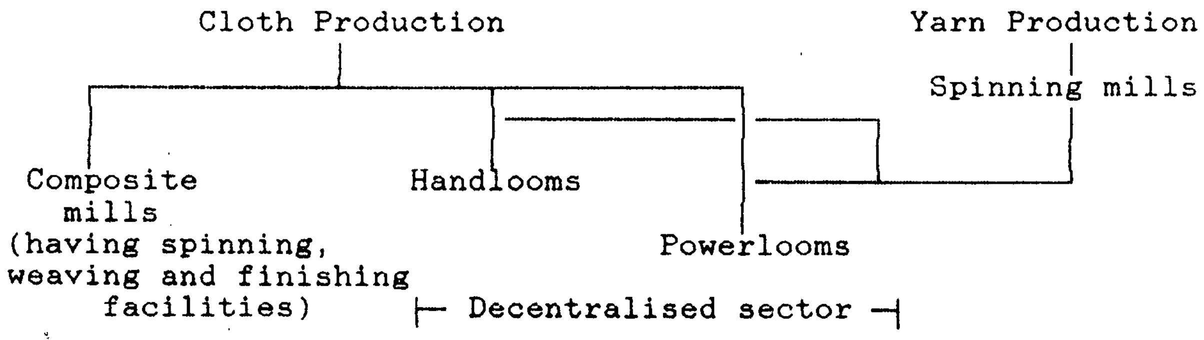
The cotton textile industry is among the oldest and largest manufacturing industries and hence occupies a prominent position in India's industrial sturcture. Clothing accounts for about ten percent of household expenditure in India. Furthermore, cotton textiles is one of important items of exports in India.

The cotton textile industry is also important from the point of view of linkages. It is linked to agriculture through its consumption of cotton and to other manufacturing industries because of its requirements of machinery, dyes and chemicals, and synthetic fibres. Hence, the industry has an important role to play both in the economic prosperity of the country and in the supply of an essential commodity for the entire population.

1.1 Structure of the Indian Cotton Textile Industry :

At present the cotton textile industry in India consists of three main sector — the mills sector, producing both yarn and cloth, and the powerloom and handloom sectors, involved only in the production of cloth. The mills sector consists of spinning mills and composite mills. Composite mills produce both yarn and cloth. The composition of yarn and cloth in these mills depends upon market conditions and other factors such as Government policies and other restrictions. On the other hand, spinning mills only produce yarn. The decentralised sector (handloom and powerloom) has mainly to rely on spinning mills for the supply of yarn.

The current structure of the textile industry in India may be presented in the following framework :



Yarn: Produced by - Composite mills which consume it internally.

- Spinning mill which sell to handloom and powerlooms.

Cloth: Produced by - Composite mills, handlooms and powerlooms.

The mills' sector is the most organised and largest sector. The mills produce practically the whole yarn output and about forty per cent of the cloth produced by the powerloom, handloom and mills segments combined.[1] This is the sector in which some firms continuously adopt modern technology both in spinning and composite mills. The continuous adoption of modern technology in a few mill makes the old capital obsolete. This is the cause of the existence of so many sick units in this sector. The public sector frequently has taken over the sick units to prevent them from closing down and to sustain employment. Thus, all the three types of ownership exists in the industry private, co-operative and public ownership, and the industry is characterised by a wide range of techniques from one firm to another.

The powerloom sector is based on mechanical methods of production but the technology is not as advanced as in the case of the mills sector except for a few cases. Units in the powerloom sector mainly rely on machinery discarded by the mills sector.[2] Most of the powerloom industry belongs to the unorganised sector because most of the firms have less than four powerlooms. The freeze on mill cloth output and capacity, and differential tax advantages are major causes of the continuous growth of the powerloom sector.

Their unregulated status, lower wages, lower capital costs and the scope for evading taxes on unreported output also have contributed to the increase in the importance of this sector. Moreover, due to its unorganised character, there were fewer strikes and lockouts in this sector. It also enjoys the advantages of an area of reservation for certain varieties of cloth. On the other hand, the compulsion to produce some proportion of coarser varieties of cloth places an economic constraint on the mills. Some of them set up their own powerloom units to reap the benefits of these advantages. All these factor stimulated tremendous growth in the powerloom sector — sometimes authorised and sometimes unauthorised all over India — particularly in Maharashtra. Thus, the powerloom sector has become stronger and has encroached upon the handloom and mills sector. On the other hand, the handloom sector which is mainly based on manual methods of production are finding it difficult to co-exist with the powerloom units in the decentralised sector.

The policies adopted by the Government to support the decentralised sector with a view to safeguarding the interests of the weaker sections both from the point of view of production and consumption is adversely affected by the rise of the powerloom sector. The bulk of yarn supplied to the decentralised sector is consumed by the powerloom sector, and the handloom sector gets only a very small proportion of it on the other hand, the powerloom and handloom sector which are supposed to produce for weaker sections of society together produce proportionally more of finer varieties of cloth than do the mills.[3] This is because the tax incentives offered by the Government to the powerlooms which enable them to enjoy a competitive advantage even in varities like 'finer grey', (plain varieties of fabrics which need no elaborate or sophisticated processing). As a result, the major part of the mills sector has to compete not only with the firms of its own sector but also with firms existing in an entirely different structure, i.e., the decentralised sector.

However, in the case of cloth that requires elaborate and sophisticated processing the mills sector faces little competition from outside. For this product the quality, design, and finish, and the extent of sales promotion rather than prices are crucial in determining the level of demand. Hence, continuous technological change is essential to maintain the level of demand for this segment. However, technological change or new investment can take place only if the lower limit to the prices at least covers prime costs alongwith the cost associated with the retrenchment benefits as well as the cost of making the existing stock obsolete. The skewed income distribution in the Indian economy is able to sustain these changes. An idea about the magnitude of this segment could be obtained from the facts that the top ten per cent of the population, expenditure wise, consumes 34.94 and 44.89 percent of the cloth consumed in rural and urban ares. (Cloth consumption here is measured in meters).[4] However, the firms do not set the upper limit of price according to the elasticity of demand, which is very low. Rather, they settle upper limit so that new firms do not find it advantageous to enter into this oligopolistic segment. This type of dual technology for finer yarn and inferior yarn also exists in the spinning sector, though to a lesser extent.

Hence, in the cotton textile industry there has developed dual technology. This is facilitated by the demand structure as well as by Government policies. On the one hand, there exists sophisticated machinery in a few firms and on the other hand there exist an obsolete technology in other mills. The latter type of firm has not only to co-exist with the advanced technology but also to face tough competition from the different firms in other segments of the industry. Moreover, the demand for the product of these firms arises from lower income groups, whose demand is prone to fluctuations in response to changes in the prices of other essential commodities, whereas the demand for superior cotton textiles is much more stable. Hence, the mills using backward techniques themselves find in a very disadvantageous position to invest. They avoid investment decisions, and hence most of the machinery in industry is either fully worn out or has long crossed its normal life span. According to the survey of 47 representative firms conducted by the Bureau of Industrial Costs and Prices, about 45 percent of carding equipment, 39 per cent of drawing machines, 30 percent of the spinning firms and 36 percent of weaving machinery were more than 40 years old.[5]

1.2 History and Geographical Concentration :

India is believed to be the first nation where cotton was grown and put to use (Excavations at Mohanjo-Daro unearthed bits of cotton cloth dating back to about 3000 BC).[6] From the ancient days, India has been a cotton manufacturing nation and exporter to all the nations of the civilised world. The coming of the industrial revolution in Great Britain brought to an end, the long era of Indian exports and the prosperity of the Indian textile industry. With the consolidation of the British power in India, once the products of the industrial revolution were introduced into India, it was inevitable that the revolution itself should follow. The first cotton mill to be started in India was Bowreah cotton mill Company, Calcutta in 1818. The first cotton spinning mill in Bombay was established in 1851 and in Ahmedabad in 1859. By 1861, there were in all 9 cotton mills in India. The growth of the industry suffered temporarily as the result of increased exports of raw cotton to Lancashire during the American Civil War. Thirty eight mills were started, mostly in Bombay state, during 1870-85. The growth of mills in Bombay was largely attributable to its ample facilities for export. Considerbale quantities of coarse yarn were being spun and exported to China and Japan. The introduction of mechanical improvements, such as the substitution of the ring spindle for the mule spindle in spinning gave a further impetus, and more mills were erected with new machinery. Except for a few temporary set backs due to famines and plagues and the stoppage of yarn exports to China during 1885-1900 the industry progressed steadily. The exports to China were halted because of the Governments initiative to close the mints to the free coinage of silver aimed at halting the decline in the value of the Indian rupee vis-a-vis the pound by switching the rupee onto the gold exchange standard. The net effect of this policy was that Japan and China who were still on the silver standard and were developing a textile industry of their own, had an edge over India in the Chinese market for yarn. Though exports subsequently picked up, the developments of 1893 gave the Japanese and Chinese industries a foothold in the China market. With the rise of Japan as a producer of cotton manufacturer and the loss of the China market, Indian industry turned its attention to the production of cloth. The fall in the exchange value of rupee during the period 1837-1897 and the inauguration of the swadeshi movement in 1895 favoured the process. The location of mills now was increasingly guided by proximity of consuming centres rather than by facilities for export. Ahmedabad rose to prominence owing to its nearness to the cotton growing tracts and major markets. In 1899-1900, in India as a whole, there were in all 193 mills with 4,945,783 spindles and 40,124 looms representing a capital investment of Rs.20 crores.[7]

During the period 1900-1939, several cotton mills were set up - World War I gave a filip to the industry when demand for cotton manufacturers increased and imports were restricted. The post war prosperity continued upto 1932. This was followed by a period of depression which lasted till about 1937-38. During the period 1921-39, the number of mills outside Bombay and particularly in Madras, Bengal, Uttar Pradesh and Central India increased by 101, while the increase in Bombay was 31. At the time of the outbreak of World War II, there were 389 mills in India with 10,059,370 spindles and 202,464 looms. From 1939-40 ownwards, Burma and Ceylon are excluded and the numbers of mills become 388.[8]

During the period 1939-47, the number of mills outside Bombay increased by 31, the new mills being located mostly in Madras and Bengal. The industry till independence was well-distributed all over the country. When India became independent, there were ten million three hundred thousand spindles and two lakh two thousand looms installed in Indian mills. There were also an estimated two and half million handloom weavers in the country. The mills were producing nearly four thousand million metres of cloth and the handlooms accounted for approximately one thousand three hundred million metres. The mill sector employed nearly seven lakhs of workers and thus was the largest organised sector in the country. Before independence, there was a continuous shift of emphasis from spinning to weaving in the mills sector. This was natural, since there had to be an established spinning industry before weaving could come into existence. In 1900-01, there were on an average 121 spindles for every loom, in 1918-19, the proportion was 57 spindles to one loom and in 1938-39, 49 spindles to one loom. From 1939-40 ownwards, Burma and Ceylon were excluded and in 1947, India became independent. The proportion become 51 spindles per loom in 1947.[9]

After independence, the newly independent Government assumed the responsibility for formulating a policy for this industry, for ensuring its growth and development, for providing adequate clothing at reasonable prices to the consumers — particularly to the weaker sections of the society — and for earning foreign exchange through exports. The structure of dependence of the decentralised sector on the mills sector alongwith the advantages of existing economies of scale in the mills' sector, made Government intervention a necessity to enable the decentralised sector to co-exist in the same product market with the mills' sector. It was recognised that the decentralised sector in labour absorbing and, hence, socially beneficial.

Several types of protection have been given to the decentralised sector at various times. Restrictions on the additional installation of looms in the mills sector was among the first of them. This affected the mills in South India in general and particularly in Coimbatore, as they were mainly spinning mills. The requirement that mills produce adequate yarn in hanks suitable for handlooms and subsidies to handloom fabrics were other favours to the decentralised sector.

However, it was realised at that stage that there had to be a gradual change in the pattern of production of handlooms in the best interest of mass consumers or the industry itself. A committee appointed in 1952 under the chairmanship of Kanungo recommended that over a period of time and in a phased manner, handloom should be gradually converted to powerlooms in the decentralised sector.[10]

However, the recommendation of the committee that handlooms should be converted into powerlooms could not be implemented due to strong opposition from the handloom sector. The failure to implement the recommendation, together with the skewed income distribution seem to be responsible for the wide range of techniques co-existing in the cotton textile industry. On the one hand, there exist firms with obsolete technology and subject to demand fluctuations caused by variations in food prices, which have been severely affected by any recession in the industrial sector. On the other hand some of the largest and most successful firms in India belong to this industry.

The textile industry faced two major recessions after independence, one in the early sixties and the other in 1974. The recessions were mainly attributable to the reduction of the purchasing power of the average man due to steep increases in food prices. After the first recession the Government tried to introduce a controlled cloth scheme to safeguard the interests of the weaker sections. But the scheme did not work properly due to the mills' attempt to escape its provisions for one reason or the other.

In brief, over the period 1950-85, the industry presents a currious mixture of impressive growth on the one hand for a few firms producing sophisticated cloth and spinning mills producing finer varieties of yarn, and near stagnation on the other for producers of coarse varieties.

In the mills sector, while the spinning segment of the industry expanded phenomenally during the period, weaving suffered stagnation. The number of spinning mills increased from 103 in 1951 to 674 in 1985. The emergence of co-operative spinning mills is an important feature of development during the period. The number of composite mills, where both weaving and spinning are combined, has not increased much and rose from 275 in 1951 to 281 in 1985.[11]

More meaningful dimensions of growth are capacity and output. Spindle capacity was more than doubled during the period, from about 11.00 million in 1951 to 24.42 million in 1985. The production of yarn increased from 591 million Kg in 1951 to 1092 million Kg in 1983. Estimated figures for 1984 are 1151 million Kg. The average count of cotton spun yarn has been increasing gradually both for spinning and composite mills. For the spinning mills the average count was slightly higher initially, and the increase in this average count is also slightly greater than that for composite mills.[12] This explains the proportionately greater production of finer varieties of cloth by the decentralised sector, which relies on the spinning mills for yarn. The proportion of production of finer varieties of cloth by the decentralised sector is increasing though at a lower rate.

On the other hand, weaving capacity remained stagnant after independence, around 2 lakh looms. This accounts for the production of mill cloth having reached a maximum of about 4800 million meters in 1956 and 1957. Since then there has been a gradual reduction and production has been stagnant throughout the 70's. In 1980, production was 4176 million metres. The eighties show a further decline in mill cloth production. Production was 3528 million meters in 1983.[13]

The twin phenomena of stagnation in looms and dramatic expansion in spindles is partly due to the Government's policy of freezing mill cloth output in order to encourage handlooms and powerlooms, and partly due to basic economic factors such as the rising prices of food and clothing, the growth of synthetics, and the skewed income distribution adversely affecting market expansion. On the one hand, these factors contributed to the trend of continuous shift of emphasis from the weaving to the spinning mills sector after independence. The average number of spindles per loom rose from 56 in 1951 to 86 in 1971. The figure further rose to 116 spindles per loom in 1985. On the other hand, stagnation in the organised sector is compensated for by the growth of the decentralised sector. The production of woven fabrics from cotton fibres for the decentralised sector increased from a mere 1013 million meters to 5911 million meters between 1951 and 1983 that is, from a mere 21 percent of total cotton cloth production to as high as 69 percent of total cotton cloth production.[14] The powerloom sector is mainly responsible for the observed growth of the decentralised sector. It is enroaching upon the area previously served by the mills and handlooms sectors.

The industry is mainly concentrated in a few parts of the country. While in the mills sector, the major concentration of the industry is in Maharashtra and Gujarat in the West and Tamil Nadu in the South. The industry in Maharashtra and Gujarat states mainly consists of composite mills. These states account for 59 percent of the total number of composite mills in India. In Tamil Nadu, the industry is dominated by spinning mills. Tamil Nadu alone accounts for 57 percent of all spinning mills. This regional specialisation of the industry is greater than appears at first glance. In each of these states, the industry is heavily concentrated within a single city. Sixtyeight per cent and Seventy percent of the total composite mills of Maharashtra and Gujarat states respectively are located in Bombay and Ahmedabad. Coimbatore alone acounts for 46 percent of the spinning mills of Tamil Nadu.[15]

1.3 Review and Evaluation of the literature :

The objective of this study is to estimate the conditions in cotton textile mills sector in different states of India during 1974-75 to 1981-82 and to analyse the nature of year to year technological changes that have taken place during the period. The other major objective is to measure the effect of technological change on total factor productivities from an engineering point of view.

With these ends in view, a critical review of the methodologies and results of earlier studies was undertaken.

Since the 1960's there has emerged a large volume of writings and empirical work on technological progress in Indian manufacturing industry. As pointed out by Brahmnanda (1982),[16] classicals had no answer to the problem of how the gains of technological change could be measured. "The 'marginalist' revolution of the 70's of the last century, associated with the names of Jevons, Menger and Walras, tried to supersede the classical approach and, until recently, had almost supplanted it."[17] They viewed the object of production as not production itself but the satisfaction of consumption wants. The efficiency of production is judged by them with reference to the measure of utility yielded thereby and the agents of production would get rates of reward, depending upon the potential scope for substitution in consumption and the methods of production.

"These developments seemed to provide a way out for estimating an index number of quantity of each of the factors and heralded the possibility of developing a method for devising a combined index of total factor quantities. Pertinent here, are the conributions of Morris Copeland (1936), Tinbergen (1942), Stigler (1947), Valavanis-Vail (1955), Solow (1957), Kendrick (1961) and Denison (1967). The empirical approach of Paul Douglas in the form of the famous Cobb-Douglas production function with the assumption of elasticity of substitution among factors equal to unity provided one explanation of invariant relative shares under conditions of disproportionate growth of different factor supplies.[18] This approach makes it possible to deal with cases of Hicks neutral technical progress.

The above are developments of the post second - World War period. A large number of studies are now available on productivity growth in different countries. More sophisticated production functions could be fitted even by dropping the assumption that factors are applied upto the point of equalisation of marginal productivities with factor prices. In this way the neo-classicals overcome the most severe criticisms used against them. The detailed overview of the most commonly used production function methodologies to determine productivity change, and the parameters of technology in Indian industry and the methodology adopted for the present study are discussed in Chapter 2.

In this chapter, it is intended to focus upon the empirical results of the lierature on the measurement of productivity and parameters of technological change in the Indian cotton textile industry. The measurement of productivity change in Indian industries has been done by most studies through simple ratios or productivity indices of capital and labour and through production function analysis.

A pioneering study by G. C. Beri (1962)[19] estimates partial and total productivity indices for four industries for the period 1948-1955. The index for the cotton textile industry in India shows an increase in labour productivity (18.53 per cent) and a decline in capital productivity. The total factor productivity index showed a marginal increase (3.22 percent). Beri's main conclusion was that the increase in labour productivity was achieved mostly through capital deepening.

H.B. Shivamaggi, N. Rajagopalan and T.R. Venkatachalam (1968)[20] examined trends in wages and compared them with trends in labour productivity and costs of production for seven important industries during the decade 1951 to 1961. The cotton textile industry registered a fifteen percent increase in labour productivity for the period. They concluded that the rise in real wages, overall and industrywise, generally lagged behind the improvement in labour productivity. They also concluded that the greater rise in labour productivity over the period may be partly associated with capital deepening and improvement in management.

J.N. Sinha and P.K. Sawhney (1970)[21] in their study measured both partial and total factor productivity for the period 1950-63. The indices for the cotton textile industry showed a 2.9 per cent per annum increase in labour productivity. Furthermore, capital productivity also showed an upward trend of 1.3 percent per annum contrary to the results of earlier studies. Raw material productivity also showed a marginal increase. The total factor productivity index showed an upward rate of growth of 2.4 percent per annum, significant at the 5 percent level.

A.K. Chatterjee (1973)[22] studied labour productivity indices for 26 manufacturing industries for the period 1946 to 1958 and for 25 industries for the period 1960-65. Chatterji found that the rate of increase of productivity in manufacturing was relatively much higher during 1946-58 than during 1960-65. However, traditional industries including the cotton textile industry showed relatively lower rates of productivity rise in both the periods. Chatterji came to the conclusion that the growth in labour productivity was not due to capital deepening in the Indian manufacturing sector.

A. Banerji (1975)[23] provides a account of productivity trends in the manufacturing sector as a whole and for five selected industries for the period 1946-64. The five industries are cotton textiles, jute textiles, sugar, paper and biycles. Cotton textiles recorded the lowest annual rate of growth of 1.6 percent in respect of labour productivity. The capital productivity index showed a declining trend at the rate four percent per annum. Total factor productivity showed a small negative growth rate (-0.4 percent) in the cotton textile industry. Banerji, on the evidence of these measures concludes that cotton and jute had not shown any significant technical progress. His overall opinion about Indian industry was that labour and capital productivity showed opposite trends. He also came to the conclusion that any increase in labour productivity was achieved mostly through capital deepening.

S.S. Mehta (1980)[24] in his study on total and partial productivity for the period 1953 to 1965 computed the partial productivity of capital and labour for several industries including the cotton textile industry. Labour productivity increased at significant rate Of 2.3 percent per annum, while the output-capital ratio showed a negative trend of 4.2 per cent per annum, which is significantly different from zero at the 5 percent level of significance in the case of the cotton textile industry. The capital-labour ratio increased at the rate of 6.8 percent per annum. However, in other industries despite a rise in the capital-labour ratio, it had not led to any gain in labour productivity, implying that the growth in labour productivity in many industries was not due to rising capital intensity. Accordingly, Mehta concluded that an increase in capital intensity need not lead to an increase in labour productivity. Mehta also calculated Kendrick's total factor productivity index, the change in efficiency rate that is, $\frac{d\,A(t)}{A(t)}$, and Solow's total factor productivity index A(t). The results are significantly different from zero only for Kendrick's method, which shows a negative trend at -4.2 per cent per annum. The effect of these changes in technology on the share of labour and capital in value added is not significantly different from zero. However, the wage rate shows a positive trend rate of growth of 1.9 percent per annum.

Mehta's study shows insignificant increases in the efficiency parameter obtained by fitting a Cobb-Douglas time series function. The result obtained for the contribution of capital in the production process is negative, which is just not possible.

D.U. Sastry (1948)[25] attempted to measure productivity trends, both partial and total factor productivity of the cotton mill industry for all India, Maharashtra and Tamil Nadu for the periods 1949-58, 1959-70 and 1949-70. For the period 1949-58, all the partial indices for both labour and capital showed negative trends. On the other hand for the periods 1959-70 and 1949-70, the real value added per man hour shows a positive trend while real value added per unit of real fixed capital shows a negative trend.

To sum up, one can conclude that the outcome of these studies shows that nothing definitive can be said about the magnitude of productivity change, though most of the studies indicate that labour productivity rises over time while capital productivity tends to decline. However, it appears that total factor productivity registered a marginal increase for the cotton textile industry. The explanation provided by these studies for the direction and magnitude of trends in productivity also differ in many ways. Similar results are obtained when one takes the manufacturing sector as a whole. However, the trends in productivity estimated in the studies of R.R.Singh (1966),[26] Raj Krishna and S.S.Mehta[27], B.N.Goldar (1983)[28] for the manufacturing sector as a whole broadly follow the same pattern as is found in most of the studies relating to the cotton textile industry. K.L. Krishna (1985)[29] compared different studies. He came to the conclusion that it is difficult to reconcile I.J. Ahluwalia's (1985)[30] results using Solow's and translog measures of total factor productivity change at different levels of industrial aggregation for the period 1959-80 with Goldar's(1986[31] results for the same period. Ahluwalia's results for growth rates in total factor productivity lie within the range of -0.6 to 0.3. This is different from Goldar's result of 1.3 percent per annum for the same period.

The studies which have estimated the elasticity of substitution between factors of production essentially involve the estimation of CES production functions, because Cobb-Douglas production function rules out the measurement of substitution elasticities.

Mehta (1980)[32] estimated the elasticity of substitution for the period 1953-65 for 27 individual industries including the cotton textile industry. His work is based on different regression models derived from CES production functions. The adjusted R^2 value is not satisfactory for most industries and the values of these adjusted R^2 for different regression equations for the cotton textile industry lie in the range of 65 to 92 per cent. Hence, one could conclude that the independent variable taken are unable to explain quite a lot of variations in the dependent variable.

D.U. Sastry (1984)[33] estimated the elasticity of substitution for the cotton mill industry for the period 1949-70 for all India, Maharashtra and Tamil Nadu by fitting a model based on a logarithmic regression of real value added per man hour on wage rates and man hour. The fits are not very satisfactory and are able to explain only 42 percent and 26 per cent of variations in cases of all India and Maharashtra respectively. However, the fit is slightly better in the case of Tamil Nadu where it explains 85 percent of the variations. The elasticity of substitution turned out to be significantly different from zero at the one percent level and is equal to 1.22, 0.96, and 1.06 for all India, Maharashtra and Tamil Nadu respectively. However, Sastry did not go into the reasons why the elasticity of substitution is so much lower for each of the two periods, when the period 1949 to 1970 is divided into parts, 1949-61 and 1961-70 for all India. The elasticity of substitution obtained is 0.34 and 0.85 for the periods 1949-61 and 1961-70 respectively.

R.K.Diwan and D.Gujarati (1968)[34] came to the conclusion that the elasticity of substitution in manufacturing industries was quite low. A.Banerji (1971)[35] concluded for manufacturing industries as a whole and five individual industries that the elasticity of substitution does not differ from unity.

To sum up, the estimates of technology parameters vary widely for manufacturing industries as a whole as well as for its components. Something serious appears to be wrong in the methodologies used to obtain productivity and technological prameters in the light of the qualitative as well as quantitative divergence of the estimates. K.L.Krishna's conclusion that Ahluwalia's and Goldar's studies can not be reconciled or explained suggests not only that a thorough examination of the methodology adopted is in order but also that there is substantial room for improvement in this field of study. Careful analysis of the procedures adopted by these studies reveal the following limitations.

The methodologies adopted in these studies are based on the principal of equalisation of marginal productivities with factor prices in equilibrium. This is not appropriate for a capital intensive industry like cotton textiles. It appears that this is a reason for adjusted R^2 values to be very low in the regression analysis of almost all the studies. This is demonstrated and discussed in detail in chapters three and four of the present study.

In addition, the regressions, fitted in earlier studies were based generally on time series data and hence fail to explain the co-existence of a wide range of different techniques in the cotton textile industry at any point of time. Fitting regressions using time series data assumes a single equilibrium for each of the variables fitted in the regression equation in any one period of time. This shortcoming may be removed by fitting cross-sectional regressions, which takes into consideration the fact that at any point of time there exists several sets of techniques.

Moreover, the time required for factor adjustment in different industries depends upon their present prices as well as existing stocks of factors of production and hence the value of the elasticity of substitution parameter based on the time series regressions depends upon the time period taken. The values of other parametric obtained from these regressions would be less reliable the greater is the extent of difference between the short run elasticity of substitution parameter and the long run elasticity of substitution parameter.

Further cause of misspecification in these studies could be that, the capital stock is not deflated appropriately in most of the studies. Goldar used a much better technique in applying the perpetual inventory method. This way he overcame the problem inherent in deflating book values of old stock by the current year's capital-stock deflator.

In addition most of earlier studies do not take into consideration, the entirely different structures prevailing in different segments of the Indian cotton textile industry. In the low capital intensive handloom sector, the substitution between capital and labour occurs mainly in response to their relative marginal productivities and costs. In the relatively capital intensive powerloom sector the existing capital stock is important in further investment decisions due to the high indirect marginal cost. (Indirect marginal cost includes costs such as cost of making old capital obsolete as well as retrenchment cost). The importance of these considerations is much greater in the mills sector. Moreover, the institutional factors and legal obligations assume special importance in determining the variations in factor proportions in the mills sector. These are not significant in the handloom and powerloom sector. Under these conditions, the fitting of production functions to estimate the parameters for the cotton textile sector as a whole needs to be avoided.

1.4 Objective and Scope of the present study :

Keeping in mind these limitations of earlier studies, the objective of the present study is to determine production conditions in the cotton textile mills sector in India as well as different states of India during the period from 1974-75 to 1981-82,. and to analyse the nature of year to year technological changes that have taken place during this period. The parameters of production functions for each year along with the variations in their parameters from year to year could express conditions in this sector. These parameters include the efficiency of technology, elasticity of substitution, economies of scale, and the contributions of capital and labour in value added. The short run parameters of technologies such as short run elasticity of substitution and the importance of rigidity due to existing stocks express short run technology conditions. The index of marginal productivities of factors could be obtained for each state with the help of long run parameters obtained using Kmenta's approximation to the CES production function. This is another way of expressing the difference in the operating conditions of various states during a period of time.

One could estimate the effect on productivity of changes in the set of combinations of machines used by taking out the effect of differences in capacity utilisation of these machines over time. This would reveal the effect of technological change, from an engineering point of view, on total factor productivities.

The work of the present study is organised as follows. Following this chapter, the second chapter is devoted to the review of methodologies and the research plan. The third chapter deals with the importance of indirect marginal costs in determining factor proportions. The short run, and long run parameters of production functions alongwith their variations are also estimated. The fourth chapter deals with the differences in relative marginal productivities in each state and their correlation with wage rates using for cross-sectional data. The effect of technological change from an engineering point of view on total factor productivity is also estimated. Chapter five is the summary of main findings of the study and conclusions.

CHAPTER-2

REVIEW OF METHODOLOGIES AND RESEARCH PLAN

Production function may express the production conditions in an industry. However, the choice of production function and the specifications of the variables are important depending upon the structure of the industry as well as the objectives of the study. The purpose of this chapter is to critically review the methodologies adopted in India to determine the factor productivities and long run production condition in different industries, based on the production function approach with a view to identifying a methodology suited for the purpose of analysing production conditions in the cotton textile mills industry. The chapter is divided into three parts. The first part discusses the methodologies used generally in India, their limitations and hence the consequences of these limitations for different structures. The second part discusses the methodologies adopted to determine long run production conditions. The third part discusses the specification of variables taken, their deflation method, source of the data, and time period of study.

2.1 Methodologies used in India :

The method used by most Indian studies may be classified into the following categories :

(I) Partial factor productivity method.

(II) Methodologies based on production functions.

(i) Kendrick's total factor productivity method based on linear production function.

(ii) Methods based on non-linear production functions such as:

(a) The Cobb-Douglas production function :

Log-linear regression form.

Solow's methodology.

(b) CES production function.

(c) Varying elasticity of production funtion.

Each of these is discussed in turn, below :

I. Partial factor productivity method :

Partial factor productivity for any factor of production is the ratio of value added to the concerned factor of production. It is sometimes also defined as the ratio of the value of output to the concerned factor of production and is also used to obtain the productivity index for raw materials.

This method has been used in most studies to determine the change in efficiency of factors of production overtime. G. C. Beri (1962), H. B. Shivamaggi, N. Rajagopalan and T. R. Venkatachalam (1968), J. N. Sinha and P. K. Sawhney (1970), A. K. Chatterjee (1973), A. Banerji (1975), S. S. Mehta(1980), used this approach for the cotton textile industry.

This method is widely used because of its simplicity. However, it does not explain whether the increase in the productivity index is due to a quality change of that factor or input or it is due to some compositional change in quality or quantity used of one or more other factors.

2. Methods based on production functions :

For a proper review of the methodologies based on non-linear production functions, it is necessary to define the production function and its parameters.

A production function expresses the way in which outputs are produced efficiently by inputs, and the way inputs co-operate with each other in varying proportions to produce any given output.

$$\text{i.e., } V = f\ (K,L) \qquad \ldots (2.1)$$

where, 'V' is value added, that is, net addition to output by the factors of production, labour (L) and capital (K).

These relations between outputs and inputs and between the inputs are determined by the technology that rules at any given time. M. Brown[36] defined four characteristic of production function which are extremely useful for economic analysis.

The efficiency parameter 'A': This characteristic of an abstract technology enters only into the relationship between inputs and outputs; it does not affect the relationship between various inputs.

The Degree of economics of scale 'm': For a given proportional increase in all inputs, if output is increased by a larger proportion, the firm enjoys increasing returns to scale, if output is increased by the same proportion, there are constant returns to scale, and if output is increased by a smaller proportion decreasing returns or diseconomies of scale, result. There could external as well as internal economies and diseconomies.

Marginal rate of technical substitution : Marginal factor productivity is defined as the increase in production caused by the application of an additional unit of a factor.

Thus, the marginal productivity of labour is :

$$(MP_L \text{ or } f'(L) = \frac{\delta Qx}{\delta L} \quad \text{or} \quad \frac{\delta f}{\delta L} = \frac{\delta v}{\delta L} \qquad \ldots (2.2)$$

and the marginal productivity of capital :

$$MP_K \text{ or } f'(K), \text{ or } \frac{\delta f}{\delta K} = \frac{\delta v}{\delta K} = \frac{\delta Qn}{\delta K} \qquad \ldots (2.3)$$

The degree of capital intensity is reflected in the size of the ratio of labour to capital for given relative factor prices. Alternatively, for a given capital labour ratio, the degree of capital intensity depends upon their relative marginal productivities, or the marginal rate of technical substitution (MRTS).

The marginal rate of technical substitution of labour for capital ($MRTS_{LK}$), refers to the amount of capital that a firm can give up by increasing the amount of labour used by one unit and still remain on same isoquant. Thus,

$$MRTS_{LK} = \frac{MP_L}{MP_K} = \frac{f'(L)}{f'(K)} = \frac{\delta Q_x/\delta L}{\delta Q_x/\delta K} = \frac{\delta K}{\delta L} \qquad \ldots (2.4)$$

$$\left[\because V = f(L,K) = Q_x \text{ (Production of 'X')}\right]$$

$$0 = DQ = f'(L)DL + f'(K)\,dK$$

$$\text{Hence,} \quad \frac{f'(L)}{f'(K)} = \frac{dK}{dL}$$

In the case where there exists perfect competition :

$$\frac{MP_L}{MP_K} = \frac{MC_L}{MC_K} = \frac{W}{R} = \frac{\text{Wage rate}}{\text{Rental Rate}} \qquad \ldots (2.5)$$

However, there are cases where this condition of perfect competition is not satisfied. In these cases the factors are employed considering their direct marginal costs as well as other costs such as the cost of discarding old capital stock, retrenchment costs, and so on.

Elasticity of substitution : This is the measure of the ease of substitution of factors such as labour for capital. The elasticity of substitution is defined as the proportionate change in the relative factor inputs to a proportionate change in the marginal rate of substitution between labour & capital.

The elasticity of substituatability of factor L for K

$$es = (es)_{LK} = \sigma \text{ is } \frac{D\ (K/L)/\ K/L}{D\ MRTS_{LK}/MRTS_{LK}} \quad \ldots (2.6)$$

$$es = \frac{D\ (K/L)/K/L}{D\ MRTS_{LK}/MRTS_{LK}} = \frac{D\ (K/L)/K/L}{D\ (MC_L/MC_K)/MC_L/MC_K}$$

$$= \frac{D\ (K/L)/K/L}{D\ (W/R)/W/R} \text{ (When perfect competition prevails)} \quad \ldots (2.7)$$

(i) Kendrick Method of total factor productivity based on linear production function :

Total factor productivity (T.F.P) is defined as the ratio of the actual contribution to value added in the n^{th} period to what the contribution to value added would have been using nth period quantities, of factors of production, had the technology of the base period prevailed.

Kendrick developed the T.F.P index using a linear production function. The Kendrick index of T.F.P. is equal to

$$\frac{V_n}{a_o L_n + b_o K_n} \quad \ldots (2.8)$$

where, V_n is the value added during period n using the amounts of labour and capital, L_n and K_n respectively. a_o and b_o stand for the base year efficiency of labour and of capital respectively. Kendrick assumed that a_o and b_o are appropriately measured by the wage rate and the rental rate respectively during the base period.

$$W_o \text{ (Wage rate during base period)} = \frac{\text{Wage bill during base period}}{\text{Number of persons employed during the base period}} = \frac{W_o}{L_o} \quad \ldots (2.9)$$

$$R_o \text{ (Rental rate during base period)} = \frac{\text{Value added during base period} - W_o}{\text{Fixed capital stock during base period}} = \frac{V_o - W_o}{K_o} \quad \ldots (2.10)$$

Kendrick developed this productivity index to estimate changes in National Productivity over time for the U.S. economy.

G.C. Beri (1962), J.N. Sinha and P.K. Sawhney (1970), A.Banerji (1975), S.S.Mehta (1980), B.N.Goldar (1983), and I.J. Ahluwalia (1985) used this method to arrive at a total factor productivity index for the cotton textile industry. D.U.Sastry (1984) used it for the cotton textile mill's sector.

The Kendrick method marks an improvement over the partial factor productivity approach in that it provides a way to measure total factor productivity. However, his attempt is marred by the following limitations :

The method is based on a linear production function which assumes first that $f'(L)$=constant, $f''(L)=0$ and $f'(K)$= constant, $f''(K)=0$. This implies that equilibrium conditions cannot exist and changes in relative factor proportions donot affect marginal productivities. In addition, this function assumes infinite elasticity of substitution between factors of production that is the substitution between one factor and another is not affected by their already existing proportion. Moreover, it assumes constant returns to scale.

Keeping the above limitations in mind, it could be concluded that the methodology is useful for rough estimation purpose in some cases. Using it, changes in national productivity over the time can be assessed. The methodology may also be used in cases where competitive conditions hold and the industry does not undergo much structural change such as changes in the capital labour ratio. However, the methodology has been applied to industries such as the cotton textile industry, an industry in which different structures co-exit.

The measure gets further distorted if methodologies are adopted without properly going into the specification of the individual variables to be used. Some studies have taken the share of wages in value added $\frac{W_o}{V_o}$ and $\frac{V_o - W_o}{V_o}$ to represent base year efficiency of labour (a_o) and capital (b_o) respectively. The consequences of taking this wrong specification could give different results for the T.F.P index depending upon the units in which the variable, labour, is measured, as illustrated :

$$T.F.P = \frac{V_n}{\frac{W_o}{V_o} L_n + \frac{V_o - W_o}{V_o} K_n}$$

L_n is measured in Man hours, V_n and K_n is in Rs.

$$\neq \frac{V_n}{\frac{W_o}{V_o} L_n + \frac{V_o - W_o}{V_o} K_n}$$

L_n is measured in Man days, V_n and K_n is in Rs.

... (2.11)

Moreover, the wrong specification would cause the T.F.P index to remain unchanged in the case of Hicks - Neutral technical progress.

$$T.F.P = \frac{V_n}{\frac{W_o}{V_o} L_n + \frac{V_o - W_o}{V_o} K_n} = \frac{V_n}{\frac{W_o}{V_o} L_n + \frac{V_o - W_o}{V_o} K_n}$$

... (2.12)

In the case of Hick's neutral technical progress

$$\frac{W_o}{V_o} = \frac{W_n}{V_n}$$

Here, W_n is the wage bill in the n^{th} period.

(ii) Methods based on non-linear production on functions such as :

(a) Review of Methodologies based on the Cobb-Douglas Production function :

Log linear regression form :

The general functional form of the Cobb-Douglas production function is :

$$V_t = A_t L^a K^b = A_o e^{rt} L^a K^b = A_L L^{m(s)} K^{m(1-s)} \quad \ldots (2.13)$$

This functional form could be transformed into the following form of regression equation :

$$\log V_t = \beta_o + \beta_1 \log L + \beta_2 \log K + rt \quad \ldots (2.14)$$

Here, V, K, L, & t are value added, capital, labour & time respectively and $\beta_o = \log A_o$, $\beta_1 = ms$, $\beta_2 = m(1-s)$, and $\beta_3 = r$.

The parameters of technology could be obtained from these coefficients as : $A = \text{Antilog}(A_o)$, $m = \beta_1 + \beta_2$ capital intesity $(K) = \frac{\beta_2}{\beta_1} = \frac{(1-s)}{s}$ and $r = \beta_3$

Equation 2.14 is based on the following assumptions :
Firstly, it assumes that the marginal productivity of factors of production is positive and declining as the proportion of one factor increases, i.e.,

$$f'(L) > 0 \ \& \ f''(L) < 0$$
$$f'(K) > 0 \ \& \ f''(K) < 0$$

In addition, it assumes unitary elasticity of substitution throughout all periods. It implies that change in shape of the curve is not possible and hence relative contribution of capital & labour remain the same over the time period. Moreover, it assumes Hicks Neutral Type of Technical Progress.

Mehta (1980) and D.U.Sastry (1984) used this methodology to determine trend rates of growth for cotton textiles and the cotton Mill's sector respectively.

Solow's Methodology based on Cobb-Douglas Production function :

Solow modified the above regression equation by putting it in the following form so that the multi-collineacity problem could be avoided. However, for that he has to assume constant returns to scale.

$$\frac{d(A_t)}{A_t} = \frac{d\,(V/L)}{V/L} - (1-s)\,\frac{d\,(K/L)}{K/L} \qquad \ldots \quad (2.15)$$

It is derived as follows :

$$V = A_t\ K^{(1-s)}\ L^{s} \qquad [\text{ Here, } a = ms = s \text{ and } b = m(1-s) = 1-s$$

$$V/L = A_t\ K^{(1-s)}\ L^{s-1}$$

$$V/L = A_t\ (K/L)^{1-s}$$

$$\log (V/L) = \log A_t + (1-s) \log (K/L)$$

$$d\,(V/L)/(V/L) = d\,(A_t/A_t) + (1-s)\ d\,(K/L)/(K/L)$$

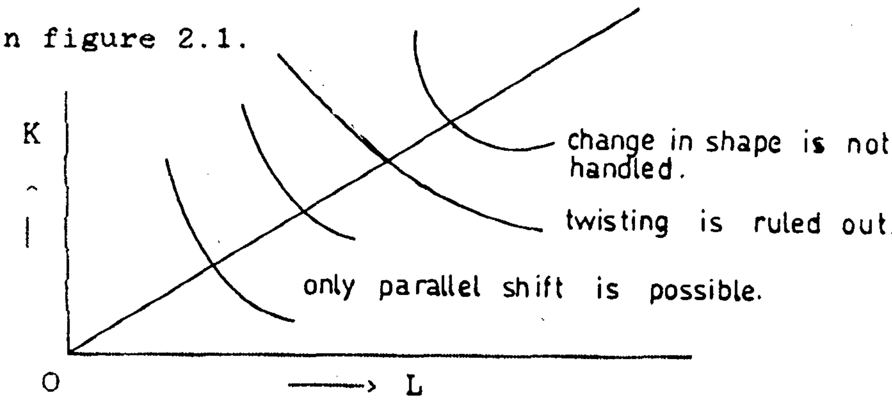
$$d\,(A_t)/(A_t) = d\,(V/L)/(V/L) - (1-s)\ d(K/L)/(K/L)$$

(Solow's equation)

In the above equation, the result, d A_t/A_t, for each year could be obtained by taking variable, V, K, and L for each year and changes in them from previous years. 'S' could be taken as the share of capital in the base year or in the current year, which should be same under unitary elasticity of substitution assumption.

The consequence of applying these methodologies based on Cobb-Douglas production function may be illustrated by the following :

This methodology assumes that a unique equilibrium exists at any particular time. The assumption of unitary elasticity of factor substitution throughout the period and Hicks neutral technical progress implies that the changing shape or twisting of isoquants is ruled out. All this means that for a given K/L ratio, all the components of technology except the efficiency parameter are kept constant at the same values for all other years. Moreover, these parameters are not estimated by data, but are assumed constant at some expected value. The above regression equation can properly analyse the case shown in figure 2.1.



(Fig.2.1)

The consequence will be that the effect of the above assumptions will reflected in the value of At. The deviation of a component from the assumed values could cause a bias in one direction in one period, and in another direction, in another period. It is not possible to predict the direction and magnitude of the combined effects of all these assumptions even if they deviate only slightly from reality.

(b) Review of Methdologies generally applied based on CES Production Function :

The general form in which the CES production function is specified is :

$$V = A_0 \left[(s)\,(Le^{r_1 t})^{-p} + (1-s)\,(Ke^{r_2 t})^{-p} \right]^{-m/p} \quad (2.17)$$

Here V, L and K are, value added, labour and capital respectively. 'S' is contribution of labour at equilibrium, '1-S' is the contribution of capital, m is returns to scale.

The substitution between capital and labour depends upon the parameter 'p'. r_1, r_2 are the rates at which labour and capital efficiently grow. ($r_1 - r_2$) is the rate of Hicks non-neutral technical progress.

The following three forms of ordinary least square regression method are most commonly used to obtain parameters of the CES production function. All these forms are based on the assumption of perfectly competitive conditions, i.e., that factors are employed equating their marginal productivities with their factor prices.

Fitting of OLS logarithmic regressions of value added on per unit of labour on wage rate :

From the production function form 2.17, the following derived equations could be obtained, using the assumption that labour is employed upto the point where its marginal productivity equals the wage rate.

$$\log (V/L) = \beta_0 + \beta_1 \log W + \beta_2 \log L + \beta_3 t \qquad \ldots (2.18)$$

Here, V,L,W and t are value added, labour, the wage rate, and a fine variable, respectively.

$$\beta_0 = \frac{m}{m + p} \log \left[\frac{A_0 p/m}{ms} \right] \qquad \beta_1 = \frac{m}{m + p}$$

$$\beta_2 = \frac{p(m - 1)}{m + p} \qquad \beta_3 = \frac{-m\, r_1}{m + p}$$

At this stage, a simplification is required to separate the three parameters. In order to avoid complications, 'm' is taken as exogenously equal to one, which makes β_2 zero, and hence equation 2.18 fitted as :

$$\log (V/L) = \beta_0 + \beta_1 \log W + \beta_3 t \qquad \ldots (2.19)$$

Here : $\beta_0 = \frac{1}{1 + p} \log \left[\frac{A_0 p}{ms} \right]$, $\beta_1 = \frac{1}{1 + p}$ and $\beta_3 = - \frac{1}{1 + p}$

From these coefficients, the technology parameters could be obtained as : elasticity of substitution is β_1 and $r_1 = \frac{\beta_3}{\beta_1}$.

Second form of fitting ordinary least square logarithmic regression of value added per unit of capital on rental rate and time period :

From the production function form 2.17, the following form of derived equation could be obtained using the assumption that the factor capital is employed under perfectly competitive conditions and that there exist constant returns to scale.

$$\log (V/K) = \beta_0 + \beta_1 \log R + \beta_3 t \qquad \ldots (2.20)$$

Here, V, K, R, and t are value added, fixed capital, the rental rate, and time variables respectively.

$$\beta_0 = \frac{1}{1+p} \log \left[\frac{A_0 p}{1-s} \right], \quad \beta_1 = \frac{1}{1+p}, \quad \beta_3 = \frac{-r_2}{1+p}$$

Hence from equation 2.20 the parameters of technology could be obtained as :

$$\text{Elasticity of Substitution} = \beta_1 = \frac{1}{1+p}, \text{ and } \quad r_2 = \frac{-\beta_3}{\beta_1}$$

Fitting of OLS logarithmic regression of capital-labour ration on wage rental rate ratio and time :

From production function 2.17 the following form of derived equation could be obtained by adopting the assumptions that factors of production are employed equating their marginal productivities and cost. Thus :

$$\log (K/L) = \beta_0 + \beta_1 \log (W/R) + \beta_2 t \qquad \ldots (2.21)$$

Here, K, L, W and R are capital, labour wage rate and rental rate respectively.

$$\beta_0 = \frac{1}{1+p} \log \frac{1-s}{s}, \quad \beta_1 = \frac{1}{1+p} \quad \beta_2 = \frac{1}{1+p} (r_2 - r_1)$$

From these coefficients, the following technology parameters could be obtained :

Elasticity of substitution = β_1

Hicks non-neutral technial progress = $\frac{\beta_2}{\beta_1}$

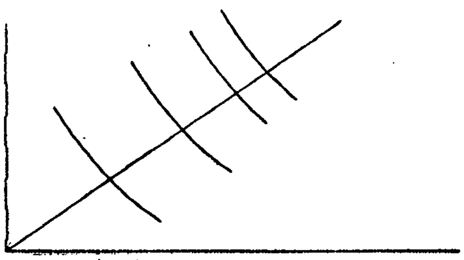
Capital intensity parameter $K' = \frac{1 - s}{s}$ = Antilog $\frac{\beta_0}{\beta_1}$

S.S.Mehta (1980), D.U.Sastry (1984), measured elasticity of substitution using some or all of these equations. They even used the equations dropping the variable time: t, to determine elasticity of substitution for time series data, that is, assuming no change in technological conditions.

Mehta has fitted regressions for the cotton textile industry as a whole, while D.U.Sastry has taken only the cotton mills sector.

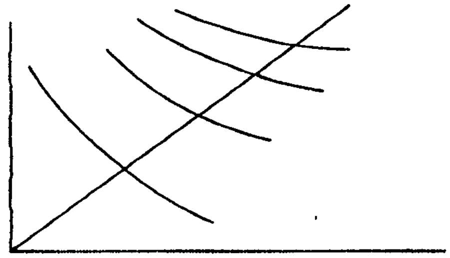
The above analysis reveal that the above regression equations in addition to perfect competition assumption also impose restrictions such as that the efficiency of labour and capital is assumed to increase at a constant rate during the period. The substitution parameter and economies of scale are kept constant throughout at a value equal to one. Due to these shortcomings, the above equations can only properly analyse cases like : the case in which Hicks neutral technical progress (as illustrated in Fig. 2.2) occurs, and the case where technological progress of one factor as compared to the other increases at constant rate during the period (as shown in Fig.2.3).

GRADUAL TECHNICAL PROGRESS OCCURRING RATHER THAN DISCRETE

K

L

(Fig.2.2)

HICK'S NEUTRAL TECHNICAL

K

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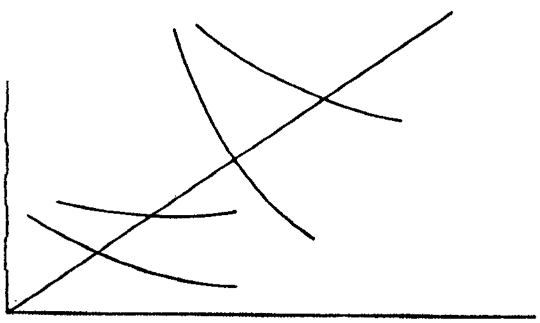
(Fig.2.3)

HICK'S NON-NEUTRAL PROGRESS
TECHNICAL PROGRESS
(i.e., at same rate during the time period)

However, the case of technological progress in which the relative efficiency of one factor goes on varying as compared with the other (Fig.2.4) cannot be properly analysed with equations of the type represented; equations 2.19, 2.20 and 2.21, some or all of which were employed by S.S.Mehta and D.U. Sastry.

K

L

(Fig.2.4)

TILTING OF CURVE WITHOUT ANY TREND

In addition, the above time series equations cannot deal with the case where curve changes shape (Fig. 2.5),It is possible to handle the type of case illustrated by Fig.2.5

only if different types of curves are fitted using cross-sectional data at different points of time.

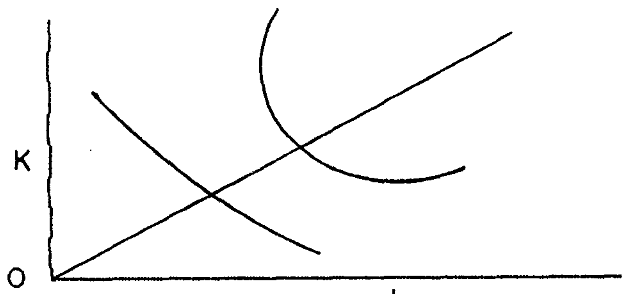


Fig.2.5.

Hence, a narrow form of technical progress may be dealt with using the above regressions equations. The deviations of a component from the assumed values could cause a bias in one direction in one period, and in another direction, in another period. It is not possible to predict the direction and magnitude of the combined effects of these components evev if they deviate only slightly from reality.

(C) The Variable elasticity of substitution production Function :

U. A. Kazi (1980)[37] used a variable elasticity production function for several Indian manufacturing industries. He argued that the omission of the capital-labour ratio from the C.E.S production function tended to produce both biased estimates and statistically poor fits generatiing low values of R^2. He used the following derived equation for the specific variable production function to determine technology parameters.

$$\log (V/L) = \log A + \beta_1 \log W + \beta_2 \log (K/L) + u \quad \ldots (2.22)$$

The corresponding equation obtained from the C.E.S production function is :

$$\log (V/L) = \log A + \beta_1 \log W + u \quad \ldots (2.23)$$

Here, V, L, W are value added, labour and the wage rate respectively.

$$\text{and } \beta_0 = \frac{1}{1+p}\left[\frac{A^p}{s}\right] \quad \text{and } \beta_1 = \frac{1}{1+p}$$

Kazi fitted the above regression equation for various industries for three digit classification. The adjusted R^2 value improved for some of cases. However, for cotton textile industry the adjusted R^2 value improved only from 76 to 78 percent for year 1975. This shows that improvement in the model is not effective for cotton textile industry.

Kazi made one improvement in the model equation 2.22 as compared to equation 2.23 based on the CES production funtion. This model can deal with cases of varying elasticity of substitution. If the coefficient of capital labour turns out to be zero, it becomes equivalent to the CES model. However, the regression equation is characterized by the other limitations such as the perfet competition and constant returns to scale assumptions. If these assumptions are violated then equation 2.22 based on the variable elasticity production function could misspecify the coefficients of the model.

2.2 Review of the methodologies used in the present study :

Kmenta's approximation to the CES production function model is used to analyse the long run production conditions in the cotton textile mills sector. Kmenta applied Taylor's series to the general form of CES production function,

$$V = A \left[sL^{-p} + (1 - s)K^{-p} \right]^{m/p} e^{u},$$

for cases when P approaches zero to transform it into the following linear form for regression analysis purposes

$$\log V = \beta_0 + \beta_1 \log L + \beta_2 \log K + \beta_3 \left| \log K - \log L \right| + u \quad \ldots (2.22)b$$

Here V, L, K are value added, labour and capital respectively. $\beta_0 = \log A$, $\beta_1 = ms$, $\beta_2 = m(1 - s)$, $\beta_3 = -1/2\, mps\,(1 - s)$. From these regression coefficients the technological parameters may be obtained using :

$$A = \text{antilog}\,(\beta_0), \qquad s = \frac{\beta_1}{\beta_1 + \beta_2}, \qquad m = \beta_1 + \beta_2$$

$$\text{and} \quad p = \frac{-2\,\beta_3\,(\beta_1 + \beta_2)}{\beta_1\,\beta_2}$$

The standard ever for these parameter could obtained from values obtained from values and coefficients of regression equation (2.22) using the following approximation :

If $\alpha = (\beta_1, \beta_2, \ldots, \beta_k)$ then the variance of α could be obtained from the variance of the coefficients $\beta_1, \beta_2, \ldots \beta_k$.

Then,

$$\mathrm{Var}(\hat{\alpha}) \approx \sum_{k} \frac{\delta f}{\delta \hat{\beta}_k} \mathrm{Var}(\hat{\beta}_k) +$$

$$2\sum_{j<k} \left[\frac{\delta f}{\delta \hat{\beta}_j} \right] \left[\frac{\delta f}{\delta \hat{\beta}_k} \right] \mathrm{Cov} \; |\hat{\beta}_j, \hat{\beta}_k|$$

$$j, k = 1, 2, \ldots, k$$

$$j < k \qquad \ldots (2.23)$$

This methodology enjoys several advantages over other methodologies on theoretical grounds. The model equation is a direct conversion of the CES production function into linear form by Taylor's theorem for cases where P is close to zero. Hene, the model is capable of estimating technology parameters from the logarithmic form of regression in which value added is taken as the dependent variable in formulations in which relations between factors of production directly stand as the independent variables. Hence, it directly give us technical parameters such as how labour and capital could be substituted, and what is the effect of increasing the amount of factors on production. Thus, it overcomes the limitation of other methodologies in which production relations are converted into linear regression form by taking the perfect competition assumption of equalisation of marginal products with factor prices. The latter methodologies are only appropriate in cases where there exist no rigidity constraints relating to existing capital and work force stocks.

The rigidity constraint parameter has a value of zero in cases where the present decisions about new investments do not depend upon the existing stocks. This condition hardly hold for cross-sectional data in Indian manufacturing industries. Hence, these methodologies could only be applied using time series data. However, the time period should be long enough that investment decisions are not affected by existing stocks. Otherwise, the parameters obtained would be misspecified in the presence of an intermediate type of rigidity constraint. However, it is difficult to decide the length of the period at which the rigidity constraint of existing stocks becomes zero. For example, in the cotton textile mills sector, some of the mills operate with machinery which has long crossed its normal life time, such as 40 years old equipment.[38] Moreover, to obtain data on the variables required for such a long period is difficult. Even the classification of industries, as well as the publication sources change during such long periods of time. Kmenta's methodology gives technical or long run parameters.

Another advantage of this model is that it determines all parameters of the production function endogenously from the data. Hence, the misspecification resulting from keeping some parameters constant at some specified value does not arise. The standard deviations for these parameters define the range within which they may vary for different observations. However, one should be cafeful that a very large standard deviation for a parameter could cause misspecification in the estimates for other parameters.

Hence, the Kmenta model seems quite suitable to express production conditions for different years in an industry, if applied to cross-sectional data. The advantage of applying it to cross-sectional data is that it could take account of every aspect of technological progress such as efficiency and economies of scale aspects of Hicks Neutral technical progress as well as of tilting and the changing shape aspects of Hicks Non-neutral technical progress. However, the structure of the industry understudy must satisfy the condition of the model that P lies close to one. Moreover, the variables required should be specified in a manner such that if used for production function analysis, they should express actual production conditions. The section which follows, deals with the specifications of variables and with the deflation method adopted to convert these variables into real figures at 1970-71 constant prices.

2.3 Specifications of variables, deflation method, sources of data, and time period of the study :

Value added 'V' : represents that part of the value of the product which is created in the factory by the factors of production. In the present study, the figures are deflated using the wieghted whole sale price-index of cotton cloth mill production, and yarn. However, the better method is to obtain the real figures by subtracting deflated gross inputs from deflated gross output figures, if the appropriation deflators are readily available. This method is better in the sense that the prices of intermediate inputs do not rise at the same rate as that of ouput. Moreover, this method gains specific importance for the cotton textile mills sector because of the continuous change in the composition of cloth and yarn production in total mills' production. The change is basically caused by structural changes in the cotton textile industry.

Fixed Capital Stock (K) :

Fixed capital comprises land, buildings including those under construction, improvements in land and other constructions, plant machinery and tools (including those not yet stated), transport equipment, and other fixed assets such as furniture, fixtures etc. It includes fixed assets under construction/installation, and assets at head office allocable to the factory.[39]

The book value of the stock of fixed capital includes several combination of machines of different ages.

It is very difficult to arrive at a current index of machine quality. Most studies simply avoid the complications and arrive at it by simply deflating the current stock of capital by the relevant deflator. However, Goldar[40] adopted a much better technique. He estimated it by perpetual inventory method.

$$K_t = I_t + (1 - S)K_{t-1}$$

where, K_t and K_{t-1} are the deflated capital stock at the end of year t and t-1 respectively; I_t is the addition to capital stock during year t at constant price, and S is the rate of replacement.

The present study also adopts a perpetual inventory method similar to Goldar's method to deflate capital stock. The deflator used is the wholesale price index of textile, jute machinery and stores.

Number of persons employed (L) :

The average number of persons employed by each factory under various heads such as workers, other than workers, and so on, is computed by taking the total attendance of persons in all shifts on all working days and dividing this by the number of days worked. These averages are aggregated over all factories in the state or industry as the case may be and the aggregate is taken as number of persons employed in the state or industry, respectively.[41]

This specification of the work force is preferred to workers because it also includes workers holding supervisory or managerial positions engaged in administrative, office, store keeping section and welfare section, sales department as also those engaged in purchase of raw materials and so on. It is also preferred to the man days specifications because man days represent the average number of man days worked during the shift and not during the day. However, the capital stock is available for twenty four hours in a day and hence capital labour ratio could change not only by changing the number of persons employed in the same shift but also by changing the number of shifts in a day. This specification only covers one possible aspect of substitution between factors of production, i.e., of changing the numbers of employees in the same shift. However, the number of employees covers both aspects and hence is a better specification to represent production conditions in an industry such as substitution between factors of production, through the parameters of the production function.

Total Emoluments (W) :

Total emoluments include all types of payments to employees (comprising workers, administrative staff, store keepers and welfare section employees), including the imputed value of benefits in kind. Hence, it is a better specification than is wages, to represent the share obtained by employees in value added. Total emoluments is also called here the 'wage bill'. The share of employees in value added is obtained by dividing total emoluments by value added. The wage rater per employee is defined as the ratio of total emoluments to the number of employees. Similarly, the rental rate is obtained by dividing the remaining value added other than total emoluments by the amount of real fixed capital stock.

The wage rate and rental rate over a period of time may be looked at from two angles. One is whether the entrepreneur is paying more now per unit of capital and labour employed as compared to an earlier period. The real figures for this purpose are obtained by deflating the wage rate and rental rate with the same index used for value added. The real figures obtained in this way for the wage rate and rental rate are called product wage rate (W) and product rental rate (R) respectively. These real figures are used for production function regression analysis to represent production conditions in the industry. However, to obtain a view of workers' real income, the wage rate has to be deflated using the consumer price index for industrial workers in selected centres.

Data Sources :

The Annual Survey of industrial reports for the years 1973-74 to 1981-82 is the main source of data. The whole sale price index series and the Reserve Bank of India Bulletin for different years are used to obtain or generate the various wholesale and consumer price indices used to convert the value variables into 1970-71 constant prices.

The following fifteen states or union territories are taken for the purpose of analysis : Andhra Pradesh, Bihar, Gujarat, Haryana, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal and Pondicherry. The states taken are those for which data for most of the years during the period of study is available.

CHAPTER-3

PRODUCTION CONDITIONS IN THE COTTON TEXTILE MILLS SECTOR

Technology is defined here as a set of combinations of techniques. These techniques operate at different scales and capital-labour ratio's during a period. The capital-labour ratio could be changed by adopting different combinations of machines or by changing capacity utilisation for a given set of machines or by changing both combinations. The capacity utilisation of a set of machines could be affected either by changing the number of shifts in the day or by changing the number of labourers employed in the shift or by changing both for that set of combinations of machines. Thus, the technology as described by production function parameters obtained using interstate cross sectional data may describe the production conditions in the cotton textile mills sector.

This chapter is divided into four parts. The first part deals with the analysis of the results based on a methodology which assumes that factors are employed according to their direct marginal costs. The second part mainly deals with an explanation of why this kind of methodology is not suited for the purpose of the present study. An account is given of the reasons for the dependence of relative direct and indirect marginal costs on relative amount of factors employed. The third part deals with the analysis of the results generated by applying Kmenta's approximation to the CES production function. The chapter concludes with the analysis of the main findings.

3.1 Regression analysis based on the assumption of perfect competitions :

The methodology adopted here is based on the derivation of CES production function under the condition that factors are applied according to their marginal costs. The regression fitted is based on the following production function form

$$V = A \left[SL^{-p} + (1 - s)K^{-p} \right]^{-1/p}$$

using interstate cross-sectional data.

The derived form of equation in which regression is filled is: $\log (K/L) = \beta_0 + \beta_1 \log (w/r)$

Here, (K/L) and (W/r) are the deflated capital-labour and productive wage-rental ratios for different states during the period.

$$\beta_0 = \frac{1}{1 + p} \log \frac{1 - S}{S}$$

and β_1 (elasticity of substitution) $= \dfrac{1}{1 + p}$

This particular derivation from CES production function based on perfect competition assumption is choosen because it requires both labour and capital to be applied according to their direct marginal costs. Hence, this method is appropriate to discover the degree of deviation from perfect competitions conditions. Table 3.1 Shows the results of regression analysis based on perfect competition assumptions.

Table 3.1

Inter state cross sectional Regression analysis based on perfect competition assumptions

Year	Constant term β_0	Elasticity of Substitution β_1	Adjusted R^2
1974-75	-4.292	- .3773767	.0238
1975-76	-3.279	+ .0356908**	.2494
1976-77	-2.888	.1356868	.0004
1977-78	1.674	.457729**	.0686
1978-79	1.705	- .0056449*	.3822
1979-80	1.590	- .2951786**	.0000
1980-81	2.406	- .3812491*	.2607
1981-82	-3.236	.2580273	.3660

** indicates significantly different from zero at 5 per cent level of significance.

* indicates significantly different from zero at 10 per cent level of significance. (two tailed test).

Dividing the constant term by β_1 and taking its antilog gives us the relative share of capital with respect to labour. Once $\frac{1 - S}{S}$ is found, one could obtain the contributions of of capital and labour to value added in the production process.

Adjusted R^2 value for this fit is very low. This is a clear indication that the above equation fitted to determine the parameters of technology is not appropriate. The values of adjusted R^2 for different years varies a lot and lie between zero and 38 percent. The very low value of adjusted R^2

suggests the possibility that some important variable is left out. The variations which are caused by the missing variables are sought to be explained by direct marginal costs, i.e., Wage-Rental ratio and hence the coefficient of regression obtained are misleading.

C.P. Chandershekhar's[39] analysis led to the conclusion that investment in new projects depends not only on direct marginal costs but also on indirect marginal costs. However, no attempt has been made so far to determine the magnitudes of indirect as well as direct marginal costs in the cotton textile mills sector in India. An analysis is possible using Brown and de Cani's short run model, as described in the next subsection.

3.2 Degree of dependence of quantities of additional factor employed on direct marginal costs :

(a) Brown and de Cani's Model :

Brown and de Cani's[42] begin from the assumption that the past history of the capital-labour price ratio, as well as the current factor price ratio, is relevant to the determination of the current capital-labour input ratio. They denoted the ratios at time points as P_0 is the labour wage capital price ratio at time t, t_{-1} is the value of the ratio one period prior to t; similarly U_0 is influenced not only by P_0 but also by P_{-1}, P_{-2}, P_{-3}, ••• . Variations in the current factor-price ratio may be very influenctial in eliciting variations in the current capital labour - input ratio. In this case it means that it is not difficult to substitute labour for capital in the current period in response to changes in current relative factor prices. On the other hand, if changes in U_0 are somewhat insensitive to variations in P_0, then it is difficult to substitute labour for capital in the current period in response to changes in relative factor price. It follows that the more the past history of the factor-price ratio affects the current factor input ratio, the more resistant to change will be installed capital-labour ratio to current changes in the relative factor-price ratio. This is called rigidity of the existing stock capital labour ratio.

They described a historical stream of factor-price ratios, whose variations influence the current factor-input ratio, by a distributed lag of the following type :

$$P = P_0 \; P_{-1}^{\Lambda} \; P_{-2}^{\Lambda^2} \; \ldots \; P_{-n}^{\Lambda^n}, \qquad (3.2)$$

Where P is called the 'decision based' factor-price ratio. It is the factor price ratio that determines the proportions of capital and labour in the production process. The constraint Λ is restricted, the interval $0 \leq \Lambda \leq 1$. Equation (3.2) posits that the effect of the factor price ratios decreases geometrically the further hack they are in the past. Now, if $\Lambda = 0$, then $P = P_0$, and the decision based factor-price ratio depends only on the current factor-price ratio. This is a multiplicative version of the well-known distributed log introduced by L.M. Koyck.

From an economic point of view, the coefficient /\ is interpreted as the degree of rigidity of substitution of the installed equipment in response to a change in the current factor-price ratio. Thus, if /\ = 0, then the decision-based factor price ratio, P, is solely determined by the current factor-price ratio, P_o; in effct the installed equipment offers little resistance to a change in factor proportions solely in response to changes in the current factor-price ratio. Clearly, the degree of resistance is represented by the size of /\; called the rigidity parameter'. "Ignoring all psychological and institutional limitations on the variations of the factor input ratio, the rigidity parameter is technologically determined." Hence, the less durable types can be more easily substituted for labour at given outputs than the more durable types.

The distributed log (3.2) can be combined with the expansion path function (3.3) :

$$u = K'^{-\sigma} p^{\sigma} \qquad (3.3)$$

where, u = K/L, the inputs of capital relative to labour and $K' = \frac{1 - S}{S}$ is the capital intensity parameter.

To obtain, $u_0 = K'^{-\sigma} (P_0 \; P_{-1}^{\lambda} \; P_{-2}^{\lambda^2} \; \ldots \; P_{-n}^{\lambda^n})^{\sigma}$ (3.4)

This states that the current factor ratio depends on the relative capital-intensity parameter, the elasticity of substitution, the rigidity parameter, and on the current and historical factor-price ratio. If (3.4) is lagged one period and raised to the λ^{th} power, one obtains

$$u_{-1} = K'^{-\sigma \lambda} \; (P^{\lambda}_{-1} \; P^{\lambda^2}_{-2} \; \ldots P^{n+1}_{-(n+1)})^{\sigma} \quad (3.5)$$

Dividing (5) by (4) produces

$$u_0 = K'^{-\sigma(1-\lambda)} \; P_0^{\sigma} \; u_{-1}^{\lambda} \quad (3.6)$$

Equation (3.6) is the short-run form of the expansion path function. To simplify the exponents (3.6) can be rewritten as :

$$P_0 = K'^{(1-\lambda)} \; (u^{1/\sigma}) \; (u_{-1}^{-\lambda/\sigma}), \quad (3.7)$$

so that the short-run relative capital intensity parameter is $K'^{(1-\lambda)}$, and the short-run substitution parameter is $= 1 - 1/\sigma$. Hence, the short-run CES production function which corresponds to (3.7) is

$$V = A \left[S^{(1-\lambda)} \; L^{-\rho} + (1-s)^{(1-\lambda)} \; K \right]^{-m/e} \quad (3.8)$$

In order to obtain estimates of parameters of production functions, the following equation is fitted to data by the method of least squares.

$$\log K/L = \sigma \; (1-\lambda) \log K' + \sigma \log w/r + \lambda \log (K/L)_{-1} \quad \ldots (3.9)$$

From the parameters of equation (i.e., the short-run expansion path), the long run parameters can be obtained.

The long-run production function that corresponds the long-run expansion path function is

$$V^* = A \left[SL^{-\rho^*} + (1-S)K^{-\rho^*} \right]^{-m/\rho^*}$$

Where V* is long-run contribution to output, i.e., the value added toward which the system would tend given the constraint of the existing fund of technical knowledge and the inpouts L and K. The V* is derived with no restrictions on substitutions of the existing capital.

The short-run capital intensity parameter is $K'^{(1-\Lambda)}$ and the long-run parameter k',

Short-run substitution parameter and the corresponding long-run parameter is $p^* = -(1 - \frac{1-\Lambda}{\sigma})$.

One property of the model is that the short-run elasticity of substitution parameters can never be larger than the long-run σ. However, it is not assumed that the short-run σ is zero. It could take any value, empirically, although one expects it to be small. This contrast denoted by a difference between the long-run and short-run elasticity of substitution and intensity parameter do not signify a technological change. The technology is the same in both time periods. They tell the path which production takes to reach the optimum use of the prevailing technology. The difference between V and V^* represents the cost of having on hand a capital stock that resists change in response to changes in factor prices, i.e., it represents the cost of a certain kind of economic inflexiblity.

Limitations of the Model :

Firstly, any deviation of the above equation from the least square assumption could cause erros in the estimation of the parameters of side relations. An important source of bias in the estimates of parameters of the side relations may be the degree of conclusion of the residuals in equation (3.9) with the explanatory variables (w/r) and $(K/L)_{-1}$.

Secondly, the effect of neglecting the impact of direct Government controls may cause misspecification of the model.

3.2b **Application of the Brown and de Cani Model :**

The model has been used here for the specific purpose of estimating the importance the rigidity constant and hence to estimate the possibility of factor substitution between capital and labour in the short-run. The latter is called the substitution parameter for the short-run. Table-3.2 shows the estimates of the parameters using interstate cross-sectional data for year-to-year analysis in derived equation (3.9).

$$\log K/L = \beta_0 + \beta_1 \log (W/R) + \beta_2 \log (K/L)_{-1}$$

Here, K/L and $(K/L)_{-1}$ is capital-labour ratio of current year and lagged year. $\frac{w}{r}$ is productive wage-rental ratio for different states.

$$\beta_0 = \sigma(1- \Lambda) \log K'$$

$$\beta_1 = \sigma(\text{short-run elasticity of substitution.})$$

$$\beta_2 = \Lambda \text{ (rigidity parameter.)}$$

TABLE 3.2 Results of interstate cross-sectional regression analysis based on assumption of rigidity constraint.

Year	β_0 $\sigma(1- \Lambda)$ log K'	β_1 Short-run elasticity of subst.	β_2 rigidity parameters	Adjusted R^2
1974-75	-0.169347	.0047078	.9680***	.9088
1975-76	.257555	.0107532*	.8066***	.8917
1976-77	.3023	.0350037	.7828***	.5466
1977-78	.414908*	-.1049655	.9338***	.8383
1978-79	-.008903	.1404657	.8763***	.8306
1979-80	-.241194	.0598788	.8209***	.7918
1980-81	.235544	-.0262336	.9778***	.9201
1981-82	.224532	.0000301	.9300***	.7208

*** indicates significantly different from zero at one percent level of significance.
** indicates significantly different from zero at five percent level of significance.
* indicates significantly different from zero at ten percent level of significance.

The regression based on equation (3.9) seems to be much better suited than that based on equation (3.1). The value of adjusted R^2 improved tremendously from a range of merely zero to 38 percent to 54 to 92 percent. However, the negative values obtained the short-run elasticity of substitution parameters for two of the years, 1977-78 and 1980-81, cautions us that there is a possibility of misspecification in estimators even for other years caused by the limitations of the model discussed earlier.

Hence, the interpretation of the results of the model should be done keeping in mind these limitations. The broad analysis should be drawn from all the year's parametric value and the year to year fluctuations in parameters should not be given much importance.

The tremendous improvement in the value of adjusted R^2 for equation (3.9) may be indication of the fact that indirect marginal costs are an important variable in determining the relative factor proportion. The more important are indirect marginal cost, the more will be the constraint for new investment in response to change in factor price. The importance of the indirect marginal costs are shown by rigidity parameter. The indirect marginal costs include the cost of making old capital stock discarded as well as cost of retrenchment.

However, the degree of dependence of investments or the capital labour ratio on direct and indirect marginal costs, combined as well as separate vary from year to year. The range of variations in the combined effect is large and may be judged from variations in adjusted R^2 values, i.e., 54 to 92 percent.

The model explains that the degree of importance of indirect marginal cost in total direct and indirect marginal costs is indicated by the variations in rigidity parameters. The rigidity parameter obtained is found to be significantly different from zero at one per cent level of significance for all years. Its value lies in the range of .7828 to .9778 for different years.

Hence, the model explain that the past factor stock acts as constraint in 78 to 97 per cent of case despite the price incentives are high enough to cover direct marginal costs. The importance of this rigidity constraint vary depending upon the importance of previous capital-labour stock and the magnitude of the change in the current factor price ratio.

The very high rigidity constraint is the cause of very low values of elasticity of substitution in the model. The value of elasticity of substitution vary from 0 to 14 for different years. This means that the capital-labour ratio respond very less to variations in factor price ratio.

The economic interpretation for low value of short-run elasticity of substitution parameter is that only a very few mills, which adopt costly and sophisticated machinery are able to cover both the direct as well as the indirect costs of upgrading technology. These mills face the demand from the upper segment of the population, who are basically concerned about the change in quality of the product and not the change in prices. However, to bring quality change requires investment in new machinery. Hence, variations in the capital-labour ratio for the mills facing the type of demand structure is not hindered by the rigidity constraint.

However, in other mills facing demand from the relatively poor segment, who are basically concerned about changes in prices or for whom the price elasticity of demand is high, it is very difficult to cover both indirect and direct marginal costs. Hence, the type of demand structure prevailing in the cotton textile industry has caused most of the mills to operate with obsolete technology.

This rigidity characteristic of the textile industry makes investment very incensitive to price changes. Unless, these price change incentives are enough to cover both direct and indirect marginal cost, new investment would not take place.

3.3 PRODUCTION CODITIONS IN COTTON TEXTILE MILLS SECTOR.

A production function may expres the production conditions in the cotton textile industry for each of a series of years over a period of time. However, the crucial factor in the choice of a production function is the elasticity of substitution parameter. The growth and vairations in the share of emoluments in value addes, and the deflated capital labour ratio should be carefully examined in order to decide the appropriate production function.

This is based on the idea that in the case where the elasticity of substitution is one, market conditions ensures that the share of emoluments in value added will be constant despite changes in factor proportions.

3.3 (i) GROWTH AND VARIATIONS IN THE SHARE OF EMOLUMENTS IN VALUE ADDED AND THE DEFLATED CAPITAL-LABOUR RATIO.

The growth rate, variations and mean value of share of emolument in value added presented in table 3.3 were computed alongwith the growth rate, variations and mean value of the deflated capital-labour ratio for the years 1973-74 to 1981-82 for fifteen states in order to determine whether or not there is any apparent relation between these variables.

The growth rate in the share of emolument in value added is insignificant for all the fifteen states for which it is calculated. However, the trend is positive for fourteen states. There is no correlation of these trends with either the growth rate of the deflated capital-labour value or of its mean value. Most states exhibit a very high and significant growth rate of the deflated capital-labour ratio over the period 1973-74 to 1982-83. Kerala, Madhya Pradesh, Maharashtra and Punjab are among the states which recorded the highest growth rates of the deflated capital-labour ratio. Madhya Pradesh, Andhra Pradesh and Bihar are the states where the mean value of the deflated capital-labour ratio was highest.

The insignificant growth rate in the share of emoluments in value added, alongwith the high growth rate of the deflated capital-labour ratio suggest that the elasticity may be close to one. The structure changes in the cotton textile industry may be one of the cause for this rise in deflated capital labour ratio. However, there may be two other reasons for the highly significant growth in the capital-labour ratio for most of the states. First of all, the demand from the upper income groups of the population could be maintained, if they have been offered continuous quality changes in the product. This requires modern and sophisticated types of machinery which are generally capital intensive as compared to existing technology. One indirect benefit of such a shift in technique is obviously that modern sophisticated machinery is generally less dependent on labour and hence the power of workers union tends to get reduced. However, the effect of this on the share of emolument in value added may not be significant due to increases in per unit worker cost caused by the need for more skilled workers to cope with the sophisticated machinery and the challange to management involved is efforts to sell the product of sophisticated machinery.

Table 3.3 : Growth rate, mean value and variations in share of emoluments in value added and deflated capital-labour ratio over the period 1973-74 to 1981-82 for different states.

STATE (1)	Growth rate of share of emolument in value added 1973-74 to 1981-82 (2)	Mean value of share of emoluments in value added from 1973-74 to 1981-82 (3)	Coeff. for variations for share of emoluments in value added from 1973-74 to 1981-82 (4)	Growth rate deflated k labour ratio from 1973-74 of 1981-82 (5)	Mean Value of defalted capital labour ratio (Rs/employee) from 1973-74 to 1981-82 (6)	Coeff. of variation of deflated capital-labour from 1973-74 to 1981-82 (7)
Andhra Pradesh	1.11	.6568	29.08%	7.37***	6.35	19.73
Bihar	2.89%	.7965	52.15%	7.49**	4.70	30.98
Gujrat	1.94	.6419	11.15%	5.91***	4.96	24.21
Haryana	2.09	.7470	27.96%	2.38	5.16	22.36
Karnataka	1.14	.6435	20.12	7.81***	4.28	27.63
Kerela	.75	.6183	23.34	10.69***	7.01	19.49
Madhya Pradesh	1.62	.7653	14.84	10.75***	2.70	50.50
Maharashtra	.0061	.6919	16.54	11.00***	4.52	30.70
Orissa	3.07	.8328	48.88	8.14***	4.30	30.75
Punjab	.091	.4604	22.76	11.98***	5.15	27.89
Rajasthan	1.16	.6383	16.92	6.62***	5.54	22.59
Tamil Nadu	.0028	.6202	22.99	8.17***	5.82	22.00
Uttar Pradesh	.792	.7786	13.73	6.14***	5.01	25.92
West Bengal	.80	.8545	9.91	7.32**	3.27	38.39
Pondicherry	2.52	.7521	18.40	2.23	3.16	35.94

Growth rates are obtained using regression based on the equation $y = ab^t$.

* indicates significantly different from zero at 10% level.

** indicates significantly different from zero at 5% level.

*** indicates significantly different from zero at 1% level.

In the second place, the continuous adoption of modern technology in a few mills causes the machinery in other mills which are not capable of adopting sophisticated technology to become obsolete. This causes excess capacity in the mills producing products of low quality in a context in which there has been a continuous shift in the product demand pattern from inferior to superior products. The under utilization of capacity in these mills cause high capital-labour ratio. One effect of these shifts may be a rise in share of emoluments in value added. This excess capacity may cause the closing down of a few mills of this kind resulting in a fall in the share of emoluments in value added, other things remaining same.

The observed variations in the share of emoluments in value added around their mean value, without any significant grwoth rate despite the rapid growth in the deflated capital-labour ratio are the combined outcome of the above factors. The coefficients of variation in the share of emoluments in value added in the range 11.15% to 48.88% for different states over the period. The coefficients of variation for states in which the cotton textile industry is most concentrated are Maharashtra (16.54%), Tamil Nadu (22.99%), and Gujrat (11.15%).

The wide variations observed in the value of the share of emoluments in value added for each stae in the absence of any significant growth rate over the period despite the high growth rate in the deflated capital-labour ratio are an indication that the value of the elasticity of substitution fluctuates around the value one. The growth rate in the deflated capital-labour ratio in some cases is as high as 12% per annum.

The above findings ruled out th applicability of the variable elasticity of production function despite the fact that the value of the elasticity of substitution seems to be continuously changing. This is because a variable elasticity of substitution model is appropriate only in the case where the share of emoluments shows some definite correlation with the value of the deflated capital-labour ratio. The Cobb-Douglas production function is appropriate only in cases in which the elasticity of substitution is one and hence is incapable of dealing with cases of non-neutral technical progress in which the contribution by factors of production in the value added changes.

Kmenta's approximation to the C.E.S production function seems appropriate in this case because of its ability to deal with cases having values of elasticity of substitution close to one. This method is able to approximate variations in value of the elasticity of substitution with the help of estimates and variations of coefficients of regression of the model. Moreover, the method has one otherdefinite advantage, which no other mehod has, in that it is able to estimate parameters of technology by directly taking value added as dependent variable in formulations in which relations between factors of production stand as the independent variable. On the other hand, in other methodologies, production relations are converted into linear regression form by taking the perfect competition assumption of equalisation of marginal productivities with factor prices. In addition, they exogenously take values for some of the parameters.

3.3 (ii) Methodology based on Kmenta's approximation to CES production function :

This model is used to measure different production conditions such as economies of scale, efficiency, relative contribution of labour and capital and long run elasticity of substitution in cotton textile mills sector for year to year interstate cross-sectional data. The regression fitted for the purpose is Kmenta's approximation to CES production function :

$$\log V = \beta_0 + \beta_1 \log L + \beta_2 \log K + \beta_3 (\log K - \log L)^2$$

Here V, L and K are value added, labour and fixed capital varibale.

$$\beta_0 = \log A \qquad \beta_1 = m\ s \qquad \beta_2 = m(1-s)$$

$$\beta_3 = \frac{-1}{2}\ m\ e\ s\ (1-s)$$

The equation is derived from the general form of CES production funtion :

$$V = A \left[S\ L^{-e} + (1-s)K^{-e} \right]^{-m/e}$$

as explained in the 2nd chapter of the present work.

The equation can be separated easily into two parts, one corresponding to the Cobb-Douglas production function and one represenging "Correction" due to the departures of p from zero. The latter part of the equation,

$$(-) \frac{1}{2} m\ p\ s\ (1-s) \left[\log L - \log K \right]^2$$ will disapper if p = 0.

This regression gives us an entirely different kind of elasticity of substitution parameter than the short-run elasticity parameter obtained by Brown-de Cani's equation. The short-run elasticity of substitution parameter tells us that what could be the expansion path for the firm in the short-run , if there occurs a relative change in relative factor prices. In the long run the rigidity constraint, /\ becomes zero. Kmenta's approximation to CES production function will provide the long run parameters of technology are technical parameters. Table 3.4 shows the coefficient of regression based on Kmenta's approximation of CES production function.

TABLE 3.4 - Coefficients, adjusted R^2 and number of observations interstate cross-sectional Regression analysis based on Kmenta's approximation to CES production function.

Year	β_0 Antilog A	β_1 m(1-s)	β_2 ms	β_3 -½ pms(1-s)	Adj. R^2	No. of obsrv. n
1974-75	-4.1617***	.2125	.3717	.00916	.9945	14
1975-76	-5.2219***	.3178	.8876	-.33024	.9666	15
1976-77	-4.6228***	.3003	.8278	-.14446	.9788	15
1977-78	-4.7031***	-1.1445	2.3412	0.53573	.9811	14
1978-79	-4.6161***	.3281	.8038	-0.05049	.9808	15
1979-80	-2.9474***	-1.8048	2.9176	.73037	.9875	14
1980-81	-3.0441***	-2.0821	3.2228	.79354	.9875	14
1981-82	-5.2401**	.4554	.6930	-.01693	.9778	14

*** indicates significantly different from zero at one percent level of significance.
** indicates significantly different from zero at five percent level of significance.

From the values of adjusted R^2, the regression seems quite satisfactory fitted for the purpose. The adjusted value of R^2 is more than 96 percent for all the years. However, in the years 1977-78, 1979-80 and 1980-81 the coefficient of log capital have negative values. This means that either that the contribution by capital in the production process, or economies of scale is negative. This is just not possible.

The possible cause of these unacceptable estimates may be:

Either that the data for these years is defective, which is quite likely because for the years 1977-78 and 1980-81, the resulsts are also unacceptable for Brown and de Cani's model. This possibility was checked by comparing the ASI data used with CSO National Accounts Statistics reports which publish revised estimate for ASI data. The comparison did not reveal any major difference form the original ASI estiamtes for these years. Secondly, the problem may be caused because there exists wide interstate contrasts for specified variables including capital and labour as is clear from the column 6 of Table 3.3. The estimate of regression were obtained using these variables by systematic compuer "trial and error". In a nutshell, the computer substitute alternative values of the parameter into the function, calculates the value of the function, and repeats this process until one well defined estimate is obtained. However, in the case when there exists substantial inter state differences a slight error of measurement or an error of rounding might shift the values quite markedly. These problems of estimation by the trial and error method in the presence of both interstate variations and possibility of multi-collinearity problems caused by a high correlation of capital and labour vairables in the regression may be the cause of the unacceptable results for some years. Hence, the unacceptable estimates obtained for these years warns us of the possibility of misspecification in estimations for other years as well. Therefore, the interpretation of the results of the model should be done keeping in mind these limitations. The broad analysis should be drawn from all the values of the parameters of all the years and the year to year fluctuations in the parameter should not be given much importance.

The technology parameters could be obtained from the regression coefficients of Kmenta's approximation to the CES production on function using the following procedure :

$$A = \text{Antilog}\ (\beta_0), \quad 1-S = \frac{\beta_1}{\beta_1 + \beta_2}$$

$$m = \beta_1 + \beta_2, \qquad p = \frac{2\ \beta_3(\beta_1 + \beta_2)}{\beta_1\ \beta_2}$$

The variance for these parameters is obtained from regression coefficients and their standard deviations using the following approximation[44] -

$$\text{Var}\ (\hat{\alpha}) \sim \sum_k \left(\frac{\delta f}{\delta \hat{\beta}_k}\right)^2 \text{Var}\ (\hat{\beta}_k)$$

$$+ \quad 2 \sum_{j<k} \left[\frac{\delta f}{\delta \hat{\beta}_j}\right] \left[\frac{\delta f}{\delta \hat{\beta}_k}\right] \text{Cov}\left[\hat{\beta}_j,\ \hat{\beta}_k\right]$$

$j,k = 1,\ 2,\ \ldots\ k$
$j<k$

Hence, the variance for the technology parameter would be:

For A :

$\beta_0 = \log A$ or $A = e^{\beta_0}$

$$\text{Hence,} \quad \text{Var}\ (A) = \left[\frac{\delta}{\delta \beta_0} e^{\beta_0}\right]^2 \text{Var}\ (\hat{\beta}_0)$$

$$= e^2\ \beta_0\ (\text{Var}\ \hat{\beta}_0)$$

For m : $m = \hat{\beta}_1 + \hat{\beta}_2$

$\therefore$ Variance of m = $V(\hat{m}) = Var(\hat{\beta}_1) + Var(\hat{\beta}_2) + 2\,cov(\hat{\beta}_1, \hat{\beta}_2)$.

For S :

$$S = \frac{\hat{\beta}_1}{\hat{\beta}_1 + \hat{\beta}_2}$$

Hence,

$$Var(\hat{S}) = \left[\frac{\hat{\beta}_2^{\,2}}{(\hat{\beta}_1 + \hat{\beta}_2)^4} \right] Var(\hat{\beta}_1) + \left[\frac{\hat{\beta}_2^{\,2}}{(\hat{\beta}_1 + \hat{\beta}_2)^4} \right] Var(\hat{\beta}_2) - \frac{2\,\hat{\beta}_1\,\hat{\beta}_2}{(\hat{\beta}_1 + \hat{\beta}_2)^4}\,Cov(\hat{\beta}_1, \hat{\beta}_2)$$

For p :

$$= \frac{-2\,\hat{\beta}_3\,(\hat{\beta}_1 + \hat{\beta}_2)}{\hat{\beta}_1\,\hat{\beta}_2}$$

Hence,

$$Var(\hat{p}) = Var(\hat{\beta}_1)\left[\frac{\delta f}{\delta\hat{\beta}_1}\right]^2 + Var(\hat{\beta}_2)\left[\frac{\delta f}{\delta\hat{\beta}_2}\right]^2 + Var(\hat{\beta}_3)\left[\frac{\delta f}{\delta\hat{\beta}_3}\right]^2 + 2\,\frac{\delta f}{\delta\hat{\beta}_1}\,\frac{\delta f}{\delta\hat{\beta}_2}\,Cov(\hat{\beta}_1\ \hat{\beta}_2) + 2\,\frac{\delta f}{\delta\hat{\beta}_2}\,\frac{\delta f}{\delta\hat{\beta}_3}\,Cov(\hat{\beta}_2\ \hat{\beta}_3) + 2\,\frac{\delta f}{\delta\hat{\beta}_3}\,\frac{\delta f}{\delta\hat{\beta}_1}\,Cov(\hat{\beta}_3\ \hat{\beta}_1)$$

Table 3.5: Technology parameters obtained from interstate cross sectional regression analysis using Kmenta's approximation to CES production.

Year.	Efficiency parameter A	Economies of scale m	Contribution capital in (1-S)	Contribution of labour S	Substitution parameters p
1974-75	0.01558 (.00608)	1.0843 (.02414)	0.1960 (.56075)	0.8039 (.56075)	- 0.1072 (2.79484)
1975-76	0.00539 (.00609)	1.2054 (.09132)	.2636 (1.46024)	0.7363 (1.46024)	2.8220 (16.585)
1976-77	.00982 (.01120)	1.1282 (0.0453)	0.2662 (1.2372)	0.7337 (1.2372)	1.31097 (8.305107)
1978-79	0.009891 (.01084)	1.13207 (.042696)	0.2899 (1.3284)	0.71009 (1.3284)	0.4333 (5.6299)
1981-82	0.005299 (0.0077)	1.148528 (0.05573)	0.39654 (2.0516)	0.603454 (2.0506)	0.123210 (4.9942)

Parametric alongwithing thier standared deviation (in brackets).

With the help of these parameter and their standard deviations the following four types of analysis could be done:

i. a test for the existence of economies of scale.

ii. the measurement of coefficients of variation in the efficiency parameters in order to analyse the difference in efficiency in different states.

iii. the measurement of coefficient of variation in the capital intensity parameter in order to analyse the difference in the set of combinations of machines and capacity utilisation of these sets in different states, and

iv. a test of whether or not the substitution parameter is different from zero.

The results of the analysis are presented below :

(1) Whether there exists economies of scale in the cotton textile mills sector :

The null hypothesis for this purpose is taken as that there exists constant returns to scale and the alternative hypothesis as; that there exists economies of scale.

$$H_0 \quad m = 1$$
$$H_1 \quad m > 1$$

The alternative hypothesis is not rejected, if the computed value of $\frac{m - 1}{\sqrt{v}}$ is positive and greater than the tabulated t value. The calculated value turns out to be greater than the tabulated t value at the one percent level of significance for all years (one tailed test). This indicates that there exist ecnomomies of scale in the cotton textile mills sector for all years.

(ii) Efficiency Parameter of Technology A :

The analysis of Table 3.5, reveals that the hypothesis that efficiency parameter is greater than zero is not rejected for only initial year at 5% level of significance. This means that this value of efficiency parameter varies a lot from one state to another. Hence, it is difficult to say with certainty that the efficiency is declining, from the declining trend of efficiency values shown in Table 3.6. Table 3.6 shows quite high values for the coefficients of variation for the efficiency parameter for cross-sectional data for various years. This means that the efficiency of different states varies over a wide range.

TABLE 3.6: Efficiency Parameter & its Coefficient of Variation

Year	1974-75	1975-76	1976-77	1978-79	1981-82
A	.1558**	.00539	.00982	.009891	.005299
C.V (in %)	39.05	39.12	114.04648	109.64133	183.637

** indicates significantly greater than zero at 5% level of significance.

The exact value of the efficiency parameter could lies within a wide range depending upon the range of variations. The high interstate variation are because in each state there exists different sets of combinations of machines whose efficiencies differ quite a lot.

The value of the efficiency parameter seems to be declining from one year to the next. However, this cannot be said with certainty, because of high interstate differences. This may be due to an increasing number of sick mills, and hence decline in capacity utilization over the period. The capacity utilization declined tremendously from 1974 to 1982.[45] The decline in capacity utilization forces mills to operate at a non-optimal capital-labour ratio, and hence is the cause of less contribution to output than the previous year.

iii) Capital Intensity or Relative Contribution of Capital and Labour in the Production Process :

It seems that though the value of capital intensity parameter are increasing from one year to the next over time, it does not satisfy test of significance in that it is different from zero for any of the years. This means that value of capital-intensity parameter vary a lot from one state to another. Table 3.7 shows the value and coefficients of variation for the intensity parameter for cross-sectional data for various years.

TABLE 3.7 Capital intensity & its coefficient of variations.

Year	1974-75	1975-76	1976-77	1978-79	1981-82
Capital Intensity Parameters	.2438	.3580	.3628	.4082	.6571
Coeff. of Variation for Relative Share of Capital and labour	230.00	407.88	341.01	325.42	312.22

The high standard deviation means that the exact value of the capital intensities for different states could lie anywhere within the range of variation. the wide variations are caused mainly by the fact that entirely different types of techniques are used in different states. These states use different sets of combinations of machines which are operated at different capacitities. This difference in the production process in different states causes difference in the relative contributions of labour and capital to the production process.

(iv) Substitution Parameter (P) :

The hypothesis to be tested in relation to the substitution parameter is whether it is significantly different from zero or not.

$$H_o \qquad P = 0$$

$$H_1 \qquad P = 0$$

The hypothesis is accepted if the value of $\frac{P - 0}{v}$ turns out to be greater than the tabulated 't' value. The calculated value turns out to be smaller than the tabulated value even at very high percent levels of significance.

Hence, it is inferred that is not significantly different from zero. Hence, one could conclude on the basis of these values that the elasticity of substitution between factors of production is not significantly different from one for the cotton textile mills sector.

However, the values vary from one state to another these interstate variations in the value of P may be attributed to:

1. the fact that a different set of combination of machines may prevail in different states.
2. the fact that changes in demand pattern may cause factor substitution in the form of alterations in the number of shifts operated per day. The capacity utilization in each state may depend upon the incidence of sophisticated machines.

   The latter depends to a considerable degree upon the first. As new and more modern machines are introduced in a few mills, there occurs a quality improvement in the product, for which demand is very high. Hence, the utilization of capacity is higher in this type of mill. On the other hand, due to such technological change in a few mills, the other mills machinery becomes obsolete, and they tend to become sick as the demand for their product falls and hence capacity utilization decreases.

3.4 Conclusions :

The production conditions in the cotton textile mills sector vary a lot from one state to another. This is the cause of very high coefficients of variations in technology parameters, such as capital intensity, efficiency and substitution parameter from year to year for cross sectional data. The high values for the coefficients of variation for these parameters imply that the value of these vary over a wide range for different states. The interstate differences are caused by contrasts in the combination of machines used as well by differnces in capacity utilization. The latter depends to a considerable degree upon the first. The cause of high coefficients of variation in efficiency parameter is the difference in combination of machines used in different states.

The structure of the cotton textile mills sector is such that there exists economies of scale. Hence, the big producers are in a relatively better position than the small producers.

The value of the rigidity constraint parameter obtained using Brown and de Cani's model is significantly different from zero at one per cent level of sifnificance for all the years for cross sectional data and varies within the range of .78 to .97. The very high rigidity constraints means that in the short run there is little scope for adjustment process and capital stock influences current investment decision a lot.

The importance of this rigidity constraint varies depending upon the importance of previous capital-labour stock and the magnitude of the change in the present factor prices ratio. These factors combine cause very slow adjustment for most mills.

This may be the cause of the dual type of technology in the cotton textile mills sector.

The biased demand structure provides sufficient incentives in terms of price increases to bring about the necessary changes in capital-stock for a few mills. The consumer of this segment give importance to quality change rather than price changes. Hence, the continuous change in techniques is taking place in the mills producing finer varieties of cloth. A very few mills producing finer varieties of cloth are able to cover both direct and indirect marginal costs. On the other hand, the demand for other low quality products has high price elasticities. It does not permit enough incentives in these mills to raise price to cover, both direct as well as indirect marginal costs. Hence, continuous changing of techniques takes place in a few mills while most of the other mills have to rley on discarded machinery. Thus, the adjustment process is very slow in cotton textile mills sector. This can be judged from the very low values for short-run elasticity of substitution parameter. The values for short run elasticity parameter lie in the range of 0 to 14 for cross-sectional data. However, if the rigidity constraint is removed, then the elasticity of substitution increases. The long-run elasticities of substitution do not significantly differ from one. Hence, the long-run decisions regarding capital stock, show that labour an capital are readily substituted for each other, although in the short-run, the existing stock acts as a hinderence in the process of adjustment.

The fact that the long-run elasticity of substitution does not differ from one, may be the cause of the insignificant growth in the share of emoluments in value added despite large increases in the deflated capital-labour ratio. However, both the elasticity of substitution and the share of emoluments in value added show quite a lot of variations.

The substantial rise in the deflated capital-labour ratio is the consequence of the adoption of sophisticated machinery as well as structural changes in the industry. The sophisticated machinery is generally capital-intensive in nature. The continuous rise in the capital intensity parameter from year to year over the period may be said to be an indications of this. However, capital intensity parameter is not siginificantly different from zero.

The adoption of sophisticated technology in a few mills, on the other hand also causes the machinery in other mills to operate at a low level of capacity utilization, implying high capital-labour ratios. The capacity utilisation showing a declining trend and is quite low in 1981 as compared to 1974. Hence, it seems the technology change has caused on the one hand high capital-labour ratio and on the other hand, may be the cause of inefficiency over the period of time.

CHAPTER – IV

"INTER STATE ANALYSIS OF MARGINAL AND TOTAL FACTOR PRODUCTIVITIES."

The long run technology parameter obtained in chapter 3 using Kmenta's approximation to the CES production function for interstate cross sectional data could be used for further analytical purposes. Marginal productivities and the marginal rate of technical substitution for different states could be obtained with the technology parameters. The difference in ~~of~~ marginal productivities for various states are caused by differences in the combinations of machines used as well as by differences in capacity utilisation. These factor may reflect the degree of concentration in the industry which differs from state to state, as well as the contrasting capital labour ratios in these states. [illegible] Total factor productivity may also be obtained using these technology parameters.

The chapter is divided into three parts. The first part deals with the interstate analysis of differences in production processes with the help of indices of marginal productivities. The second part of the chapter presents the results of an analysis of total factor productivity based on the CES production function. (The second part of the chapter presents the results of an analysis of total factor productivity based on the CES production function) The chapter concludes with the main findings.

Three years are taken for this analysis 1974-75, 1978-79 and 1981-82. These three years were chosen keeping in mind the controversy about the investment in manufacturing sector in India.

"One of the major conclusions of Panchamukhi (1986) contracts a widely held view, namely, the alleged increasing inefficiency of capital investment in India over the period 1976-79"[46]. Panchamukhi analysed that increase in capital output ratio is due largely to shifts in the sectoral composition of aggregate investment and therefore cannot necessarily be interpreted as reflecting declining efficiency in the use of capital resource at the sectoral level.[47]

4.1 Interstate contrasts in techniques :

The analysis of interstate contrast in technique can be done by comparing marginal productivities of labour and of capital.

The state lèvle values of marginal productivity for each year are obtained using the technology prameter derived by the application of Kmenta's approximation to the CES production function on interstate crsoss sectional data using the following equation.

$$\text{Marginal Productivity of labour} = \frac{m\ s\ v}{Z(L)^{-(p+1)}}$$

$$\text{Marginal Productivity of capital} = \frac{m.(1-s).\ V}{Z.(K)^{-(p+1)}}$$

Here, $Z = (1-s)K^{-p} + SL^{-p}$

V is deflated value added. K is deflated fixed capital

L is number of employees.

The marginal rate of technical substitution of labour for capital is obtained from the ratio of marginal productivities of labour and capital. However, the values obtained from there equations may overestimate or underestimate the true values for each state by the same proportion during a given year, due to misspecification in parameter values. Hence, the interstate analysis is done in relative terms rather than in absolute values by preparing indices and ranks of these values.

In columns (5), (7) and (9) of Table 4.1 the indices of marginal productivity of labour for the years 1975-75, 1978-79 and 1981-82 are given. These are prepared by dividing each state's marginal productivity value by the lowest state marginal productivity value. The ranks for columns (5), (7) and (9) are presented in descending order in columns (6), (8) and (10) respectively. The index column (5), (7) and (9) of table 4.1 reveal that there exist wide interstate contrats in the marginal productivities of labour in all years.

The year 1981-82 witnessed the widest gap between the marginal producitivies of labour of different states. The

Table 4.1

Interstate Analysis of Marginal Productivity of Labour and Product Wage Rates

STATES	Marginal Productivity of labour for the year in Rs.			Index (I) and Ranking (R) of marginal Productivity of labour for the years						Product wage rate for the years in Rs			(I) Index along with Rank (R) of Product wage rate for the years : in Rs.					
	1974-75	1978-79	1981-82	1974-75		1978-79		1981-82		1974-75	1978-79	1981-82	1974-75		1978-79		1981-82	
(1)	(2)	(3)	(4)	(5) I	(6) R	(7) I	(8) R	(9) I	(10) R	(11)	(12)	(13)	(14) I	(15) R	(16) I	(17) R	(18) I	(19) R
Andhra Pradesh	4.0710	4.2399	3.5508	1.23	7	1.19	12	1.38	9	2.3997	2.6552	3.5124	1.22	12	1.01	13	1.23	11
Bihar	3.5514	3.5374	2.7869	1.07	13	1.00	14	1.07	13	1.9566	2.6247	3.4729	.00	14	1.00	15	1.21	12
Gujrat	5.3610	7.2011	5.3476	1.62	1	2.03	2	2.08	2	3.7850	4.3124	4.6781	1.93	2	1.64	2	1.64	1
Haryana	4.1698	4.6346	2.5683	1.26	8	1.31	11	1	14	2.6200	3.0354	2.8478	1.34	10	1.16	10	1	14
Karnataka	3.5760	5.0121	4.3683	1.08	12	1.41	7	1.7	7	2.6644	2.8333	4.0666	1.36	9	1.08	12	1.42	9
Kerela	4.4815	6.4786	4.8361	1.35	5	1.83	5	1.88	5	3.4059	3.4866	4.2794	1.74	4	1.33	7	1.50	6
Madhya Pradesh	3.8107	4.7457	3.3703	1.15	9	1.34	10	1.31	10	3.5570	4.1347	4.181	1.82	3	1.57	4	1.54	5
Maharashtra	5.0333	6.5838	6.6901	1.52	3	1.86	4	2.60	1	4.1515	4.4631	4.642	2.12	1	1.70	1	1.63	2
Orissa	3.3113	3.7712		1.00	14	1.06	13			2.4616	2.6750		1.26	11	1.02	11		
Punjab	4.6646	5.2235	5.3414	1.41	4	1.47	6	2.07	3	2.2713	2.6352	2.9400	1.16	13	1.00	14	1.03	13
Rajasthan	4.2734	6.9425	4.4458	1.29	6	1.96	3	1.73	6	2.9289	3.7439	4.1804	1.49	8	1.42	5	1.46	7
Tamil Nadu	5.1109	7.7377	4.9097	1.54	2	2.18	1	1.91	4	3.3906	4.1810	4.5108	1.73	5	1.59	3	1.58	3
Uttar Pradesh	3.788	4.9201	3.7038	1.14	10	1.39	8	1.44	8	3.1755	3.1675	4.1060	1.62	6	1.24	9	1.44	8
West Bengal		4.2172	2.9486			1.19	12	1.14	12		3.6707	3.7130			1.40	6	1.30	10
Pondicherry	3.7165	4.8550	3.3626	1.12	11	1.37	9	1.30	11	3.1100	3.4545	4.5017	1.89	7	1.31	8	1.58	4

marginal productivity of labour in Maharashtra is 2.60 times that of the lowest state for that year. The position of most of states in the ranking alters from year to year. However, Gujrat, Tamil Nadu and Maharashtra are states which occupied three of the four top positions in all years, though their rangking interstate altered in all years. Bihar and Orissa ares states which remained among the bottom three positions although their ranks also change. The other states which entered into the top four positions from time to time are Rajastahan, (once), and Punjab (twice). On the other hand, Haryana is a state which once was placed among the bottom three positions. The ranking for all other states varies quite a lot within the intermediate range.

Columns (2), (3) and (4) of Table 4.2 reveal that similar wide interstate contrasts are observed for the marginal productivities of capital. The year 1978-79 witnessed the maximum widening of the gap between the marginal productivities of capital of different states. The marginal productivity of capital in Madhya Pradesh was 5.02 times that of the lowest for that year. Gujrat, Maharashtra are states for which marginal productivity of both factor, capital and labour are in the upper rank, while for Tamil Nadu and Madhya Pardesh marginal productivity is quite high for one factor but only moderately high for the other. On the other hand, Bihar and Orissa record low marginal productivities of both factors of production. Karnataka, kerela, Punjab, Rajasthan and Pondicherry are states in which the marginal productivity of only one factor is high. Hence, for these, states the rank position in the case of the marginal productivity of labour is entirely different from that for the marginal productivity of capital. Moreover, the relative position of these states alters quite lot from one year to another.

Thus, four sets of states can be identified.

First, states where the marginal productivity of both factors is high, and there is no significant change in their rank, they remain among the top four. They are Gujrat and Maharashtra.

Secondly, these are two states in which one marginal productivity is high, in all three years, while the other in medium. They are Tamil Nadu and Madhya Pradesh. For Tamil Nadu the marginal productivity of labour remain among the top four, while for Madhya Pradesh marginal productivity of capital remain at the top of the ranking.

Thirdly, there are states in which marginal productivity is low for both factors. Their ranks scarcely change. They remain at the bottom. They are Bihar and Orissa.

Finally, these are nine states in which one marginal producitivity is high, while ther other is low or both are medium. Their rank change from one year to another.

TABLE 4.2

Interstate Analysis of Margina Product of Capital and Product Rental Rates.

STATES (1)	1974-75 (2)	1978-79 (3)	1981-82 (4)	1974-75 (5)	1978-79 (6)	1981-82 (7)	1974-75 (8)	1978-79 (9)	1981-82 (10)	1974-75 (11)	1978-79 (12)	1981-82 (13)
	Marginal Prod. Capital			Index of MPK			Rank of MPK			Prod. Rental Rate		
Andhra Pradesh	.2412	.1051	.2042	1.3619	1.0	1.362	13	15	13	.500	.2473	.1297
Bihar	.1771	.1310	.1500	1.0	1.2464	1.0	14	14	14	.3863	.2094	.0178
Gujrat	.3667	.3253	.4059	2.0706	3.0951	2.706	4	4	7	.6172	.7284	.3501
Haryana	.2708	.2766	.2873	1.5291	2.6318	1.9153	8	7	10	.5280	.5211	.1237
Karnataka	.2981	.2665	.4191	1.6832	2.5357	2.794	7	9	5	.4653	.6198	.3174
Kerela	.2630	.1692	.2286	1.4850	1.6099	1.524	10	13	12	.3900	.4778	.1924
Madhya Pradesh	.5607	.5277	.5188	3.1660	5.0209	3.4587	1	1	1	.4857	.4893	.0468
Maharashtra	.4126	.3212	.5134	2.3298	3.0561	3.4227	2	5	2	.5251	.5910	.6217
Orissa	.2620	.2010	—	1.4797	1.9125	—	12	11	—	.4095	.3361	—
Punjab	.3645	.1934	.4198	2.0582	1.8402	2.7987	5	12	4	.9037	.5416	.6238
Rajasthan	.2623	.2859	.2167	1.4811	2.7203	1.7447	11	6	11	.4577	.7346	.1917
Tamil Nadu	.3338	.2717	.3107	1.8837	2.5852	2.0713	6	8	9	.6102	.7192	.2911
Uttar Pradesh	.2730	.2019	.3251	1.5415	1.9210	2.1673	9	10	8	.3332	.3954	.1363
West Bengal	—	.3456	.3709	—	3.2883	2.4227	—	3	6	—	.3231	.0600
Pondicherry	.3785	.4361	.5134	2.1372	4.1494	3.4227	3	2	2	.4684	.6753	.0178

The first set it may be argued are using a higher proportion of better quality machines. These better quality machines require more highly skilled labour and management. The second set, it appears are using a relativley high proportion of better quality of machines but less than first category. the contrast in marginal productivities of factors is mainly attributable to the difference in the proposition of the type of units, such as spinning or weaving units* or differnece in capacity utilisation of these machines. The third set, it appears are using a large proportion of poor quality machines and labour. The interpretation of the results in the case of the fourth set presents greater difficulties. But it appears that they are using machines of mixed quality, with a relatively heavy preponderance of intermediate quality of stock and of labour. The cause of the marked contrast in marginal productivities within the group is again, mainly attributed to the difference in the proportion of the type of units, such as spinning or weaving units or difference in capacity utilisation of these machines, along with some differences in proportion of types of machines used.

The above inferences find support from the results of analysis of interstate differences in wage rates. The state which use relatively more sophisticated machinery require more

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* Ratio of looms per thousand spindle is given in appendix Table 4.4.

highly skilled labour and management. Hence, one should expect that the wage rate should be higher for the states which use relatively more sophisticated and vice versa. In 1974-75, Maharashtra pays the highest product wage rate to their workers more than double the rates paid in Bihar, Columns (11), (12) and (13) of table 4.1 reveal that Madhya Pradesh, Tamil Nadu, Maharashtra and Gujrat pay consistently higher product wage rates. Bihar units pay the lowest product wage rate. Orissa stands third from the bottom. Thus, the interstate contrasts in techniques used parallels the interstate contrast in wage rates. However, one should be aware that although high marginal productivity of both factors is likely to be associated with high wage rates the reverse is not necessarily the case. The reason is that wage rates depend not only upon the employees, wages could rise also due to trade unions pressures, and are generally downward inflexible.* Moreover, marginal productivities of factors could change because of changes in factor proportions. The continuous shift in demand patterns forces units to operate some machines at inefficient capital-labour ratio. This is the cause of the very low correlations between both index and ranks of marginal productivities and their factor prices. (The comparision of

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* Product wage rate are given in Table 4.5.

columns (6), (8) and (10) with (15), (17) and (19) of Table 4.1 reveals this)*.

4.2 Total Factor Productivity methodology based on CES production function :

Total factor productivity (TFP) is defined as the ratio of the actual contribution to value added in the n^{th} period quantities of factors of production, had the technology of the base period prevailed. This is the way to separate out the effect of capacity utilisation on production from the total effect of technological change on production. Technology at a point of time is defined as different sets of combinations of machines operating at different levels of capacity utilisation. Hence, the total factor productivity tells us the effect of technological change from the engineering point of view on relative total production of n^{th} period as compared to base period. It should be noted that there could be tremendous changes in technology, that is, in each components of the production function such as the efficiency parameter, the capital intensity parameter, substitution parameter and

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* The importance of constraints caused by capital-labour stocks, psychological and institutional factors could be judged from the lack of correlation between ranks and indices of marginal rate of technical substitution of labour for capital and product~~ive~~ wage rental ratio (Appendix Table 4.5).

economies of scale due to change in combinations of machines used or capacity utilisation or both. However, this may not necessarily lead to changes in total factor productivity. This is because the effect on production of changes in different components may cancel out each other and hence may not affect total factor productivity much.

The methodology used to measure TFP is based on the CES production function. In the normal procedure actual value added in the n^{th} period (in the numerator) should be divided by value added figures obtained using base year production function parameters and n^{th} period quanitities of capital and labour (in the denominator) to arrive at total factor productivity.

$$TFP_{np} = \frac{\text{Actual value added in the } n^{th} \text{ period}}{\text{Value added figures obtained using base year production function parameters and } n^{th} \text{ period quantities of capital and labour.}} = \frac{V_n}{V_{on}}$$

$$\text{Here, } V_{on} = A_o \left[S_o L_n + (1-S_o)K_n\right]^{-m_o/p_o}$$

A_o, S_o, $(1-S_o)$, p_o, m_o are base year production function parameters. L_n and K_n are quantities of labour and capital respectively used in the n^{th} period. However, an adjustment has been made to this normal procedure to arrive at actual TFP. This is done, keeping in mind the deviations of base years actual value added figures for different states form trend value of value added for that state obtained using base period parameters in inter state corss-sectional data of variables for that period. This is done by multiplying the denominator figures thus obtained in the normal procedure by the ratio of actutal value added during the base year to value added figures obtained using base year (to value added figures obtained using base year) production function parameters and base year quantities of labour and capital.

$$TFP = TFP_{np} \times \frac{1}{\text{(Actual base year value added figures)/(value obtained using base year production function parameters and base year quantities of labour and capital)}}$$

$$= TFP_{np} \times \frac{1}{V_o / V_o^o} \qquad \ldots (4.2)$$

Here, $V_o^o = A_o \left[S_o\ L_o + (1-S_o) K_o \right]^{-m_o/p_o}$

L_o and K_o are base year quantities of labour and capital respectively.

$$\text{Hence, } TFP = TFP_{np} \times \frac{V_o^o}{V_o} = \frac{V_n}{V_o^n} \cdot \frac{V_o^o}{V_o} \qquad \ldots (4.3)$$

Thus, Total factor productivity (TFP) is obtained.

Columns (2), (3) and (4) of Table 4.3 show total factor productivity indices for the year 1978-79 taking 1974-75 as the base year, for 1981-82 taking 1978-79 as the base year and for 1981-82 taking 1974-75 as the base year. These results are discussed, in turn, below.

TABLE 4.3
Total Factor Productivity Analysis

	Total facttor Productivity Index Period			No. of mills reported during				
	1978-79	1981-82	1981-82					
	Base years							
STATES	1974-75	1978-79	1974-75	1974-75	1975-76	1978-79	1979-80	1981-82
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Andhra Pradesh	.82	1.033	.8234	32	36	36	36	36
Bihar	.8639	1.0017	.7697	4	4	6	7	4
Gujrat	1.1379	.8833	.994	112	115	112	117	101
Haryana	1.0511	.6450	.67	20	13	18	21	14
Karnataka	1.2157	.9342	1.18	33	40	38	37	35
Kerela	1.1590	.8794	.9646	22	26	23	24	24
Madhya Pradesh	1.1297	.7882	.8851	32	32	28	30	26
Maharashtra	1.1165	1.2447	1.3096	114	126	123	124	113
Orissa	.9579	—	—	6	5	6	6	5
Punjab	.8845	1.2039	1.0539	7	10	8	9	9
Rajasthan	1.4161	.7904	1.0256	19	23	19	16	13
Tamil Nadu	1.2636	.7460	.9067	188	218	208	223	246
Uttar Pradesh	1.0847	.7900	.9688	38	34	36	36	40
West Bengal	—	—	—	46	46	46	46	43
Pondicherry	1.1964	.8018	.8699	5	6	7	7	7

Total factor productivity index : period 1978-79 base year 1974-75 :

Total factor productivity increased for ten states and declined for the four remianing states for the period 1974-75 to 1978-79. The rise in th total factor producitvity index in all of them ten states in which the index rose is mainly attributable to the setting up of large number of new mills in all these stats during the sub-period 1974-75 to 1975-76 and to the closing down fo sick units thereafter as is clear from colums (5), (6) and (7) of Table 4.3. Only a very few mills were set up after 1975-76 and in none of states was the increase in number of mill more than is the first sub period. Hence, in those states the main investment took place before 1976.

The total number of mills reporting increased from 584 in 1974-75 to 639 in 1975-76. The period 1975-76 to 1978-79 saw a decline in the number of mills reporting by six due to the closing down of a large number of sick units in these states.

The cause of the decline in the TFP index in three out of the four remaining states appears to be attributable to the inefficient investment which took place in the sub period 1975-76 to 1978-79.

For a proper analysis the increase or addition in capital stock* are considered along with the increase in the number of mills for these states during the sub periods 1974-75 to 1975-76 and 1975-76 to 1978-79.

The number of mills reported in Andhra Pradesh remained at 32 during the first sub period, (1974-75 to 1975-76) and then increased to 36 during the next, (1975-76 to 1978-79). The value of fixed capital stock increased marginally from 160,054 thousand Rupees to 168,164 thousand Rupees in the first sub period and nearly doubled during the next.

The number of mills reported in Bihar remained at four during the first period and then increased to six in the next

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* Additions to capital stock include the net effect of increase in investment in new as well as old units as well as the effect on capital stock due to negative effects of depreciation, closing down or restarting of sick units as well as non-reporting of certain units. Hence, additions to in capital stock figures do not mean investment in new machinery only. However, it is the only alternative in the absence of data on the age of additional capital stock. Deflated figures of capital stock obtained through perpetual inventory method are given in Appendix Table 4.4.

sub period. The value of fixed capital stock increased form Rs 19204 thousand to the 24202 thousand, and from is 24202 thousand to the 33332 thousand during these two sub periods. For the third state Punjab, for which TFP declined despite a decline in the number of mills reporting during the latter sub-period, the capital stock more than doubled as against an increase of only 23 per cent in the first sub period. However, in the case of the fourth state, Orissa for which the tottal factor productivity index declined, the cause may be somewhat different. The number of mills reported in 1978-79 was the same as in 1974-75. the value of capital stock figures show a rise. the increase was more than double during the period 1974-75 to 1975-76 and only 16 per cent during the period 1975-76 to 1978-79. This state shows a decline in total factor producitivity, but the decline was small as compred to other states. Hence, for this state, the decline in TFP cannot be only attributed to inefficient investment during 1976-79, the inefficient investment appears to have taken place also in 1974-75 to 1975-76.

The above analysis reveals that in all the states in which relatively more investment took place during the period 1976-77 to 1978-79 a decline in the total factor productivity index took place. For Orissa state, inefficient investment started before 1976.

Total factor productivity index : period 1981-82, base year 1978-79 :

In this peiod the total factor productivity index showed a decline for nine states and stagnated or increased for the other four during the period 1981-82, taking 1978-79 as the base year.

The cause for the rise in total factor productivity is the relatively greater proportion of investment during sub period 1979-80 as compared to 1981-82. The cause for stagnation in total factor productivity may be attributed to the combined effects of two factors working in opposite directions namely the non-reporting of sick-unis which causes a rise in total factor productivity and relatively more inefficient investment in period 1978-79 to 1981-82. Andhra Pradesh and Bihar are states which exihibit stagnation in total factor productivity Punjab and Maharashtra are states which shows increases in the total factor productivity index. Andhra Pradesh shows stagantion despite a decline in the total factor productivity index in the earlier period and a 70 per cent increase in capital stock from 1979-80 to 81-82. Hence, it seems that investment in this state does not differ much with respect to the type of capital stock. the nunmber of mills reporting which remained at 36 druing the sub-period 1978-79 to 1979-80, increased to 38 in 1980-81 and then came back to 36 in 1982-82. For Bihar the cause of stagnation in total factor productivity is the combined effect of 25 percent increase in capital stock in the first sub period (1978-79 to 1979-80) and thus decline due to closing down of sick units. Generally, closing down of sick units causes a rise in toal factor productivity. Hence, it seems its effect is cancelled out by inefficient investment during period 1978-79 to 1979-80. In the case of Punjab, the 49 per cent increase in capital stock during the sub period 1978-79 to 81-82 which is more than 33 per cent during first sub period 1978-79 - 1980-81 may be responsible for the increase in total factor productivity. The tremendous rise in total factor productivity in Maharashtra state may be attributed to the closing dwon of a large number of sick unit. The number of mills reportedly declined from 122 to 102 during the period 1978-79 to 1981-82. The period did not witness any major addition to capital stock.

The decline in total factor productivity in six states namely Gujrat, Haryana, Kerala, Madhya Pradesh, Rajasthan and Uttar Pradesh is attributed to the installation of new mills as well as to the rehabilitation of sick units during the sub period. The number of mills reported increased from 186 to 194 during sub period 1978-79 to 1979-80 and then declined to 167 during next sub period for these staes 1978-79 to 1979-80. Most of the unis closed down during the next sub period. Hence, for these states the decline in total factor productivity could be attributed to inefficient investment during the sub period 1978-79 to 1979-80.

The cause of the decline in total factor productivity for these states namely Karnataka, Tamil Nadu and Pondicherry is mainly attributed to proportionally much more increase in capital stick during the latter sub period. The capital stock for Karnataka and Tamil Nadu during the period 1978-79 to to 1981-82 more than doubled. The increase was 64 percent for Pondicherry state. The first sub period shows a comparitively a much smaller increase in capital stock and for Karnataka it even shows a decline. Hence, for the states the decline for total factor productivity is the outcome of inefficient investment in both the sub periods 1978-79 to 1979-80 and 1980-81 to 1981-82. In the latter sub period inefficient investment seems more responsible for the decline in total factor productivity in contrast to earlier analysis for other states.

Hence, it could be concluded from the above analysis that the decline in total factor prodctivity for the period 1981-82 taking 1978-79 as in cotton mills sector is mainly attributable to continued inefficient investment after 1978-79. The states in which total factor productivity index has not declined all those in which non-reporting sick units cancelled out the negative effect of inefficient investment during the period. The only state in which investment after

1978-79 seems to have caused a rise in total factor productivity is Punjab. This happened because in Punjab relatively inefficient investment took place between 1976-77 and 1978-79 as is evident from earlier analysis and subsequent investment was more efficient.

Total factor productivity index : period 1981-82, base year 1974-75 :

The total factor productivity index is the combined effect of changes in the two periods already analysed namely 1974-75 to 1978-79 and 1978-79 to 1981-82. During the combined long period, Karnataka and Maharashtra are states which show a high rise in total factor productivity, while Punjab and Rajasthan are states for which the rise is very small. For all other states, total factor productivity has declined. The cause of the rise in total factor productivity in Karnataka and Rajasthan is efficient investment made before 1976, which was enough to overcome the negative effect of investment after 1976. This is evident from the increase in the number of mills in these states from 33 to 40 and 19 to 23 during the period 1974-75 to 1975-76. The cause of the rise in the total factor productivity index is mainly because of the closing down and non reporting of sick units.

The cause for the decline in total factor productivity in other states is mainly inefficient investment after 1975-76.

4.3 Conclusions :

The interstate analysis of differences in with the help of marginal productivities of labour and capital reveal that there exists a wide differences between the techniques used in different states - Gujrat, Maharashtra, Tamil Nadu and Madhya Pradesh are states which use a larger proportion of better quality machines than other states. Bihar and Orissa used back ward techniques. The other states employed machines of mixed quality, with a relatively, heavy preponderance of intermediate quality of stock and of labour. Within these groups these exist differences in techniques relating to contrasts in the proportion of various types of units, such as spinning or weaving units, or differences in capacity utilisation of these machines.

The analysis of total factor productivity in the cotton textile mills sector supports the wide held beleive regarding increasing in efficiency of investment in India over the period 1976-79 in content with cotton textile mills' sector. the analysis reveals that in the cotton textile mills sector the inefficient investment not only occurred during the period 1976-79 but continued even after that upto 1981-82. Punjab state inefficient investment took place between 1976-77 to 1978-79 and subsequent investment was more efficient. For Orissa state inefficient investment started before 1976.

Table 4.4

Figures & Growth Rates for Deflated Fixed Capital Stock.

	Deflated fixed capital stock for years Thousand Rs.					Growth rate of deflated fixed capital for the years			Looms per thousand spindles
STATES	1974-75	1975-76	1978-79	1979-80	1981-82	1974-75 to 1978-79	1978-79 to 1981-82	1974-75 to 1981-82	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9).	(10)
Andhra Pradesh	95069	99073	158426	140854	190597	12.14	7.25	10.99	1.25
Bihar	11365	13832	17698	20213	16983	11.52	-1.1	7.18	5.0
Gujrat	725597	758158	863232	959831	1090884	4.24	8.61	6.57	15
Haryana	47014	42186	40965	38964	59406	-3.8	16.12	3.57	2.8
Karnataka	115666	129295	146565	154348	185927	5.88	7.57	5.57	7.2
Kerela	50868	56897	77482	100360	128059	10.82	18.93	15.44	2.5
Madhya Pradesh	94766	100059	118346	168827	172891	5.84	12.16	11.09	16.6
Maharashtra	820668	852446	1097146	1113219	1061349	7.31	-1.8	4.31	15.14
Orissa	16728	30601	33522	31330	30635	14.10	-2.8	5.48	7
Punjab	36311	43570	77841	93897	120379	22.31	13.48	18.09	3
Rajasthan	86532	96292	107439	102283	102613	5.42	-.05	2.51	4.6
Tamil Nadu	452689	516043	621983	687345	945217	7.57	15.00	10.06	1
Uttar Pradesh	200895	191875	310351	326737	402232	14.76	9.58	9.39	9
West Bengal	121289	140327	152513	179093	239884	4.52	16.10	9.28	9
Pondicherry	25425	31311	33523	33957	43746	6.82	9.35	5.30	16

* Deflated figures for fixed capital are obtained from values of fixed capital using perpertual inventory method.

* Growth rates are obtained fitting trend based on equation $y = ab^t$.

Table 4.5

Marginal Rate of Technical Substitution and Wage Rental Ratios'.

	Marginal Rate of Tech. Sub. L.K. for the year Rs per unit employee			Product Wage rental ratios for the years Rs per unit employee			Ranking of marginal Rate of Tech. Sub. LK: for the years			Ranking of Product Wage Rental Ratios' for the years :		
STATES	1974-75	1978-79	1981-82	1974-75	1978-79	1981-82	1974-75	1978-79	1981-82	1974-75	1978-79	1981-82
Andhra Pradesh	16.88	40.33	17.38	4.798	10.73	27.07	3	1	3	12	3	6
Bihar	20.04	27.00	18.58	5.065	12.53	194.88	1	5	2	10	1	2
Gujrat	14.62	22.13	13.17	6.132	5.92	13.36	7	8	6	6	9	11
Haryana	15.39	16.75	8.94	4.962	5.82	23.02	5	12	11	11	10	7
Karnataka	11.99	18.80	10.42	5.726	4.57	12.81	12	10	10	8	15	12
Kerela	17.04	38.29	21.15	8.733	7.29	22.23	2	2	1	2	8	8
Madhya Pradesh	6.79	8.99	6.47	7.348	8.44	94.28	14	15	14	4	4	3
Maharashtra	12.19	20.49	13.03	7.90	7.55	7.46	11	9	7	3	7	13
Orissa	12.63	18.75	—	6.011	7.95	—	10	11	--	7	6	--
Punjab	12.79	27.01	12.72	2.51	4.86	4.71	9	4	8	14	14	14
Rajasthan	16.29	24.28	16.98	6.39	5.10	21.81	4	7	4	13	13	9
Tamil Nadu	15.31	28.48	15.80	5.55	5.81	18.70	6	3	5	9	11	10
Uttar Pradesh	13.87	24.37	11.39	9.53	8.26	30.12	8	6	9	1	5	5
West Bengal	—	12.20	7.95	—	11.36	61.86	15	13	12	15	2	4
Pondicherry	9.81	11.13	6.55	6.64	5.12	253.05	13	14	13	5	12	1

CHAPTER-5

SUMMARY AND CONCLUSIONS

The central objective of the study was to examine the production conditions in the cotton textile mills sector in India as well as in the different states of India during the period 1974-75 to 1981-82 and to analyse the nature of year to year technological changes that have taken place during this period. The other major objective was to measure the effect of technological chagne from an engineering point of view on total factor productivity.

The effect of technological change on total factor productivity could only be calculated by applying neo-classical methods of estimation though these methods suffer from a major problem in so far as measuring capital is concerned. The existing studies measure parameters of technology by fitting different production function equations (linear, Cobb-Douglas, CES and varying elasticity of substitution) based on the principle of equalisation of marginal productivity with factor prices. Hence, these are only applicable for long time series regression during which the rigidity constraint of existing capital-labour stock becomes zero. In addition these methodologies have several other limitations. Brown and de cani's model has been applied using interstate cross-sectional data, to estimate the indirect marginal cost constraints on new investment in the short run. It has been observed that in the cotton textile mills sector, the existing stock of capital and labour create major constraints for new investment. Investment only took place where both direct and indirect marginal costs are covered. (Direct marginal cost is the costs are covered). Direct marginal cost is the cost of employing additional factors, while indirect marginal cost is the cost of making old capital obsolete, the cost of retrenching redundant workers, and so on. The price incentives are high enough to cover both direct and indirect marginal investment costs only in the case of finer varietites of cloth and yarn. For this variety of product demand is very price inelastic and quality change is the main consideration for demand to be maintained. On the other hand, there is hardly any price incentive for inferior varieties of yarn and cloth. The demand for these products is very price elastic. Hence, most machinery operates unchnged for years in units producing ordinary varieties. The outcome is the presence of a dual type of technology in the cotton textile mills sector. The very high variations in the parametric values obtained by Kmenta's approximation to hte CES production function methodology applied to interstate cross-sectional data is an indicaton of very wide differences in the techniques used in different states. Further, it has been observed, with the help of estimates of the marginal productivities of labour and capital that Gujarat, Maharashtra, Tamil Nadu and Madhya Pradesh are states where the proportion of good quality machines is greater as compared to other states. Bihar and Orissa used the most backward techniques. Other states appear to be using machines of mixed quality, with a relatively heavy preponderance of intermediate quality stock and labour. The causes of the marked contrast in marginal productivity within the groups are mainly attributed to the differences in composition of units as between spinning and weaving units, for example, or to differences in capacity utilization of these machines, alongwith some differences in the proportions of different qualities of machines used.

Hence, in the cotton textile mills' sector there is great scope for improving techniques in backward areas so as to get the benefit of economies of scale. If this is not done the continuous concentration of industry in a few areas may increase regional disparities in the distribution of industry. However, the availability of very cheap labour has caused the adoption of labour intensity techniques in backward states and the inelastic price demand for their products does not permit the process of gradual conversion into modern processes. On the other hand, the fear of strikes and lockouts always goes in favour of the adoption of capital intensive modern techniques in machines producing better qualities, even if the relative share of capital sometimes declines.

For these units continuous adoption of modern machinery is necessary to maintain demand, which tends to cause the existing machinery stock to be operated at less than capacity, and hence to raise capital-labour ratios.

The combined effect of all the above factors such as changes in types of machines used and changes in capacity utilization, alongwith the change in the structure of the industry is to raise the deflated capital-labour ratio to a considerable extent in the cotton textile mills' sector. However, the rise in defalted capital-labour ratio has not significantly changed share of emoluments in value added because elasticity of substitution fluctuate arond the value one.

The rise in capital-output ratios in Indian industry during the period 1976-79 interpreted as the result of inefficient investment, not withstanding the fact that it could be due to changes in capacity utilisation ~~of~~ or structural changes in the industry. Panchmukhi's[48] conclusion seems quite relevant in the context of cotton textile mills' sector that a mere rise in capital output ratios should not be interpreted as the result of inefficiency in investment, when the industry undergoes stuctural changes. The capital-output ratio is related to partial factor productivity analysis as partial factor productivity capital is equal to ratio of output or value added to capital.

The analysis of efficiency in the cotton textile mills sector has been done using a total factor productivity measure based on the CES production function. Total factor productivity describes the effect of technological change on relative value added of two periods from an engineering point of view. Hence, it measures the effect of change in the type of machines used on production in two periods, and takes out the effects of any changes in capacity utilisation. Therefore, by analysing the change in total factor productivity indices and capital stock figures, one could assess the effect of investment on productivity. The analysis revealed that inefficient investment in the cotton textile mills sector has taken place during the sub period 1976-81.

Hence, it appears that in the case of the cotton textile mills sector whatever investment has taken place is with a view to bringing about quality changes without perceptibly increasing total factor productivity. This is done keeping in mind the relative prices of fine and ordinary cloth that will ensure higher profit margin in units catering to the needs of the rich section of the society.

The gradual technological change in mass cloth production mills as well as dispersion of industry to backward areas to raise employment and wage rates of all types of workers are socially desirable features. The restructuring and upgradation of technology in the cotton textile mills sector is essential for these purposes. However, it is difficult to say how these objectives could be attained under conditions where price incentives are not enough to cover both indirect and direct marginal costs.

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