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COST & PRODUCTIVITY IN INDIAN TEXTILES: POST MFA IMPLICATIONS

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Foreword

With the Multi Fibre Agreement (MFA) expiring on 1st January 2005, the competition in textile and clothing industry is likely to increase.

Among the factors determining the competitiveness of industries would be the unit cost, which depends upon the factor prices on the one hand and the productivity level on the other. The present study examines these two factors for the three main textile industries, cotton yarn, man-made textiles and readymade garments. Decomposition of the unit cost shows that an increase in material price has been the largest contributor to the unit cost growth in the three industries. In cotton yarn sector, technological retrogression and inefficiency add to the unit cost growth.

The paper finds an inverse relationship between the unit cost and productivity: Industry and States, which witnessed higher productivity (growth) experienced lower unit cost (growth) and vice-versa. Better capacity utilization, reductions in Nominal Rate of Protection and increased availability of electricity are found to be favourably affecting the productivity in all the three industries. Non Tariff Barriers, average firm size (output per firm) and credit disbursements have a positive relationships with productivity in man-made and garment sectors.

All three industries have (non-homothetic) labour & energy saving production function. Thus, variation in scale of an industry across States is inversely related to Energy and Labour use. In other words, a State with a larger (cotton yarn / garment / man-made textile) industry will use less labour/energy per unit of output in that industry.

Technological change is found to be labour saving in the case of man-made textile. In the cotton yarn and garment sectors it was neutral, implying that they failed to save labour over time, which could be attributed to the rigid labour laws. Both man-made and garment sectors suffer from diseconomies of scale. Since there are scale economies at the firm level, the reason for this could be the increasing un-utilized capacity and possibly some external diseconomies. The garment sector also experiences a great degree of inefficiency, indicating a need for better mix of inputs. The excise duty on polyster needs to be reduced to the basic CENVAT rate. It can be concluded that the mill sector, which produces almost the entire cotton yarn, requires level playing field at par with handloom and powerloom sectors. There is also a need to encourage large-scale production, particularly in man-made and garment industries.

The paper identifies disbursement of credit, cheaper raw materials (e.g. BT Cotton), better availability of electricity at reasonable rates, promoting better capacity utilization, flexible labour laws, easy exit norms for the firms are some of the measures to make the Indian textile and garment industry become more cost effective. He suggests that it may be prudent to focus on selected states having comparative advantage in a specific textile industry. Bold policy reforms could help the post MFA challenges being converted into an opportunity for large expansion in labour-intensive exports.

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Arvind Virmani
Director & CE
ICRIER

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I. Introduction

The trade in textiles has been regulated since the 1960s and since January 1, 1974, through the Multi-Fibre Arrangement (*MFA*). The *MFA* exempts the textiles and garments trade from the *GATT* disciplines, allowing industrial countries to place bilateral quotas on imports of various textile and garments product categories. This was meant to protect producers in the North and allow them time to restructure and adapt to competition from cheaper imports from the South. During the Uruguay Round of trade negotiations, it was agreed that the *MFA* would be phased out in steps through the implementation of the Agreement on Textiles and Clothing (*ATC*). On January 1, 2005 the *MFA* will be fully phased out and hence the trade in textiles and garments will no longer be subject to quotas.

Although this will result in an increased market for the developing nations, competition is expected to increase manifold. Hence, it also brings a good share of worry to a country like India, where the textile industry contributes heavily to *GDP*, industrial output, foreign exchange earnings and employment. In 2000-01, it contributed around 4 per cent to *GDP*, 14 per cent to the industrial production, 27 per cent to the country's export earnings and 18 per cent to the employment of the industrial sector. India's share in the global textile industry is 4 per cent and the same in the global garments industry is 3.4 per cent. During 1991-92 to 2001-02, India's textiles and garment exports grew at an annual growth rate of 8.5 per cent.

The textiles and garment sectors contribute almost equally to India's foreign exchange earnings. During 1999-00 while the former contributed Rs 239.8 billion (49.1%), the letter contributed Rs 248.3 billion (50.9%) to the foreign exchange earnings. Within textiles, cotton fabrics and madeups contributed the maximum to the export earnings (44.3%), followed by cotton yarn (26.9%), man-made textiles (19.1%), silk (5.1%), and wool and woollens (4.5%). Similarly, in the export earnings of garments the cotton fabric garnered the major share (69.7%), followed by synthetic fabric (26.3%), woolen (3.3%), and silk (0.7%). Except silk, and wool & woollens, which have relatively less shares in its export earnings, India will have to work hard to maintain and strengthen its earnings from textiles and garments. Though cotton fabrics and madeups contribute the highest to the foreign exchange earnings, the cotton yarn sector deserves special attention because it is not only the second largest foreign exchange earner in textiles but it is also a major input for cotton fabrics and madeups. Man-made textile also deserves special attention in view of its still un-exploited potential. India's advantage in this textile is evident from the fact that in spite of being a late starter, she holds the fifth rank for synthetic fibre (Viscose, Polyester, and acrylic staple fibre) and the third for the world production of cellulose fibre (D'Souza 2003)[1]. The focus of the present paper is, therefore, confined to cotton yarn and man-made textiles besides readymade garments

With the complete phasing out of the quota regime, one of the most important determinants of exports would be the cost competitiveness of the exporting country in which India is not in a very comfortable position. A study by Gherzi (2003) suggests that India needs to focus on cost reduction if it has to compete with Asian textile giants like China, Indonesia and minnows such as Sri Lanka, Pakistan and Bangladesh. It argues that while China remains the undisputed leader with cost advantages in all the factors of production, India is fast losing its traditional advantages in homegrown cotton and low labour cost. The study noted that in the cotton textiles besides technology, the costs of raw materials, energy, dyes & chemicals, and wages are crucial for India to stay cost competitive. In garments, the cost competitiveness of India is restrained by limited scale of operation and the use of traditional technology, as this sector was till recently reserved for the small scale industries (*SSI*). But surprisingly, India still managed to perform satisfactorily in the world garments' market. Verma (2002), on the basis of India's export to two most important markets the *EU* and the *USA*, argues that in post *MFA* regime garment is on a strong footing, unlike the case of textiles. According to him while the quota regime has constrained the export of apparel exports to these two markets, it has protected the export of yarn and fabric. Similarly, in line with many other studies Porter (1994) also argues a strong case of India's garments in post *MFA* regime. However, it should still be noted that in garments also there is no room for India to be complacent as there will be tougher competition from countries like China, producing on a much larger scale by using better technology.

[1] China ranks first in production of both these fibres.

The performance of the three selected industries - cotton yarn, man-made textiles, and garments - in terms of unit cost growth has not been encouraging in the past. In cotton yarn case, in spite of India being the third largest producer of cotton after China and the *USA*, the unit cost during 1989-97 grew at the rate of 13 per cent, which is much higher than the normal inflation rate in the country. In case of man-made textiles, though the average annual increase in unit cost has been relatively low at around 7 per cent, it is still high if one considers the fact that man-made textiles are far more costly in India than in the international market. For instance, the price of polyester yarn in India was Rs 70 per Kg, whereas the same in international market cost only Rs 43 per Kg in 1998-99 (see Appendix A). Similarly, in case of garments the unit cost increased at an average annual rate of 10.6 per cent over 1989-97 period, which is again higher than the normal inflation rate during the corresponding period.

In backdrop of the above, the present paper makes an attempt to analyze the factors which influence the unit cost growth in Indian textiles and garments industries. As productivity is one of the main determinants of the unit cost growth, besides the prices of inputs, an attempt is made to regress it on some of the main micro and macro variables. Some important production characteristics (like scale economies, capacity utilization etc) have also been examined in view of their bearing on productivity and the unit cost. Finally, an attempt is made to decompose the changes in unit cost growth into various specific sources of productivity and factor prices for ascertaining the role of each individual factor. Since different states of India operate in somewhat different conditions and have comparative advantages and disadvantages over others, a state level analyses is undertaken in present study.[2]

The rest of the paper is organized as follows: Section II provides a brief overview of the Indian textile and garment sectors. Section III discusses the methodology. Section IV mentions the sources of data and explains the construction of variables. Section V discusses the empirical findings. Finally, Section VI concludes the study.

[2] Analysis based on state level data also facilitates the larger degree of freedom for econometric estimates.

II. An Overview

A. Performance of the Selected Industries

(a) Cotton Yarn

Almost the entire spun yarn (cotton and man-made) in the country is produced by the mill sector.[3] Within the spun yarn category, the share of cotton yarn is the largest. It was 72 per cent in 1999-00, having declined from 82 per cent in 1989-90. While meeting the domestic requirements of spun cotton yarn from the powerloom and handloom sectors, the mill sector has done well to produce the high value yarn for exports to important destinations like the *USA*, Canada, Japan, and the European countries. This is substantiated from the fact that the cotton yarn exports of the country increased from 11 million kg in 1984-85 to 485 million kg in 1997-98. This earned India for the first time a distinction of being the largest exporter of cotton yarn in the world. In value terms too, there has been a sharp increase in export earnings from cotton yarn. In 1995-96 it was only Rs 33.4 billion, which increased Rs 59.5 billion in 1998-99 and constituted around 9-13 per cent of the export earnings from textile and garment. There has also been increase in average unit value realization from the export of cotton yarn. Over the period of 1989-99, it increased from Rs 58.4/kg to Rs 120.4/kg.

The spinning (cotton, man-made and blended) units, predominantly concentrated in the organized sector, have registered an impressive growth particularly in the wake of liberalization in 1991. The installed spindleage, which had increased from 25.57 million in 1985 to only 26.67 million in 1991, registered an impressive increase to 33.93 by the end of the year 1998. The open-end (OE) rotors also witnessed a massive increase from 45 thousand in 1989 to 317 thousand by end of 1998. There has also been increase in number of spinning mills (including composite) from 955 in 1985 to 1062 in 1991 and to 1788 by 31 December 1998. As many as 82 export oriented spinning units were also installed to take care of the export market.

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[3] Mills' contribution in the production of cloth is very low and it has also steadily declined from 27 per cent in 1984-85 to just 4 per cent in 1999-00.

Despite the impressive performance, the spinning sector is still plagued by a number of problems. Firstly, the level of modernization in this sector is low. According to a study by *SITRA*[4], a large number of mills continue using outdated technology, resulting in operational inefficiency of the mills. Also, the *OE* rotors account for not even 1 per cent of the total installed spindles. Secondly, aging of spindles is another serious problem. About 65 per cent of installed spindles are more than 10 years old and (Verma 2002, p. 21). Thirdly, as per the hank yarn obligation (*HYO*), textile mills are required to pack 40 per cent of their specified varieties of civil deliveries of cotton and viscose spun yarn in 'hank' form.[5] This policy has adversely affected the mill sector as the production of hank yarn is uneconomical, wasteful, and extremely labour oriented[6]. Fourthly, disproportionately high excise revenue collected from spinning (cotton as well as man-made) is another major problem of this sector. Spinning accounts for only 39 per cent of the value added but it contributes as much as 55 per cent to the total excise revenue from entire textiles and garments (*EPW 2002)*.

(b) Man-made Textiles

The man-made fibre / filament yarn industry consists of fibre and filaments of both cellulosic and non-cellulosic in nature, which are commonly known as rayon and synthetic fibre/yarn respectively. The share of man-made and blended yarn in total yarn production has increased from 14 per cent in 1984-85 to 28 per cent in 1999-00.[7] Similarly, the share of man-made and blended textiles in total cloth production doubled from 25 per cent in 1984-85 to 50 per cent in 1999-00. This has helped the country to release some demand pressure from cotton fabrics in domestic market and use the same for exports. This is reflected from the fact that the per capita availability of cotton fabrics (excluding export and including imports) increased only marginally from 12.53 square meters in 1984-85 to 15.94 square meters in 1997-98. In case of 100 per cent non-cotton and blended fabrics, on the other hand, it increased to as much as 14.98 square meters from 4.62 square meters

[4] As quoted in the Government Report (1999).

[5] The present level of *HYO* came into effect only recently following an announcement by the government in January 2003 to reduce it from 50%.

[6] See the Government Report (1999).

[7] Compendium of textile statistics (2000).

during the same period. The man-made textile has made tremendous stride in export earnings as well from Rs. 54 crore in 1984-85 to Rs 4068.4 crore in 1998-99. Its share in total export earnings of textiles (excluding Jute, Coir and Handicrafts) increased from 2.8 per cent to 9 per cent during this period. The installed production capacity of man-made fibres /filament yarn also witnessed a sharp increase from 0.3 billion kg in 1985 to 2.1 billion kg in 1999-00.

However, the man-made sector in India has yet to realize its full potential. Non-availability of raw materials at international prices[8] and the high rate of fiscal levies have hampered its growth. Even years after trade liberalization, the excise duty on polyester fibre yarn (PFY) was as high as 36.8 per cent in 2000-01, against 9.2 per cent on cotton. The raw materials for synthetic fibre attracted an excise duty of 16 per cent. Import of man-made raw materials attracts higher taxes. In 2000-01 it faced an effective import tariff of 48.5 per cent, against 5.5 per cent for cotton. It shows that the man-made textile sector has a great potential to bring down its cost and increase the global competitiveness.

(c) Garments

The garment industry consisted of about 58 thousand units in December 1999, which were spread across the country. Of this, 48 thousand units belonged to the woven sector and remaining 10 thousand units to the knitted sector. Until recently the garment sector was reserved for small-scale industries (*SSI)*, and the large-scale firms were required to undertake a risky 50 per cent export obligation.[9] Since the *SSI* sector availed various fiscal and other tax incentives, it encouraged fragmentation of the garment industry. This in turn adversely affected the setting up of large-scale production capacity and also the modernization of the sector. This is evident from the fact that only 6 per cent of the manufacturers operated with more than 50 machines in 1998. Over 80 per cent of them had less than 20 machines in their units (average was around 15 machines), and 99 per cent of these were in form of individual proprietorships or partnerships. Even export oriented units in terms of size compared unfavorably with international standards. An

[8] For difference in prices of raw materials between the domestic and international markets, see the appendix A.

[9] The Government in November 2000 decided to de-reserve the woven-garment sector. It left the knitted-garment sector reserved for the *SSI.*

average firm in India was found to have only 119 machines compared to 698 in Hong Kong and 605 in China (Verma 2002).

Low level of operation has seriously constrained the technological upgradation of the sector. A study by *NIFT* (1999) found that in the export sector only 21 per cent manufacturers used modern technology even by Indian standards and 70 per cent between modern technology by Indian standard and primitive technology. Only 17 per cent owners had world class plants. As expected, in the domestic sector the situation was worse. Here only 9 per cent factories are modern by the Indian standard and none of them had world class plants. This has seriously affected the productivity of capital as well as labour in the garment sector. Productivity measured per machine per day in terms of number of blouses in India was found to be only 10.2, compared to 20.6 in case of Hong Kong (Verma 2002). A worker in an Indian factory typically makes 6-7 shirts whereas the one in Sri Lanka, Nepal or Dubai makes as many as 22 to 32 shirts a day. According to a study by Mckinsey (2001), the productivity of labour in the Indian apparel industry (measured as men's shirt produced per hour) is only 16 per cent of the US level. The study linked this to a number of factors like, poor organization of functions and tasks, lack of viable investments in technology and low scale of operation etc. In backdrop of all these problems, the garment and made up sectors account for only around 15 per cent of the valued added in the textiles sector in spite of high value added potential of this sector as compared to other textile sectors *(EPW 2002)*.

B. Shares of Various States in Textiles and Garments

In spite of the textile and garments policy being the same across all states, there is wide difference in shares of states in the production of textiles and garments, as can be seen in Table 1. It is significant to note that in each industry, there are only a few states, which have reached 5 per cent or higher share. For instance, in cotton yarn out of the 16 states, only 4 states could manage a share of 5 per cent and above. Similarly, in man-made and garment sectors out of the 13 states, only 6 and 5 states respectively could cross the 5 per cent mark.

The states across industries have performed differently in terms of shares in output. For instance, Tamil Nadu has as much as 39.4 per cent and 23.4 per cent shares in cotton yarn and garments respectively, but its presence in man-made textile is low at only 3.5 per cent. Similarly, Delhi has almost negligible presence in both the textiles, but holds the largest share in garments. Maharastra is the only state, which holds important position in all the three industries.

Table 1: Average (1989-97) Shares of Various States in Total Output

(%)

State	Cotton Yarn	Man-made	Garments
AP	5.0	2.2	0.1
Bihar	0.2		
Delhi	0.6	0.2	27.1
Gujarat	11.6	13.7	3.8
Haryana	1.3	2.7	1.5
HP		2.1	
Karnataka	3.4	1.6	9.1
Kerala	2.1		0.4
MP	3.4	10.0	0.2
Maharastra	16.4	21.4	17.5
Orissa	0.9		
Pondicherri	1.1		
Punjab	4.5	8.5	10.3
Rajasthan	2.2	22.1	1.4
Tamil Nadu	39.4	3.5	23.4
UP	4.2	7.0	3.1
WB	2.6	2.5	0.6
Total	**98.8**	**97.53**	**98.57**

Source: Annual Survey of Industries.
Note: Underlined fugues indicate the major states in respective industries with share of 5% and more in total output. In cotton Yarn, man-made, and garment sectors the shares of the major states are 72.4%, 82.7% and 87.4%, respectively.

III. Methodology

A. Multilateral TFP Index

Improvement in productivity means getting more output from the same inputs or alternatively using fewer inputs to obtain the same output (Tretheway *et al.* 1997). There are two measures of the productivity growth, namely, the partial factor productivity and Total Factor Productivity (*TFP*). Partial factor productivity is calculated by dividing the total output by the quantity of an input. The main problem of using this measurement of productivity is that it ignores the fact that productivity of an input also depends upon the level of other inputs used. For example, a higher dose of capital application may increase the productivity of labour even when other inputs including labour remain constant. The

TFP approach overcomes this problem by taking into account the levels of all the inputs used in the production of output. In other words, *TFP* approach measures the amount of aggregate output produced by a unit of aggregate input. Hence, in addition to partial factor productivity, *TFP* is also estimated in present study. The *TFP* is calculated by aggregating four major inputs, namely, labour, capital, energy and materials with the help of the following translog multilateral index procedure, proposed by Caves *et al.* (1982):

$$\ln X_k = \sum_i \frac{1}{2}\left(W_{ik} + \bar{W}_i\right)\ln\left(\frac{X_{ik}}{\tilde{X}_i}\right) \qquad \text{-------------- (1)}$$

where, X_k is the aggregate input index for observation k; X_{ik} is the input i for observation k; W_{ik} is the cost share of input i for observation k; $\bar{W}_i$ is the arithmetic mean of the cost share of input i over all observations in the sample; and $\tilde{X}_i$ is the geometric mean of input i over all observations.

B. Determinants of Productivity

Since the unit cost is directly related to the *TFP*, it is necessary to analyze the main determinants of productivity. While some of these are internal to firms (like capacity utilization, size of a firm's output), there are others that are outside the firms' control (like the size of industry output, various government policy decisions etc). By taking the help of fixed effects regression models, an attempt is made to estimate the following relationship[10]:

$$Log\ (TFP) = f\ [\ Log\ (OPF, CU_m, ENRA, RDD, CRT, NRP, NTB, NRPTM, NTBTM)] \qquad \text{-----(2)}$$

where, *TFP, OPF,* CU_m*, ENRA, RDD, CRT, NRP, NTB, NRPTM, NTBTM* are respectively, total factor productivity, output per firm, capacity utilization, electricity available, road density, credit disbursement by schedule commercial banks to a specific industry, nominal

[10] It should, however, be noted that due to lack of industry-specific data at the state level, many important variables, like import & export intensity, R&D variable, man-days lost due to strikes etc, could not be incorporated in the analyses.

rates of protection (*NRP*) for products, non-tariff barriers (*NTB*) for products, *NRP* for food & textile machinery, and *NTB* for food & textile machinery.

The rationale for including *OPF* is that the industry output is related to both: (i) the number of firms in the industry and (ii) the size of each firm. So it is possible that even when average firms have scale economies, industry as whole witnesses scale diseconomies due to factors like the entry of small-size firms, falling capacity utilization etc. CU_m is defined as the ratio of actual output to the output corresponding to the minimum point on the short-run average coast curve. If CU_m is short of optimum, then its improvement would lead to productivity growth. The level of *ENRA*, *RDD* and *CRT* are all expected to influence the productivity growth positively. Lower level of *NRP* and *NTB* for product concerned is likely to increase the productivity of domestic firms through increased competition. Similarly, lower level of *NRP* and *NTB* for machines is also expected to increase the productivity by encouraging the import of machines.

The above industry specific models are estimated with pooled cross-section and times series data, by applying panel data technique. In order to avoid the problem of multicollenearity, selected combinations of independent variables are attempted at a time.

C. Cost Function

The production characteristics of an industry can be examined either through production function or cost function, as there is duality between the two when certain regularity conditions are satisfied. However, the cost function approach is preferred to production function approach when output level and input prices can plausibly be assumed to be exogenous (Berndt 1992). As the firms in the textile industry purchase inputs from the market with some elements of competition, it is realistic to assume that the input prices are exogenously determined, which leaves the quantities of inputs to be decided by the firms. Furthermore, since the investment and other decisions of the firms are based on output projections in view, output is also taken as an exogenous variable. Thus, in present study we estimate the cost function of the textile industries. Here it should be noted that the quasi-fixity of capital may not always allow the total cost minimization; as a result a firm may end up minimizing the total variable cost only (Caves, *et al.* 1987). In view of the fact that the size of capital in textile industries is not amenable to immediate adjustments, a variable cost function is preferred to a total cost function.

When a firm with given capital stock attempts to minimize the variable costs for producing a given level of output, there will be a total variable cost function as follows:

$$TVC = f(P_i, Y, K, t) \qquad \text{----------------- (3)}$$

where, TVC is the minimum variable cost, P_i is a vector of input prices, Y is output, K shows stock of capital and t represents the technology.

In this study, the following form of a translog variable cost function is estimated:

$$\ln TVC = b_0 + b_Y \ln Y + \sum_i b_i \ln P_i + b_k \ln K + b_t(t) + \frac{1}{2} b_{yy} (\ln Y)^2 + \frac{1}{2} \sum_i \sum_j b_{ij} \ln P_i \ln P_j$$

$$+ \sum_i b_{ki} \ln K \ln P_i + \frac{1}{2} b_{tt}(t)^2 + \sum_i b_{iy} \ln P_i \ln Y + \sum_i b_{it} \ln P_i (t) + b_{yt} \ln Y(t) \qquad \text{-------- (4)}$$

Where, $b_{ij} = b_{ji}$, TVC = total variable cost, b_0 = constant term, Y = output, K = capital stock, P_i = vector of input prices, t = trend variable.

For a well-behaved production function, the following restrictions need to be imposed on the variable cost function (4) so that it is homogeneous of degree one in input prices:

$$\sum_i b_i = 1, \quad \sum_i b_{iy} = 0, \quad \sum_i b_{ij} = \sum_j b_{ji} = \sum_i \sum_j b_{ij} = 0, \quad \sum_i b_{it} = 0 \qquad \text{-------- (5)}$$

In order to improve the efficiency of estimates, the translog variable cost function is estimated along with the share equations. The share equations (S_i) for each factor can be arrived at by differentiating the total variable cost function with respect to input prices. The resulting share equations, known as Shephard's lemma (Shephard 1953), take the following form:

$$\frac{\partial \ln TVC}{\partial \ln P_i} = S_i = b_i + b_{ii} \ln P_i + \sum_i b_{ij} \ln P_j + b_{iy} \ln Y + b_{ki} \ln K + b_{it}(t) \quad \text{---------} \ (6)$$

$(i = l, e)$.

For this study, the specified cost function and the share equations have been estimated jointly with the help of the econometrics software package *Shazam*, applying the maximum likelihood method. To overcome the problem of singularity, one of the share equations (material equation in this study) is arbitrarily dropped from the system estimation. It should be noted that the resulting maximum likelihood estimates are invariant to the equation dropped (Barten 1969).

An advantage of translog cost function is that it allows simplification of the model by imposing several alternative restrictions on a well-behaved non-homothetic cost model. A cost function is homothetic, if $b_{iy} = 0 \ \forall \ i = 1 \ldots n$. Further, it is homogenous of constant degree in output, if $b_{iy} = 0 \ '' \ i = 1 \ldots n$, and $b_{yy} = 0$.

The validities of various restrictions, mentioned above, are checked with the help of likelihood ratio test (Christensen and Greene 1976). The likelihood ratio statistics (l) is calculated as:

$$l = 2(\ln U - \ln R) \quad \text{-------------------} \ (7)$$

where, $\ln U$ and $\ln R$ are the values of likelihood ratio statistics of unrestricted and restricted models respectively. Here l follows asymptotically a *chi-square* distribution with degree of freedom equal to number of independent restrictions imposed.

A well-behaved cost function, in addition to being homogeneous of degree one in input prices, should be: (i) non-decreasing in input prices (known as the condition of monotonicity), and output, (ii) non-increasing in K, and (iii) concave in P_i. Negative own-price elasticities of factor demand are a necessary condition and negative semi-definiteness of 'n ´ n' matrix of substitution elasticities is both necessary as well as sufficient conditions for concavity.

D. Estimation of Production Characteristics

Three main production characteristics - capacity utilization, scale economies and price elasticity of demand for inputs - have been analyzed. The methodology followed in each case is discussed below.

(a) Estimation of Capacity Utilization

The capacity utilization (*CU)* is defined as the ratio of shadow cost to the actual production cost; i.e.:

$$CU_t = \frac{TC^*}{TC} \qquad \text{--------------------(8)}$$

Where, $TC = \sum_i P_i X_i + P_K K$ = actual cost (i = variable input); and $TC^* = \sum_i P_i X_i + Z_K K$ = shadow cost. The difference between TC^* and TC would emerge when the market rental of capital (P_K) is different from the shadow cost of capital (Z_K).[11]

From our estimated cost function, following Lau (1978), the shadow cost of capital can be arrived at as:

$$Z_K = -\frac{\partial VC}{\partial K} \qquad \text{--------------------(9)}$$

$$= -\frac{VC}{K}\{\mathbf{b}_K + \mathbf{b}_{KK}\ln\left(\frac{P_L}{P_M}\right) + \mathbf{b}_{KE}\ln\left(\frac{P_E}{P_M}\right) + \mathbf{b}_{KE}\ln\left(\frac{P_E}{P_M}\right) + \mathbf{b}_{ky}\ln Y + \mathbf{b}_{Kt}t\} \qquad \text{--------(10)}$$

It should be noted that CU_t as measured above pertains to the utilization of capacity from long run point of view, i.e. it corresponds to the long run average cost curve. Alternatively, following Cassel (1937) and Hickman (1964), capacity utilization can be calculated as a ratio of actual output to the output at the minimum point[12] (Y_m) of the short run average cost (*SRAC)* curve. Symbolically,

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[11] In short-run, a firm may end up either over-utilizing or under-utilizing the capacity, depending upon the change in demand. When there is an increase in demand, the firm perceives the shadow price of its existing capital stock to be higher than the market rental and hence $TC^* > TC$, and $CU > 1$. In case of unexpected decline in demand, the firm would perceive shadow price of its capital to be lower than the market rental, resulting in $TC^* < TC$, and $CU < 1$.

[12] See Appendix B for derivation of *Ym.*

$$CU_m = \left(\frac{Y}{Y_m} \right) \quad \text{--------------------(11)}$$

where CU_m is short run capacity utilization.

If Y > Y_m, then CU > 1, indicating over utilization of short-run capacity. Conversely, if Y< Y_m, then CU_m < 1, indicating under utilization of short-run capacity.

(b) Estimation of Economies of Scale

There are two types of scale economies; one pertaining to short-run and the other pertaining to the long-run. Since the size of capital is fixed in the short-run, economies associated with level of production reflect returns to variable factor only and hence are known as short-run returns to scale (*SRTS*). From the estimated variable cost function, the *SRTS* can be calculated as:

$$SRTS = \left(\frac{\partial \ln VC}{\partial \ln Y} \right)^{-1} \quad \text{---------------(12)}$$

In long-run, however, when all the factors including capital are variable, returns associated with scale are known as long run returns to scale (*LRTS*). Following Brautigam and Daughety (1983), the *LRTS is* estimated as:

$$LRTS = \frac{1-(\partial \ln VC / \partial \ln K)}{\partial \ln VC / \partial \ln Y} \quad \text{--------------(13)}$$

The *LRTS* includes the effects of shift in the long run average cost (*LRAC)* curve - upward or downward - and the movement along the given *LRAC* curve of an industry. Due to factors like, the entry and exit of firms with varying scale and efficiency, changing capacity utilization, general scale economies and diseconomies etc, an industry may not only witness movement along the cost curve but it may also witness its cost curve shifting upward or downward. Hence, it is possible that *LRTS < 1* in spite of all the existing firms producing output on the falling portion of the *LRAC* curve.[13] In present study, therefore, an attempt is also made to locate whether the existing firms were producing on the falling or the rising portion of the *LRAC* curve at a point of time For locating the position of an industry on the *LRAC* curve at a point of time, the difference between CU_t and CU_m is calculated. If the difference is found positive, the industry would be operating on the falling portion of *LRAC* curve and when it is negative it would be operating on the rising portion of the *LRAC curve.*

(c) Estimation of Price Elasticities of Inputs

From the parameters of the estimated variable cost function, the own- and cross-price elasticities of factor demand for the respective industries can easily be estimated. By building the work of Uzawa (1962), Berndt & Wood (1975) showed that for the translog model, the own- and cross price elasticities of demand can be calculated as:

$$e_{ii} = \hat{S}_i \sigma_{ii} = \frac{b_{ii} + \hat{S}_i^2 - \hat{S}_i^2}{\hat{S}_i}, \quad \text{and} \quad e_{ij} = \hat{S}_j \sigma_{ij} = \frac{b_{ij} + \hat{S}_i \hat{S}_j}{\hat{S}_i}, \; i \neq j \qquad \text{-------(14)}$$

where $\hat{S}_i$ are the fitted cost shares for input *i*, and σ_{ij} are the Allen partial elasticity of substitution. In context of equation (14), it is important to note two points: (a) own- and cross-price elasticities are only partial. For instance, the estimated cross price responses only account for the substitution between the variable input factors under constraint that the aggregate quantity of output remains *(Y)* constant. (b) These price elasticities are valid for the levels of the capital stock at which they are evaluated. In other words, they should be interpreted as capturing only the short-run responses to relative price changes in variable factors.

E. *Decomposition of the Unit Cost*

Caves and Christensen (1988) showed that with the help of a variable cost function the unit cost differential between any two observations, 1 and 0, can be decomposed into various sources using the following formula:

[13] On the basis of *LRTS < 1* alone, one might wrongly conclude that smaller size of firm/industry would be more economical than larger.

$$c^1 - c^0 = S\left[\frac{1}{2}\left(d_y^1 C_v + d_y^0 C_v\right) * \left(Y^1 - Y^0\right) - \left(Y^1 - Y^0\right)\right] \text{ output}$$

$$+ S\left[\frac{1}{2}\left(d_k^1 C_v + d_k^0 Cv\right) * \left(K^1 - K^0\right)\right] + (1 - S)\left[\left(K^1 - K^0\right) - \left(Y^1 - Y^0\right)\right] \text{capital stock}$$

$$+ S\left[\frac{1}{2}\left(d_t^1 C_v + d_t^0 C_v\right) * \left(t^1 - t^0\right)\right] \text{ technical change}$$

$$+ S\left[\frac{1}{2}\left(d_w^1 C_v + d_w^0 C_v\right) * \left(W^1 - W^0\right)\right] + (1 - S)\left(W_k^1 - W_k^0\right) \text{ all input prices --- (15)}$$

where, subscripts denote observation 1 and 0, Y is output, W_k is the price of capital input, S denotes the average share of variable cost in total cost for observations 1 and 0, $d_x^i C_v$ is the partial derivative of variable cost for observation i with respect to variable x, and * shows the multiplication between the vectors.

In equation (15), the first three rows of *RHS* show the effect of productivity growth[14] whereas the last row shows the effect of the change of all input prices on unit cost. It should, however, be noted that the productivity change as measured from equation (1) comprises of technical change as well as technical efficiency whereas the same from equation (15) includes only the former. In order to account for the later too, an attempt is made to calculate it indirectly by taking the difference of productivity growth estimated by equations (1) and (15).

IV. Data and Variables

This section is divided in three sub-sections. First sub-section describes the data and their sources. In second sub-section, construction of variables for the analysis is discussed. Finally, the last sub-section explains the trends in selected variables.

[14] Productivity growth is the difference between the growth in unit cost and the factor prices.

A. Data

To asses the performance selected industries - cotton yarn, man-made and garments - a panel data consisting of 16 states in cotton yarn, and 13 each in man-made and garments are utilized for a period of 1989-90 to 1997-98[15]. In order to be more specific in the analysis, the important three digit level industries are chosen from respective two-digit level classification of the Annual Survey of Industries (*ASI*). For cotton yarn the *ASI* code *235* is considered, which refers to 'cotton spinning, weaving, and processing in mills'. Since mills' contribution in production of cloth is low at around 4 per cent, this category is taken to represent the cotton yarn only. For man-made textile *ASI* code *247* is selected, which represents 'spinning, weaving and processing of man-made textiles fibres'. The required data for garment industry is arrived at by adding *ASI* code *260* (manufacture of knitted or crocheted textile products) to *265* (manufacture of all types of textiles garments and clothing accessories).[16]

Estimation of the variable cost function requires data on prices of the factors of production and the quantities of inputs and output. These statistics at the state level are drawn mainly from the *ASI*, published by the Central Statistical Organization (CSO), Government of India. For estimating the determinants of productivity growth, data are obtained from other sources as well. State level data on road-density, availability of electricity, credit disbursement by schedule commercial banks (*SCBs*) specific to an industry are collected from various publications of the *CMIE*. Statistics on *NRP* and *NTB* are incorporated from a study by the *NCAER* (2000). The data have also been utilized from sources like the Chandhok (1990), various publications of the *Monthly Index Numbers of Wholesale Prices, National Accounts Statistics, RBI Bulletin,* and the *Input-Output* table.

[15] At attempt was made to include data up to 1999-00. However, there was found to be a big jump in each series between 1997 and 1998, due to the change in industry code.

[16] It may be noted that each of these groups at three-digit level accounted for a significant share in the total output at two-digit levels. For instance, in 1997-98, the share of cotton yarn in total 'manufacture of cotton textiles' (23) was 69 per cent, of man-made in 'manufacture of wool, silk, and man-made fibre textiles' (24) was 61 per cent, and of garments (*260+265*) in 'manufacture of textile products' (26) was 84 per cent.

B. Construction of Variables

(a) Cost Function

Inputs: For the purpose of estimating the variable cost function, the total expenses are divided into four broad categories – labour (*l*), energy (*e*), materials (*m*), and capital (*K*). Of these labour, energy and materials are taken as the variable factors, whereas the capital is assumed to be a quasi-fixed factor. The price index of labour is derived by dividing the 'total emoluments' provided to the employees by the 'total persons engaged'. Total emoluments include the total wages and imputed value of benefits in kind. The 'total persons engaged' is a broad category and includes all labour input that has gone into production process directly or indirectly. Share of labour is arrived at by dividing the total emoluments by the total variable cost. The category 'energy' includes all the items of fuel, lubricants, electricity, water and gasoline consumed by the factory during the accounting year. A weighted price index for 'energy' is prepared for each industry by using the relevant weights and wholesale price indices of coal, mineral oil, and electricity. Weights of these items are taken from the input-output table of the year 1993. Share of energy in variable cost is obtained by dividing the total expenses on energy by the total variable cost. The input material includes all items of raw materials, components and chemicals, which entered into production process. A weighted price index for materials is constructed by applying weights *from input-output* table of 1993. Out of 115 sectors reported in *input-output* table, the production process in textiles and garments industries draw significant quantities for materials only from few sectors. Hence, 4 to 7 major groups were prepared to construct weights for material inputs, depending upon the industries. The share of material input is derived by dividing the total material expenses by total variable cost.

Assuming that the flow of service is proportional to stock, the following 'perpetual inventory method' is used to create the real capital stock (Christensen and Jorgenson 1969):

$$K_{it} = I_{it} + (1 - d_i)K_{i,t-1} \qquad \text{-------------------- (16)}$$

where, K_{it} = the real capital stock of category i at year t, I_{it} = the real value of net investment on category i at time t, and $d_i = 1/n_i$, where, n_i = economic life of asset i, showing a constant rate of depreciation of asset i over its life span.

In order to apply the perpetual inventory method, the following information are required: (i) benchmark capital stock, (ii) annual investment, (iii) life of capital assets, and (iv) price of capital assets. The benchmark capital stock (1989-90) for respective industry is calculated by applying the ‘all India’ ratio of fixed capital stock (constant prices) to the net fixed capital stock (current prices) for the year 1973-74. To arrive at the benchmark capital stock (constant prices) for 1973-74, ‘gross net ratio’ for respective industry was calculated from the *RBI bulletin* (1976), and the gross fixed capital stock was divided by the price of capital assets averaged over 1958 to 1973 period. Annual gross investment series is constructed by adding deprecation to the net fixed capital stock as reported in the *ASI*. By deflating the annual gross investment series with the index of capital price, annual real investment for each year is calculated. To deflate the annual investment series, following the studies like Banerjee (1975), Goldar (1986), and Das (2003), a weighted wholesale price index of construction and machineries is constructed; weights being the proportion of their share in capital stock during the year 1973-74. An implicit price deflator for investment in construction is prepared from *National Account Statistics*. Price index of ‘industrial machinery for food and textile’ is used as a proxy of machinery price index. Life of capital stock is assumed to be 25 years in line with some of the studies like Hulten and Srinivasan (1999) and Barik (2003). Consequently, capital is allowed to depreciate at the constant rate of 4 per cent per annum.

The price of each of the capital input is computed to reflect one period ‘user cost of capital’. Since a well-developed rental market for capital does not exist, the price of capital service is derived indirectly. Hall and Jorgenson (1967) argue that the price of capital services should include four components: (i) the opportunity cost of capital, (ii) depreciation associated with the use of capital, (iii) expected capital gains or losses, and (iv) expected changes in direct taxes at the time of purchasing the capital goods. In the present study, however, only the first two components could be incorporated in the price of capital, as the data on the remaining was not available. Thus, the price of capital services ‘i’ (P_{ki}) is calculated as:

$$P_{ki} = P_{ni}(R + d_i) \qquad \text{---------------- (17)}$$

where, P_{ni} = price of investment goods i, R = current interest rate (the long term lending rate of the Industrial Development Bank of India), d_i = depreciation rate of assets i, ($d_i = 1/n_i$, where, n_i = economic life of the asset i).

Output: The gross value of the output, as given in the *ASI*, is taken as a measure of output. Since the output values are reported at historical prices, there is a need to neutralize price changes by using appropriate price deflators. In the present study, the whole sale price indexes (at 1981-82 prices) of cotton yarn, man-made textiles, and textile products have been applied to deflate the output of cotton yarn, man-made and garment sectors, respectively.

(b) Determinants of Productivity

TFP series is estimated as per equation (1). Output per firm (*OPF*) for each industry is arrived at by dividing the output of a state by the number of factories in that state. *CUm* is estimated by applying equation (11). State level credit disbursement to cotton textiles, non-cotton & non-jute textiles and total textiles are used for cotton yarn, man-made and garment industries, respectively. The series on 'electricity available' (*ENRA*) and credit disbursements (*CRT*) are divided by the output of the concerned industry to make them comparable across states. Road density is the road per unit of the geographical area of a state.

C. Trends in Variables

{a) Cost Function

Table 2 provides the yearly mean-level statistics (averaged across states) of the important variables at selected sample points. The output of garment during the study period increased the maximum at the average annual rate of 24.5 per cent, followed by man-made at 12.4 per cent and cotton yarn at 3.1 per cent. There is a significant difference in the growth of the prices of labour and material inputs across the industries. Cotton yarn witnessed a high increase in price of materials (11%), whereas man-made and garment sectors experienced a high increase in price of labour (11% and 12% respectively). The garment sector has the largest potential to provide employment. A 25 per cent average annual growth in its output resulted in growth in employment by 13 per cent, compared to man-made textile where a 12 per cent growth in output generated only 3 per cent additional employment. The cotton yarn sector, however, appears to have limited scope for employment, as here the growth in output is accompanied by reduced employment. All the three industries witnessed sharp increase in the capital stock, resulting in declining share of variable cost in total cost. The garment sector has relatively larger share of variable cost in total cost, indicating labour intensive nature of the industry. Also, it witnessed growing share of wages in variable cost (2.3%), as opposed to other two industries where it declined. The share of energy increased in all the cases, which could be attributed to increasing capital intensity of the industries.

Table 2:Relative Statistics of Some Important Variables at Selected Sample Points*

Year	Q_y	P_l	P_e	P_m	P_k	Q_l	Q_e	Q_m	Q_k	S_l	S_e	S_m	VC	VC / TC
	Cotton Yarn													
1989-90	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.18	0.11	0.71	1.00	0.83
1991-92	1.05	1.21	1.23	1.23	1.26	0.94	1.02	1.09	1.08	0.17	0.10	0.73	1.30	0.83
1993-94	1.11	1.49	1.74	1.46	1.46	0.93	1.05	1.17	1.26	0.16	0.12	0.72	1.65	0.81
1995-96	1.23	1.83	2.00	2.05	1.80	0.97	1.31	1.43	1.73	0.14	0.11	0.76	2.68	0.80
1997-98	1.27	2.03	2.56	2.07	1.77	0.90	1.33	1.54	1.93	0.14	0.13	0.73	2.98	0.79
GR (%)	*3.07*	*9.42*	*12.69*	*10.96*	*8.54*	*-0.99*	*3.92*	*5.61*	*9.35*	*-4.06*	*1.85*	*0.61*	*15.90*	*-0.72*
	Man-made Textiles													
1989-90	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.10	0.08	0.82	1.00	0.86
1991-92	1.58	1.31	1.22	1.11	1.25	0.96	1.09	1.09	1.35	0.09	0.09	0.82	1.22	0.86
1993-94	2.37	1.68	1.74	1.32	1.45	1.04	1.31	1.37	2.31	0.08	0.10	0.82	1.83	0.83
1995-96	2.39	2.03	1.99	1.55	1.77	1.23	1.57	1.77	2.69	0.08	0.10	0.83	2.74	0.80
1997-98	2.85	2.32	2.56	1.62	1.74	1.14	1.42	1.73	3.16	0.08	0.12	0.81	2.83	0.81
GR (%)	*12.36*	*10.90*	*12.70*	*6.90*	*8.30*	*2.82*	*5.80*	*7.73*	*17.62*	*-3.27*	*3.47*	*-0.05*	*15.34*	*-1.32*
	Garments													
1989-90	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.12	0.02	0.86	1.00	0.92
1991-92	1.48	1.26	1.27	1.17	1.26	1.12	1.30	1.18	1.65	0.12	0.03	0.86	1.39	0.91
1993-94	2.37	1.67	1.75	1.36	1.47	1.76	1.84	1.84	3.14	0.13	0.03	0.84	2.53	0.90
1995-96	4.53	1.98	1.97	1.74	1.82	2.24	3.12	2.47	8.55	0.11	0.03	0.86	4.34	0.88
1997-98	5.32	2.36	2.52	1.83	1.79	2.23	3.41	2.59	10.89	0.14	0.04	0.83	4.91	0.87
GR (%)	*24.5*	*12.1*	*12.19*	*8.68*	*8.69*	*12.9*	*18.8*	*14.1*	*38.4*	*2.31*	*4.63*	*-0.48*	*24.5*	*-0.85*

Note: (i) * these are mean values averaged across states for each year. (ii) GR = average annual growth rate.

(b) Determinants of Productivity

Trends in the selected variables of the productivity determinants are shown in figures 1-4. TFP in man-made and garment sectors reached the maximum level during 1993-94, whereas that in cotton yarn could never go beyond the base year level. Productivity of only man-made textile has shown improvement over the study period. In terms of output per firm, the garment sector has registered the maximum increase, followed by the man-made sector. Cotton yarn sector witnessed the lowering of output per firm over the years. Compared to the base year, the CU_m in case of cotton yarn and garments has declined considerably, whereas in man-made textile it moved both sides of the base year value. Total credit disbursement to the entire textile sector did not improve much, except during 1997-98. Cotton textile and non-cotton and non-jute textile witnessed sharp increase in credit demand from 1994-95, which continued till last year in former but stopped a year before in the later. The indexes of energy availability and road density improved consistently over the study period from 1.00 to 1.61 for former and to 1.25 for later, registering an average annual growth of 6 per cent and 3 per cent, respectively. Reforms also led to a significant decline in *NRP* and *NTB* for textile products and machineries. Over the period 1989-90 to 1997-98, the *NRP* went down from 97 to 10 per cent in cotton, 201 to 43 in art silk & synthetic fibre textiles, 150 to 45 in readymade garments, and 107 to 27 in food & textile machinery. Similarly, the *NTB* for cotton, art silk & synthetic fibre textiles, readymade garments, and food & textiles machinery fell from the index of 100 in 1989-90 to 50, 42, 91, 7 per cents, respectively in 1997-98.

Figure1: Total Factor Productivity (*TFP*)

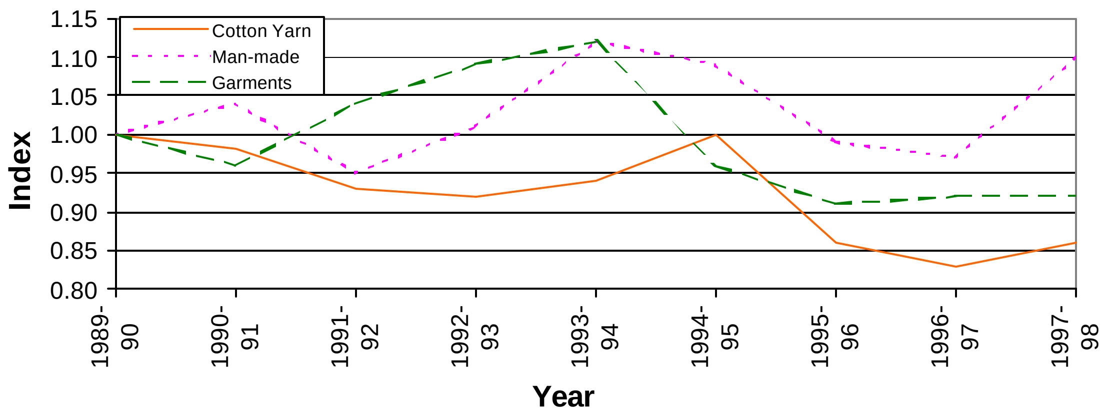


Figure 2: Output Per Firm (*OPF*)

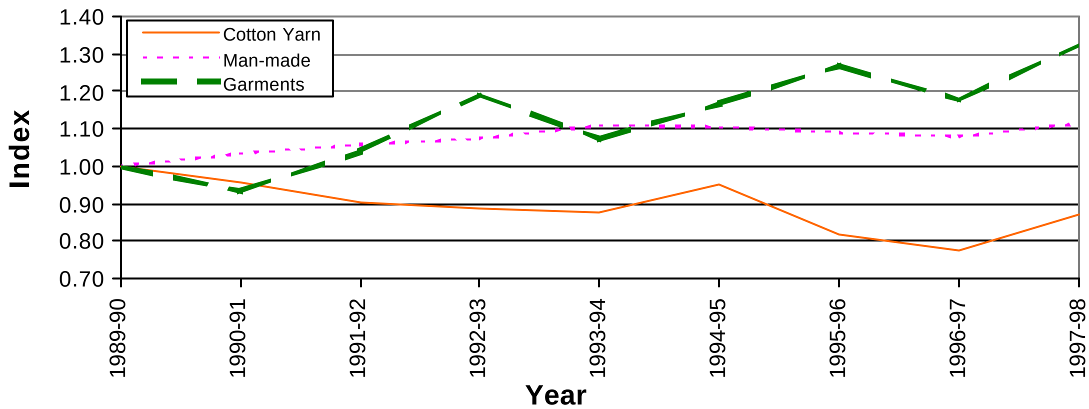


Figure 3: Capacity Utilization (*CUm*)

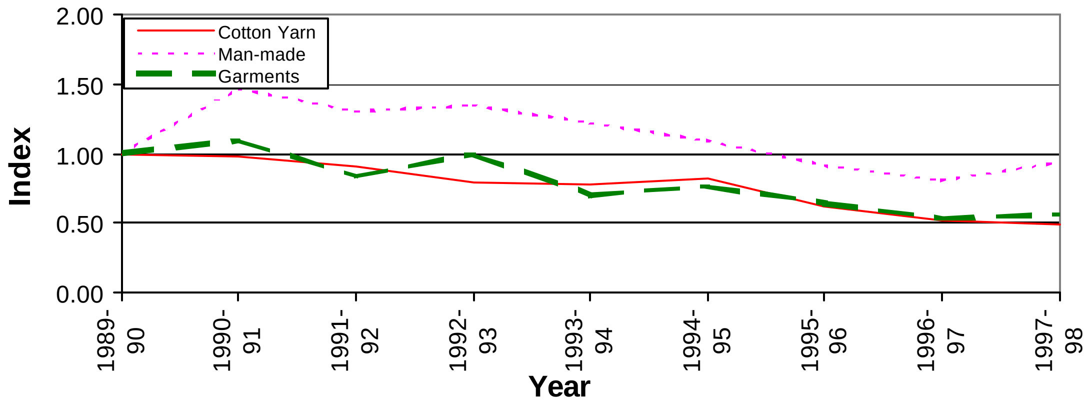
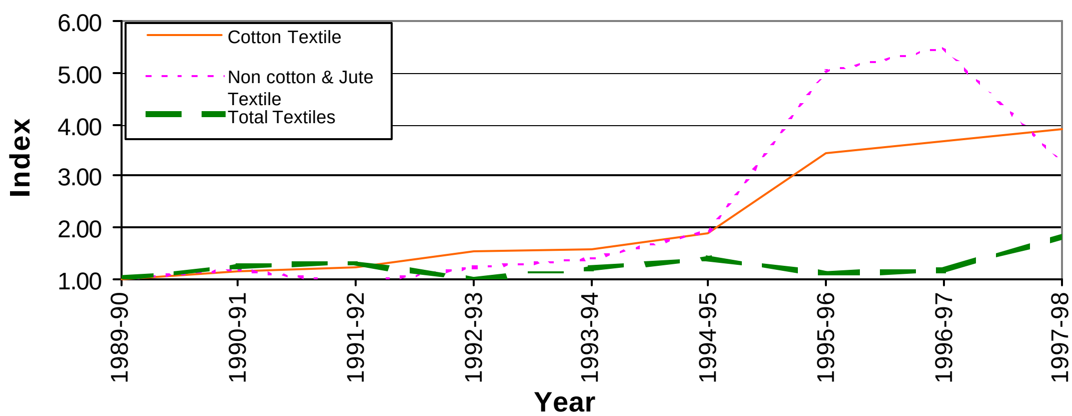


Figure 4: Credit Disbursement (*CRT*)



V. Empirical Findings

A. Unit Cost and Productivity

Table 3 shows the unit cost and *TFP* levels for selected industries over the study period, with values of both the variables for 1989-90 as one. To provide an idea of the increase in cost in real terms, the unit cost at constant prices is also indicated. Since the exchange rate of domestic currency affects the import price for a foreign country, the unit cost needs to be shown in the foreign currency as well. In this study, the unit cost at constant prices is converted into US dollars.

Comparing the growth in unit cost at current prices across industries, it can be seen that the cotton yarn industry witnessed the highest growth in unit cost (13%), followed by garments (10.5%) and man-made (7%) sectors. In case of cotton yarn and garments, the real unit cost increased too. This is unwarranted particularly for cotton yarn, as India enjoys distinct advantage in production of cotton. There is perhaps a need to increase the cotton yield.[17] All the three industries registered a significant decline in real unit cost, when measured in US dollars, which can largely be attributed to the appreciation of dollar against rupee. This to a great extent explains why India performed satisfactorily in export of textiles, despite not so-good performance in terms of productivity. In future, if the value of money does not decline so fast as it did in the past (or it increases), it will make the job of exporting textiles from the country relatively difficult.

The high unit cost growth in cotton yarn and garments can be attributed to poor productivity performance, as both the industries witnessed negative *TFP* growth over the study period. Though the man-made sector recorded improvement in productivity and relatively lower unit cost growth, its performance could have been still better, if material prices were brought down at par with the international standard.

[17] Yield of cotton in India is only around 300 kg/ha, compared to 1064 kg/ha in China.

Table 3: Unit Cost (*UC*) and *TFP* levels

(1989-90=1)

Sector	UC & TFP	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	GR
Cotton Yarn	**UC** (Current)	1.08	1.33	1.47	1.59	1.82	2.32	2.41	2.35	*12.66*
	UC (constant)	0.98	1.06	1.07	1.06	1.10	1.30	1.27	1.18	*3.18*
	UC in $ (constant)	0.91	0.72	0.58	0.56	0.58	0.65	0.60	0.53	*-6.49*
	TFP	0.98	0.93	0.92	0.94	1.00	0.86	0.83	0.86	*-1.94*
Man-made	**UC** (Current)	1.01	1.18	1.25	1.20	1.30	1.59	1.69	1.55	*6.77*
	UC (constant)	0.92	0.94	0.91	0.80	0.78	0.89	0.89	0.78	*-2.21*
	UC in $ (constant)	0.85	0.64	0.49	0.43	0.42	0.44	0.42	0.35	*-11.38*
	TFP	1.04	0.95	1.01	1.12	1.09	0.99	0.97	1.10	*0.55*
Garm-ents	**UC** (Current)	1.11	1.14	1.18	1.24	1.61	1.93	2.01	2.07	*10.62*
	UC (constant)	1.01	0.91	0.85	0.83	0.97	1.08	1.06	1.04	*1.31*
	UC in $ (constant)	0.93	0.62	0.46	0.44	0.51	0.54	0.50	0.47	*-8.19*
	TFP	0.96	1.04	1.09	1.12	0.96	0.91	0.92	0.92	*-1.42*

Note: * refers to the average annual growth rate, GR = average annual growth rate.

Table 4 shows the productivity and cost levels for the three industries across states. It can be seen that the ranking of a state in terms of unit cost and productivity has merged in number of cases. When they have not merged, there is only slight difference. The coefficient of correlation between productivity and the unit cost levels turned out to be –0.69 in cotton yarn, -0.46 in man-made textiles, and –0.68 in garment sectors. States managing better productivity performance incurred lower unit cost and vice-versa.

Table 4: Average (1989-97) Unit Cost and TFP Levels

State	Cotton Yarn		Man-made textiles		Garments	
	Unit Cost	*TFP*	*Unit Cost*	*TFP*	*Unit Cost*	*TFP*
AP	1.00 (09)	1.00 (09)	1.00 (10)	1.00 (08)	1.00 (13)	1.00 (13)
Bihar	0.97 (08)	1.04 (06)	-	-	-	-
Delhi	1.05 (12)	0.95 (12)	1.05 (11)	0.94 (11)	0.54 (01)	1.90 (02)
Gujarat	1.05 (11)	0.94 (13)	1.00 (09)	0.99 (09)	0.78 (10)	1.34 (10)
Haryana	0.96 (07)	1.04 (07)	0.99 (07)	1.01 (06)	0.68 (07)	1.48 (07)
HP	-	-	0.98 (05)	1.01 (07)	-	-
Karnataka	0.94 (03)	1.08 (03)	0.81 (01)	1.29 (01)	0.68 (05)	1.55 (04)
Kerala	0.94 (04)	1.07 (05)	-	-	0.85 (12)	1.20 (11)
MP	0.95 (05)	1.01 (08)	0.90 (02)	1.11 (02)	0.83 (11)	1.19 (12)
Maharastra	1.04 (10)	0.98 (10)	0.95 (04)	1.05 (04)	0.60 (03)	1.71 (03)
Orissa	1.16 (15)	0.90 (15)	-	-	-	-
Pondicherri	1.06 (13)	0.97 (11)	-	-	-	-
Punjab	0.86 (01)	1.17 (01)	0.98 (06)	1.02 (05)	0.74 (08)	1.37 (08)
Rajasthan	0.96 (06)	1.07 (04)	1.00 (08)	0.99 (10)	0.55 (02)	2.05 (01)
Tamil Nadu	0.89 (02)	1.12 (02)	0.95 (03)	1.11 (03)	0.67 (04)	1.54 (05)
UP	1.20 (16)	0.84 (16)	1.06 (12)	0.94 (13)	0.68 (06)	1.52 (06)
WB	1.10 (14)	0.90 (14)	1.06 (13)	0.94 (12)	0.76 (09)	1.37 (09)
Average	**1.01**	**1.01**	**0.98**	**1.03**	**0.72**	**1.48**

Note: (i) Figure in bracket indicates the ranking of the industry concerned in a state.
(ii) Ranking of unit cost is based on ascending order and that of TFP is based on descending order of the levels.
(iii) Figures of states are normalized with the first-year productivity & unit cost levels of AP.

Table 5 provides the average annual growth in unit cost and *TFP* for the three industries during 1989-97 period. Despite the general textile and clothing policy being the same, states have experienced a varied unit cost growth in an industry. For instance, in cotton yarn the average unit cost growth varied from 8.6 per cent for MP to 16 per cent for Orissa. Similarly, in man-made textiles the growth in unit cost varied from 2.8 per cent in Karnataka to 8.6 per cent in UP. The garments too witnessed the difference in unit cost growth from 7 per cent in MP to 18 per cent in Rajasthan.

It can also be seen from the table that in general the states suffering poor productivity growth suffered higher growth in unit cost and vice-versa. For instance, in case of cotton yarn, Orissa witnessed the maximum decline in productivity (-5.3%) and it also suffered the largest growth in its unit cost (16.3%) amongst all states.

Analyzing the productivity performance across states, one finds that there has been varying productivity performance in the three industries. While most of the states in cotton yarn and garment sectors witnessed negative *TFPG*, in man-made majority of them registered positive productivity growth over 1989-97 period.[18] Negative productivity growth in cotton textiles registered by all the four major states – *AP*, Gujarat, Maharastra, and Tamil Nadu, accounting for around 72 per cent of the total output of the country - is a worrying sign. In case of man-made textiles though the situation is better but it is still not satisfactory. Six major states - accounting for 83 per cent of the output of man-made textile - could register an average annual growth of only 0.45 per cent, varying from 1.97 in *MP* to –1.31 in *UP*. In garments, all the five major states - accounting for 87 per cent of the output – witnessed negative productivity growth over the study period.

Table 5: Average Annual Growth in Cost and Productivity in Indian Textile and Garment Industries (1989-97)

(%)

State	Cotton Yarn		Man-made		Garments	
	Unit Cost Growth	TFPG	Unit Cost Growth	TFPG	Unit Cost Growth	TFPG
AP	12.27	-1.42	8.83	-1.46	11.30	-2.43
Bihar	13.62	-2.63	-	-	-	-
Delhi	14.51	-4.15	7.10	-0.13	11.51	-2.27
Gujarat	11.17	-0.81	6.56	0.61	11.17	-1.83
Haryana	10.90	-0.16	6.80	0.69	4.81	4.21
HP	-	-	5.39	1.80	-	-
Karnataka	12.56	-1.71	2.78	5.04	11.73	-2.09
Kerala	13.32	-2.46	-	-	11.12	-2.27
MP	8.55	1.49	5.34	1.97	6.97	1.90
Maharastra	13.33	-2.46	6.91	0.34	10.06	-1.10
Orissa	16.31	-5.33	-	-	-	-
Pondicherri	13.52	-2.74	-	-	-	-
Punjab	12.10	-1.35	7.13	0.18	9.82	-0.97
Rajasthan	14.60	-3.47	6.22	0.92	17.58	-7.42
Tamil Nadu	12.48	-1.70	8.53	-0.88	10.22	-0.94
UP	13.92	-3.18	8.65	-1.31	12.44	-2.89
WB	9.12	1.40	7.93	-0.45	9.48	-0.70
Average	**12.64**	**-1.92**	**6.78**	**0.56**	**10.63**	**-1.45**

The partial factor productivity estimates of inputs are shown in table 6. There is decline in productivity of capital in all the three industries. This could perhaps be attributed to the industries becoming more capital intensive in post-liberalization period. Consequently, the productivity of labour in all the industries improved. However, the improvement in labour productivity in case of man-made textile is more pronounced. The rigid labour laws in

[18] The exceptions to this have been the *MP* and *WB* in cotton yarn; *AP*, Delhi, Tamil Nadu, *UP* and *WB* in man-made textiles; and Haryana and *MP* in garments.

other two industries seem to have come in the way of satisfactory improvement in labour productivity. These two industries also suffered due to the decline in productivity of energy and materials, in contrast to man-made textiles, which recorded improvement in productivity of these factors too.

Table 6: Average Annual Growth in Partial Factor Productivity in Indian Textile & Garment Industries during 1989-97

(%)

State	Cotton Yarn				Man-made Textiles				Garments			
	Y/k	y/l	y/e	y/m	y/k	y/l	y/e	y/m	Y/k	y/l	y/e	y/m
AP	-2.3	4.2	-1.9	-1.8	-10.4	9.0	2.1	1.2	-5.80	1.31	-3.24	-0.22
Bihar	-2.8	-1.6	-3.4	-2.8	-	-	-	-	-	-	-	-
Delhi	-13.5	-1.6	5.0	-4.3	-17.7	11.7	10.8	1.1	-8.6	1.7	-5.5	-2.0
Gujarat	-8.5	8.2	5.8	-0.1	-3.2	1.3	5.8	1.5	-17.3	-1.1	-11.0	0.4
Haryana	2.7	6.5	-2.2	-1.5	-7.9	10.7	3.8	1.6	-2.4	7.4	-2.4	5.9
HP	-	-	-	-	1.3	6.6	-1.3	2.1	-	-	-	-
Karnataka	-5.3	2.5	-2.6	-1.1	7.2	15.8	8.1	3.6	-11.8	0.2	-4.7	-1.2
Kerala	-5.3	2.3	-3.8	-2.3	-	-	-	-	-18.8	0.8	4.4	-0.4
MP	-5.4	15.6	5.1	-0.2	-1.5	3.5	1.1	3.1	-0.9	-2.5	14.1	3.2
Maharastra	-6.5	1.5	-0.8	-2.4	-8.2	10.8	4.2	1.7	-11.2	1.0	-4.2	-0.3
Orissa	-12.5	-10.4	-8.1	0.7	-	-	-	-	-	-	-	-
Pondicherri	-8.4	-2.7	-0.4	-0.3	-	-	-	-	-	-	-	-
Punjab	-3.1	2.1	-5.6	-0.9	-3.9	11.9	2.1	0.9	-7.7	0.5	-1.7	-0.5
Rajasthan	-11.1	0.0	-3.1	-2.3	0.5	1.4	2.9	1.5	-16.1	-10.6	-10.3	-5.8
Tamil Nadu	-3.3	3.4	-2.4	-1.8	-10.2	9.6	-2.7	1.8	-6.2	3.1	-4.4	-0.8
UP	-12.4	2.6	-0.6	-0.7	-2.7	2.5	3.3	-0.6	-7.6	-0.5	-7.2	-1.9
WB	-1.6	8.8	1.6	0.7	-8.3	11.3	4.7	0.6	-9.3	4.7	6.9	-0.7
Average	**-6.2**	**2.6**	**-1.1**	**-1.3**	**-5.0**	**8.2**	**3.5**	**1.5**	**-9.5**	**0.5**	**-2.2**	**-0.3**

B. Determinants of Productivity

The results on determinants of productivity growth are reported in table (7). There is a positive relationship between *TFP* and *OPF*, and except for cotton yarn it is significant in other two cases.[19] All the three industries witnessed a significant positive relationship between *TFP* and CU_m. Cotton yarn sector, however, shows the largest scope to improve productivity by increasing CU_m. Here, 10 per cent increase in CU_m enhances the productivity by around 2 per cent. The relationship

[19] The scale economies available to an average firm could be one of the reasons for almost all the major states in garments falling in the first five states of the lowest unit cost category. This is because the degree of correlation between the state's output (Qy) and *OPF* is 0.5, implying higher the output, higher is the *OPF*.

between *TF*P and *RDD* in man-made and garment sectors is not conclusive. In all the three industries *TFP* is having a statistically significant relationship with *ENRA*. Lowering of *NRP* and *NTB* for textile machines and the products concerned have positive effects on *TFP*, though the degree varies across industries. A cut in *NRP* is expected to improve the productivity in cotton yarn and man-made textiles. Garments and man-made sectors benefit from lowering of *NTB* levels for textile machines and the respective products. So it can be argued that while *NRP* reduction would benefit the cotton yarn, lowering of *NTB* benefits the garments. Man-made, on the other hand, benefits from reduction in both *NRP* and *NTB*, though the effect of former is higher. The disbursement of credit significantly affects the *TFP* in man-made and garments but not in cotton yarn sector. A 10 per cent increase in *CRT* is likely to increase the *TFP* in the first two sectors by as much as around 1 per cent. The inconclusive relationship between *TFP* and *CRT* in cotton yarn, despite impressive credit disbursement to the sector, perhaps indicates the structural problems with the industry.

Table 7: Estimates of Determinants of Productivity

Dependent variable is Log (TFP)

Industry	*Log*										
	CONT	***OPF***	***CU_m***	***NRP***	***NTB1***	***NRPTM***	***NTBTM***	***CRT***	***ENRA***	***RDD***	*Overall R^2*
Cotton Yarn	-0.251 (-1.33)	0.045 (1.50)	0.228 (11.46)								0.173
(N=144)	-0.017 (-0.06)	0.030 (0.94)	0.267 (7.21)		0.0001 (0.01)	-0.025 (-1.48)		0.004 (0.18)			0.152
	-0.547 (-1.33)	0.024 (0.81)	0.443* (7.37)			-0.058 (-2.89)	0.0003 (0.07)		0.165* (3.25)	0.116* (2.45)	0.035
	-0.018 (-0.07)	0.030 (0.95)	0.267 (7.18)			-0.025 (-1.51)	0.001 (0.08)	0.004 (0.20)			0.152
	-0.534 (-1.27)	0.024 (0.79)	0.444* (7.38)		-0.001 (-0.06)	-0.059* (-2.84)			0.166* (3.26)	0.115* (2.43)	0.035
	0.076 (0.32)	0.010 (0.34)	0.282 (8.26)	-0.033 (-3.25)	0.001 (0.17)			-0.006 (-0.28)			0.153
	-0.435 (-1.17)	0.008 (0.27)	0.464* (9.63)	-0.051* (-4.64)	0.004 (0.52)				0.179* (4.08)	0.107* (2.38)	0.035
Man-made Textiles	-0.711 (-5.01)	0.113 (4.98)	0.133 (5.29)								0.137
(N=117)	0.874 (6.19)		0.383 (9.25)			-0.091 (-4.70)	-0.023 (-2.98)	0.107 (3.35)			0.078
	0.846 (1.84)		0.361* (7.19)			-0.138* (-5.55)	-0.029* (-3.22)		0.084* (2.04)	-0.029 (-0.44)	0.102
	1.120* (2.31)		0.362* (7.19)		-0.088* (-3.22)	-0.138* (-5.58)			0.085* (2.04)	-0.028 (-0.44)	0.102
	1.090 (6.74)		0.381 (9.25)		-0.069 (-2.98)	-0.092 (-4.74)		0.107 (3.35)			0.078
	1.005 (2.37)		0.401* (8.56)	-0.176 (-7.80)					0.121* (3.10)	-0.028 (-0.48)	0.094
	0.927 (6.78)		0.381 (9.81)	-0.115 (-7.86)				0.101 (3.40)			0.083
Garments	-0.324 (-2.25)	0.094 (2.61)	0.157 (5.48)								0.023
(N=117)	9.402 (4.19)		0.334 (6.88)		-2.03 (-4.15)			0.103 (2.74)			0.077
	10.435 (3.82)		0.316 (7.43)		-2.388* (-4.20)				0.092* (3.04)	0.040 (0.48)	0.089
	0.360 (2.31)		0.330 (5.69)			-0.011 (-0.37)	-0.055 (-4.33)	0.108 (2.68)			0.079
	0.133 (1.12)		0.194 (4.83)	-0.022 (-0.73)							0.011

Notes: (I) + NRP & NTB refer to those for ‘cotton’ in cotton yarn industry, ‘art silk, synthetic fibre textiles’ in man-made textiles, and garments in garments industry.

C. Estimate of the System of Equations

The parameter estimates and the corresponding *t*-statistics for the three industries are reported in Table 8. Out of 21 parameters estimated, 13, 12, and 14 are statistically significant (at 5% level) in cotton yarn, man-made textiles, and garment sectors respectively. The first-order coefficients have expected signs and they are all statistically significant, except in case of time variable. The estimated cost function satisfied the monotonicity condition, as the fitted cost shares turned out to be positive at all observations for each industry. Further, the fitted cost functions were found to be increasing in output and decreasing in capital at all observations. The necessary condition for satisfying concavity was also satisfied to a great extent, as the own-elasticities of substitution was found to be negative in most of the cases. In some cases, however, the own elasticity of substitution turned out to be positive at the sample mean. A violation of this magnitude can be ignored as a "small adjustments of certain of the cost function parameters would eliminate this problems and have no effect on the cost elasticities and productivity growth estimates" (Caves et al. 1981). Further, it should be noted that such a violation in concavity condition may possibly be attributed to *x-inefficiency*, as in most of firms of these industries a poor management and weak motivational factors are not ruled out.

Table 8: Parameter Estimates of Translog Variable Cost Function

	Cotton Yarn		Man-made		Garments	
Parameter	***Estimate***	***T-Ratio***	***Estimate***	***T-Ratio***	***Estimate***	***T-Ratio***
b_0 (Constant)	14.432	36.097*	14.204	28.229*	13.065	22.512*
b_K (Capital)	-0.21051	-15.075*	-0.1479	-9.365*	-0.076948	-6.106*
b_L (Labour)	0.18354	25.916*	0.10722	20.317*	0.10574	10.059*
b_E (Energy)	0.10202	21.008*	0.081853	16.020*	0.020358	7.154*
b_y (Output)	1.2191	56.533*	1.2747	47.529*	1.5657	24.255*
b_t (Time)	0.13193	0.704	-0.009331	-0.042	-0.17873	-0.709
b_{KK}	-0.18243	-5.532*	-0.15924	-8.012*	-0.061373	-4.054*
b_{KL}	-0.023902	-1.364	0.002257	0.305	0.007117	0.595
b_{KE}	-0.010064	-0.845	0.000693	0.107	0.002768	0.771
b_{KT}	0.002138	0.652	0.000863	0.229	-0.006974	-2.389*
b_{LL}	0.055277	2.155*	-0.000141	-0.009	0.093721	3.372*
b_{LE}	0.00017478	0.0105	0.079111	5.700*	0.039545	5.202*
b_{LT}	-0.0025018	-1.501	-0.004822	-3.155*	0.002945	1.155
b_{EE}	0.10117	3.711*	0.031674	0.714	-0.001802	-0.0915
b_{KY}	0.16422	7.160*	0.057841	5.400*	0.081387	5.078*
b_{LY}	-0.085604	-7.169*	-0.028377	-4.713*	-0.038902	-3.201*
b_{EY}	-0.018419	-2.372*	-0.006520	-1.130	-0.008344	-2.90*
b_{YY}	0.097531	3.125*	0.093491	3.669*	0.15045	3.044*
b_{ET}	0.0026914	1.386	-0.000503	-0.197	0.000698	0.712
b_{YT}	-0.016401	-3.965*	-0.010138	-1.794*	-0.035141	-2.739*
b_{TT}	-0.022535	-0.616	-0.000650	-0.015	0.028090	0.579

Note: (i) The estimates pertain to equation (3). (ii) * indicates statistical significance at 5% level.

The results of the likelihood ratio test, shown in Table 9, suggests that cotton yarn and garment sectors witnessed Hicks-neutral technical change, as against the man-made sector where technical change is biased. This means that the relative factor shares in cotton yarn and garment sectors have not undergone significant changes, whereas the same in man-made textile did change. Statistically significant coefficient of b_{LT} for man-made textiles further confirms the biased technical progress, which is against the labour use. The results showing unbiased technical change in cotton yarn and garment sector is surprising, as there has been extensive capital investment in these industries in post-liberalization period. This indicates that capital has not sufficiently substituted the labour in these two industries. Rigid labour policies and intensive labour using nature of these sectors may possibly be the reasons for this.

Likelihood ratio tests further show that all the three industries have non-homotheic structure of production.[20] This is also confirmed by the fact that the coefficients b_{LY} b_{EY} and b_{YY} are statistically significant at 5 per cent level in nearly all cases. It means the isoquants in case of Indian textile and garment industries are not radial projections of one another, as input bias in returns to scale is involved. Negative coefficients of b_{LY} and b_{EY} suggest that increase in scale is labour as well as energy saving in all the three industries.

Table 9: Results of Likelihood Ratio Tests

Hypothesis	Cotton Yarn	Man-made Textiles	Garments	Degree of Freedom	Table Value*
Hicks-Neutrality	5.41	9.49	1.51	3	7.82
Homotheticity	42.00	20.51	12.45	3	7.82
Homogeneity	44.35	27.64	23.59	4	9.49

Note: (i) Likelihood Ratio Tests are based on equation (7). (ii) * at 5% level of significance.

D. Economies of Scale and Capacity Utilization

Results on scale economies and capacity utilization are shown in Table 10. The major states in cotton yarn witnessed increasing returns to scale[21], whereas those in man-made and garment sectors witnessed decreasing returns to scale. Degree of decreasing returns to scale in case of garment is, however, much higher than that in man-made. The case of decreasing returns to scale in man-made and garment may give an impression that smaller firms are more cost effective than the larger firms. However, this would be an erroneous impression, since the major states in respective industries produced output on the falling portion of *LRAC* curve. Statistically significant positive relationship between

[20] This justifies the need of estimating a full translog cost function in present study.

[21] Using *ASI* data at two-digit-level for cotton textiles and by applying the Cobb-Douglas production function, Kumar (2001) found decreasing returns to scale for the cotton textile industry over 1973-94 period. There could be many reasons for the difference of the result. Unlike his analysis, the present analysis is based on a three-digit-level data. Also, the study-period and the methodology are different in the two studies.

TFP and *OPF* as noted earlier in this study further confirms the presence of scale economies in these two industries. In other words, it is the upward shift in the *LRAC* curve, which could be blamed for decreasing returns to scale in man-made and garment sectors.[22] Upward shift in *LRAC* curve, among other things, could possibly be attributed to the declining CU_m. This indicates that a few large firms without the loss of capacity utilization would have perhaps helped the industry experiencing the increasing returns to scale by moving sufficiently down the *LRAC* curve.

Another important feature of the result is that the major states (except Karnataka in garments) in respective industries produced output on the falling portion of the *LRAC* curve.[23] Minor states, by and large, on the other hand, produced output on the rising portion of the *LRAC* curve. In general, as the share of a state in output fell below 5 per cent, the negative gap between CU_t and CU_m increased. This implies that unless the output of the industry in a state reaches a minimum threshold level, it cannot start reaping the benefits of increasing returns to scale. This could mainly be due to: (a) lack of competition allowing firms to overuse their existing capacity, and (b) low level of technology associated with the smaller level of output.

The result on capacity utilization (CU_t) shows that on an average all the industries utilized their capacity optimally. But still the main states in respective industries, by and large, deviated from the optimum capacity utilization. While cotton yarn and man-made textiles in most of the major states witnessed under utilization of capacity, in garments all the major states over utilized it. Result on CU_m reveal that almost all the major states under utilized their capacity in all the three industries. On the other hand, all the minor states in man-made and garments over utilized their capacity, as measured in terms of CU_m.

[22] It may be recalled that the section on 'Determinants of Productivity' also indicated increasing returns to scale for an average firm in man-made and garment industries, as the relationship between *TFP* and *OPF* turned out to be positive and statistically significant.
[23] This could be one of the main reasons for states with larger output having relatively lower unit cost.

Table 10: Capacity Utilization and Returns to Scale in Indian Textile and Garment Industries (1989-97)

State	Cotton Yarn				Man-made				Garments			
	LRTS	***CU_t***	***CU_m***	***Diff******	***LRTS***	***CU_t***	***CU_m***	***Diff******	***LRTS***	***CU_t***	***CU_m***	***Diff******
AP	1.00	0.93	0.49	0.44	0.92	1.00	2.46	-1.46	0.76	0.91	4.58	-3.68
Bihar	1.09	1.13	3.10	-1.97	-	-	-	-	-	-	-	-
Delhi	1.11	1.09	1.63	-0.54	1.02	1.08	4.90	-3.83	0.73	1.04	0.75	0.30
Gujarat	1.09	0.93	0.19	0.75	0.96	0.98	0.30	0.68	0.81	1.04	1.04	0.01
Haryana	0.94	0.98	2.24	-1.26	0.95	1.05	1.49	-0.44	0.61	0.93	7.73	-6.80
HP	-	-	-	-	0.87	0.99	2.97	-1.97	-	-	-	-
Karnataka	1.07	0.99	0.59	0.40	0.84	1.09	13.43	-12.34	0.68	1.03	1.73	-0.70
Kerala	1.04	0.98	0.85	0.13	-	-	-		0.66	1.00	10.12	-9.13
MP	1.03	1.00	0.66	0.35	0.95	1.05	0.64	0.41	0.81	0.95	3.24	-2.30
Maharastra	1.06	0.99	0.21	0.78	0.95	1.00	0.32	0.68	0.74	1.05	0.81	0.24
Orissa	1.16	0.98	0.77	0.22	-	-	-	-	-	-	-	-
Pondicherri	1.06	0.99	1.05	-0.07	-	-	-	-	-	-	-	-
Punjab	0.96	1.02	0.98	0.04	0.93	0.97	0.57	0.40	0.86	1.07	0.42	0.65
Rajasthan	0.98	1.08	1.89	-0.81	0.91	0.95	0.31	0.64	0.62	1.00	8.62	-7.62
Tamil Nadu	1.00	1.03	0.21	0.82	0.96	1.05	1.32	-0.27	0.69	1.02	0.87	0.15
UP	1.14	1.00	0.30	0.70	0.92	0.90	0.63	0.27	0.72	0.95	1.39	-0.45
WB	1.05	0.94	0.51	0.42	0.92	0.95	1.25	-0.30	0.77	1.07	5.09	-4.02
Average	**1.05**	**1.00**	**0.98**	**0.02**	**0.93**	**1.00**	**2.35**	**-1.35**	**0.73**	**1.00**	**3.57**	**-2.57**

Note:* it refers to the difference between CU_t and CU_m.

E. Price Elasticities of Factor Demand

The estimates of short-run own- and cross-price elasticities of factor demand are presented in Table 11. They are calculated at the mean of the fitted cost shares for each industry. Virtually all the price elasticities, own as well as cross, are less than one, indicating inelastic demand for inputs and rigidity in the mix of inputs. Also, they vary in degrees as well as signs across the industries. The own-price elasticity, which should theoretically be negative, turned out to be slightly positive for one of the inputs in each case; perhaps an indication of the presence of *x-inefficiency* in the industries.

Cotton yarn and garments exhibit rigidity in the use of labour as indicated by the inelastic own as well as cross-price elasticities of demand. This is surprising particularly for garments, which is highly labour intensive sector. One possible reason for such a low response to change in price of labour could be the rigid labour policy preventing firms to remove the labour when they are in excess. To avoid such situations, firms often do not employ more labour even when its relative price is low. So a flexible labour policy may help cotton yarn and garment sectors in overcoming their inefficiencies in the mix of factors. In man-made sector, the demand for labour is elastic, possibly because this sector has only recently started growing and also it is less labour intensive.

In all the three industries the cross elasticity of demand between labour and energy is positive, signifying substitutability between the two inputs. Low values of $\mathring{a}_{LE}$ & $\mathring{a}_{EL}$ in case of cotton yarn could possibly be the result of rigid labour laws. This is in contrast to the man-made where both these values are elastic. In garment, however, $\mathring{a}_{LE}$ is high whereas $\mathring{a}_{EL}$ is low. This means that high price of labour would not discourage the garment sector to be labour intensive, but lower price of energy would encourage it to be more capital intensive. So the price of energy would play a decisive role in modernization of the garment sector.

Table 11: Estimated Own- and Cross-Price Elasticities of Factor Demand

Elasticities	Cotton Yarn	Man-made	Garments
Own-Price			
LL	-0.46	-0.92	-0.05
EE	0.02	-0.57	-1.05
MM	-0.06	0.05	0.05
Cross-Price			
LE	0.16	0.92	1.85
EL	0.11	1.07	0.38
ML	0.34	-0.16	-0.33
LM	0.08	-0.01	-0.04
EM	-0.03	-0.04	-0.02
ME	-0.18	-0.35	-0.80

Note: Elasticities evaluated at the mean values of the fitted cost shares.

F. Decomposition of Unit Cost

Growth in unit cost is related to productivity change on the one hand and the change in input prices on the other. While it is inversely related to the change in productivity, the change in input prices affects it positively. The changes in productivity and inputs' prices are themselves determined by number of individual factors. For instance, while the productivity change is determined by scale economies, technological change etc., the total change in inputs' prices is comprised of the individual factor prices. Since each of these effects may be working differently with varying magnitude, it becomes necessary to identify the main sources of problem in order of their magnitude. Hence, the present study attempts to decompose the unit cost growth into different sources of productivity and factor prices with the help of equation (15). On the basis of the results, reported in Tables 12-14, the following broad observations can be made:

(a) *Productivity:* Poor productivity performance, in general, has contributed to the unit cost growth. The main reasons for poor productivity performance across industries are, however, different. While technological retrogression and inefficiency contribute to poor productivity performance in cotton yarn, diseconomies of scale along with inefficiency affect the productivity performance in man-made and garments sectors.

(b) *Technological Change:* While in cotton yarn the technological change led to an increase in unit cost growth by 1.6 per cent, in man-made and garment sectors it lowered the unit cost growth by 1.6 and 6 per cents, respectively. In cotton yarn, hence, there is an ardent need for technological upgradation by adopting modernization. Low profitability and high capital cost have affected the modernization of this sector. Profitability issue, to a large extent, can be addressed by reducing the 'hank yarn obligation' on the part of the mills and also by rationalizing the excise collection from the spinning sector. As regards the cost of capital, there is a need to make the present *Technology Upgradation Fund Scheme* (*TUFS*) more attractive.[24] Various factors associated with this scheme such as the hidden cost involved in processing of loan, prepayment penalty, and higher lending rates of financial institutions etc make the cost of capital high.[25] On the basis of technology led reduction in unit cost growth for man-made sector, it can be argued that this sector has tremendous potential to grow if the government is more rational on excise and custom duties imposed on its raw materials. Though the garment

[24] *TUFS*, which is in vogue since April 1999, allows textiles units to draw long and medium term loans at a rate 5% lower than the normal lending rates of the banks.
[25] See Verma (2002), p.24.

sector has recorded impressive performance in terns of technology led reduction in unit cost growth, it is still not sufficient, considering the wide spread prevalence of outdated technology. This is evident from the fact that even the exporting apparel firms of India have investment as low as $250 per machine, compared to $3510 in Hong Kong and $1500 in China (Verma 2002). There is existence of large number of manual machines and even the power-based machines are not as sophisticated.

(c) *Inefficiency:* Inefficiency in the production process has also adversely affected the unit cost growth across the states and industries. The main sufferers include Maharastra in all three industries, UP in man-made textiles, and Delhi and Punjab in garments. Of these, the presence of inefficiency in garments for three major states – Delhi, Punjab and Maharastra - requires largest attention, where it alone led to an increase in unit cost by an average of 5 per cent over 1989-97 period. The problem of inefficiency could possibly be attributed to the improper mix of inputs on the one hand and the difficulty faced by firms to exit from the industry on other. Rigid labour laws relating to retrenchment, transfers, dismissals etc come in the way of optimum mix of inputs.

(d) *Scale Diseconomies:* The scale diseconomies (combined effects of output and capital stock), on an average, added to the unit cost growth in all the three industries. In cotton yarn this resulted in small growth in unit cost at 0.1 per cent. In man-made and garment sectors the effect of scale diseconomies is larger at 1.1 and 7 per cents, respectively. Across the major states of man-made and garment sectors, the scale diseconomies-led growth in unit cost has been relatively lower at 0.6 and 4.7 per cents, respectively. But even this was unexpected since the major states in man-made and garment sectors were found to be producing output on the downward sloping portion of the *LRAC* curve. Hence, it can be argued that increasing the industry output by expansion of existing firms (rather than by new entry) and also a check on decline in capacity utilization would have perhaps avoided the unit cost growth attributable to the diseconomies of scale in these two industries.[26]

(e) *Total Input Prices:* Contribution of total input prices to the unit cost growth has varied from an average of 8.9 per cent in cotton yarn to 6.9 per cent in man-made textiles to 7.8 per cent in garments. In this, the price of materials has been the largest contributor at 5.5 per cent in cotton yarn, 4.2 per cent in man-made and 5.9 per cent in garments. Hence, a great deal of growth in unit costs can be avoided by checking the rise in prices of materials. Gherzi report (2003) pointed out a need for reducing the cotton prices by at least 10 per cent by adopting measures such as mechanization of cotton farming, adoption of drip irrigation, and amendment of the Land Ceiling Act enabling corporate farming in the cotton. The study noted that raw materials in India cost 15 per cent more than what it did in China. It also felt a need for reducing the dyes and chemical costs by 10 per cent, which was around 47 per cent higher in India than in China. There is also a need for heavy rationalization of duties and taxes imposed on the raw materials of man-made textiles, as proposed by the N. K Singh Committee Report (2003).

(f) *Energy Price:* Although the growth in unit cost due to energy price is relatively low in all the three industries, it still needs to be brought down as the power cost in India compares unfavorably with that in many other countries. According to Gherzi report (2003) if power costs Rs 100 in India then it costs only Rs 68 in China and Rs 39 in Bangladesh.

(g) *Capital Price:* In all the three sectors, the contribution of capital price to the unit cost growth on an average, has been relatively low, ranging from 1.3 per cent in cotton yarn to 0.66 per cent in garments. This suggests a scope to enhance the *TFP* by upgrading the technology. Gherzi report (2003) points out that the China's low

[26] There is very little reason to believe that the external diseconomies would be behind the upward shift in the cost curves. In case of textiles and clothing, the factors of production appears to be available in sufficient quantities at given prices, particularly in view of lowering of *NRP* and *NTB* and also the fact that skill requirement for labour in such industries doesn't take too long.

interest rates for technology upgradation has accelerated the investment in the textiles sector. India can also emulate it to facilitate lager technology upgradation.

Table 12: Decomposition of Unit Cost Growth: Cotton Yarn Industry (1989-97)

State	Due to Prices					Due to Productivity					Unit Cost Growth
	Labour	*Energy*	*Materials*	*Capital*	*Total Input Prices*	*Output*	*Capital*	*Tech*	*Efficiency*	*Total Productivity*	
AP	0.72	1.10	5.50	1.64	8.97	0.67	-0.59	1.23	0.11	1.42	10.39
Bihar	1.17	1.28	6.14	0.52	9.10	-0.34	0.14	1.97	0.86	2.63	11.73
Delhi	0.56	1.27	5.62	0.80	8.25	-0.88	0.69	2.22	2.12	4.15	12.41
Gujarat	1.18	1.30	4.53	1.70	8.70	-0.22	0.80	1.90	-1.67	0.81	9.51
Haryana	0.80	0.80	6.34	1.21	9.15	1.88	-1.44	0.69	-0.96	0.16	9.31
Karnataka	1.16	1.00	5.69	1.30	9.16	-0.07	0.05	1.63	0.10	1.71	10.87
Kerala	1.15	0.73	5.44	1.52	8.84	0.62	-0.68	1.49	1.03	2.46	11.30
MP	0.62	1.24	4.85	1.48	8.19	2.15	-2.17	1.73	-3.21	-1.49	6.70
Maharastra	1.62	1.35	4.80	1.40	9.17	0.07	-0.08	1.63	0.85	2.46	11.64
Orissa	1.20	1.15	4.95	1.36	8.67	-0.72	2.94	2.17	0.94	5.33	14.00
Pondicherri	1.19	0.91	4.98	1.53	8.62	-0.16	0.06	1.78	1.06	2.74	11.36
Punjab	0.72	0.77	6.32	1.15	8.95	1.68	-1.43	1.05	0.05	1.35	10.31
Rajasthan	1.23	1.20	6.20	0.77	9.40	0.53	-0.68	1.22	2.39	3.47	12.87
Tamil Nadu	0.72	1.11	6.03	1.17	9.02	1.53	-1.55	1.29	0.43	1.70	10.73
UP	1.49	1.02	4.97	1.36	8.85	0.07	-0.33	2.26	1.18	3.18	12.02
WB	1.70	1.07	4.94	1.53	9.24	0.53	-0.78	1.55	-2.71	-1.40	7.83
Average	**1.08**	**1.08**	**5.46**	**1.28**	**8.89**	**0.46**	**-0.32**	**1.61**	**0.16**	**1.92**	**10.81**

Table 13: Decomposition of Unit Cost Growth: Man-made Textile (1989-97)

State	Due to Input Prices					Due to Productivity					Unit Cost Growth
	Labour	*Energy*	*Materials*	*Capital*	*Total Input Prices*	*Output*	*Capital*	*Tech*	*Efficiency*	*Total Productivity*	
AP	0.53	0.81	4.10	1.32	6.77	6.31	-3.91	-1.76	0.82	1.46	5.31
Delhi	0.65	0.78	4.18	0.81	6.43	-0.81	-0.29	-0.84	2.07	0.13	4.49
Gujarat	0.58	0.82	4.21	1.18	6.78	1.20	-1.18	-1.01	0.38	-0.61	5.80
Haryana	0.98	0.94	4.26	0.86	7.05	1.50	-1.17	-1.54	0.52	-0.69	5.84
HP	0.46	0.56	4.56	1.01	6.58	4.89	-2.60	-2.03	-2.06	-1.80	6.84
Karnataka	1.19	1.46	4.52	0.40	7.57	9.45	-3.36	-3.13	-8.00	-5.04	10.52
MP	0.79	1.19	4.29	0.83	7.09	1.82	-1.39	-1.45	-0.95	-1.97	6.07
Maharastra	0.77	0.94	4.03	1.03	6.76	2.02	-1.61	-1.28	0.53	-0.34	5.89
Punjab	0.64	0.78	4.13	1.33	6.87	1.94	-1.23	-1.42	0.53	-0.18	6.16
Rajasthan	0.35	0.92	4.07	1.36	6.70	1.96	-1.21	-1.36	-0.31	-0.92	6.09
Tamil Nadu	0.92	1.03	4.15	0.87	6.98	1.20	-0.72	-1.52	1.92	0.88	5.94
UP	0.47	0.94	3.75	1.77	6.93	2.40	-1.31	-1.43	1.65	1.31	6.60
WB	1.04	1.20	3.71	1.20	7.15	2.47	-1.59	-1.33	0.90	0.45	6.69
Average	**0.72**	**0.95**	**4.15**	**1.07**	**6.90**	**2.80**	**-1.66**	**-1.55**	**-0.15**	**-0.56**	**6.33**

Table 14: Decomposition of Unit Cost Growth: Garment Industry (1989-97)

State	Due to Prices					Due to Productivity					Unit Cost Growth
	Labour	*Energy*	*Materials*	*Capital*	*Total*	*Output*	*Capital*	*Tech*	*Efficiency*	*Total Productivity*	
AP	-0.40	0.25	5.16	1.30	6.31	2.57	0.75	-4.16	3.28	2.43	8.74
Delhi	0.82	0.20	6.48	0.37	7.88	4.10	-1.03	-6.00	5.19	2.27	10.15
Gujarat	1.57	0.29	5.76	0.57	8.20	-0.64	-0.10	-4.06	6.63	1.83	10.02
Haryana	1.15	0.35	5.58	0.85	7.93	25.53	-1.65	-9.48	-18.61	-4.21	3.71
Karnataka	2.12	0.20	5.63	0.53	8.49	13.31	-2.24	-7.85	-1.12	2.09	10.58
Kerala	0.85	0.18	5.95	0.43	7.41	13.79	-2.07	-8.29	-1.15	2.27	9.68
MP	1.73	0.56	4.69	1.07	8.05	0.28	-0.10	-3.15	1.07	-1.90	6.15
Maharastra	0.86	0.20	6.36	0.39	7.81	3.39	-1.06	-5.82	4.59	1.10	8.92
Punjab	0.62	0.27	6.28	0.54	7.71	-1.66	-0.59	-2.53	5.75	0.97	8.68
Rajasthan	0.74	0.19	6.19	0.71	7.82	23.66	-3.07	-9.95	-3.23	7.42	15.24
Tamil Nadu	1.13	0.18	6.29	0.50	8.09	11.19	-1.86	-7.03	-1.36	0.94	9.03
UP	1.06	0.33	5.64	1.03	8.06	8.78	-1.43	-5.57	1.11	2.89	10.95
WB	1.12	0.22	6.27	0.23	7.83	1.65	-0.43	-4.92	4.39	0.70	8.53
Average	**1.03**	**0.26**	**5.87**	**0.66**	**7.81**	**8.15**	**-1.14**	**-6.06**	**0.50**	**1.45**	**9.26**

VI. Summary and Conclusion

With effect from January 1, 2005 trade in textiles and clothing will be fully integrated into the *WTO* system. This would mark the departure of quota-restrictions, which regulated the trade in textiles and clothing for decades. Since the competition in the post *MFA* scenario will increase manifold, the unit cost will be one of the main determinants of the export performance of a country. The unit cost depends upon the factor prices on the one hand and the productivity level on the other. The present study attempts to examine these two factors for the three main textile industries, namely, the cotton yarn, man-made textiles and readymade garments by using a panel data analysis for selected states over 1989-97 period. To begin with, an attempt is made to estimate the *TFP*, relate it with unit cost and analyze its determinants. To throw some more lights on the scope of improvement in *TFP*, major production characteristics are then examined with the help of translog variable cost functions. Finally, in order to analyze the relative roles of factor prices and TFP in the growth of unit cost, a decomposition analysis of the unit cost growth is also undertaken.

The average annual growth in productivity was lowest in the cotton yarn (-1.9%), followed by garment (-1.5%) and man-made textiles (0.56%) during the study period.

The corresponding figures for unit cost growth were 13, 11, and 7 per cents, respectively. Productivity (growth) is found to be an important factor determining the unit cost (growth) across the industry and the states. There are number of factors, which determine the productivity. While some of them are common across the industries, others are not. Better capacity utilization, reductions in *NRP* and *NTB*, increased availability of electricity are found to be favourably affecting the productivity in the three industries. But output per firm and credit disbursements by commercial banks have a conclusive positive relationship with productivity only in man-made and garment sectors. In cotton yarn sector though the relationship is positive, it is not conclusive, suggesting a need for corrective measures.

Some important production characteristics, with bearing on productivity, are also analyzed with the help of translog variable cost functions. The technological change in cotton yarn and garment sectors is found to be Hicks-neutral, whereas the same in man-made is biased against labour use. Hence, the improvement in productivity of labour in cotton yarn and garment sectors is the key to *TFP* enhancement. These two sectors did not experience an improvement in productivity of energy and materials, which the man-made sector did impressively. Further, the three industries are found to have non-homotheic structure of production, and demonstrate that the increase in scale is labour as well as energy saving. The price elasticity of demand for factors (own and cross) is mostly found to be inelastic. Since the own price elasticity of demand for one of the inputs in each case turned out to be slightly positive, the presence of *x-inefficiency* cannot be ruled out in the three industries. In case of cotton yarn, the cross price elasticity demand for $\mathring{a}_{LE}$ and $\mathring{a}_{EL}$ are very low, which could possibly be attributed to the rigid labour laws. In garment sector, the cross price elasticity of demand is found to be high for $\mathring{a}_{LE}$ but low for $\mathring{a}_{EL}$, indicating that higher price of labour may not discourage the garment industry to be labour intensive, but the lower price of energy may encourage it to be more capital intensive. So the price of energy plays a decisive role in modernization of the garment sector.

The estimated variable cost function is further utilized to decompose the unit cost growth into productivity and cost sources. The decomposition of productivity into individual sources reflects somewhat varied results across industries. Technological retrogression is the main reason for poor productivity performance in the cotton yarn sector. Hence, there is a need to upgrade the technology level by encouraging firms to utilize larger funds available under *TUFS*. Scrapping of the *HYO* policy could provide a good incentive for the firms to invest in technology. Though the technological change in garments is positive, it requires to be strengthened further as this sector is still plagued with out-dated technology.

Diseconomies of scale are found to have adversely affected the productivity growth in man-made and garment sectors. It led to the unit cost growth by 0.6 and 4.7 per cents, respectively. This happened in spite of the fact that the two sectors operated on the downward sloping portion of the *LRAC* curve, and also there was an increase in output per firm. It suggests that the scale economies effect was not sufficient to prevent the upward shift in the *LRAC* curve. Hence there is a need to encourage large-scale production, particularly in the garment sector. This can be done by offering incentives like significant reduction in interest rate with the increase in size of investment.

Although the inefficiency is found to be present in number of major states across the industries, the case of garment in Delhi, Punjab and Maharastra - accounting for over 50 per cent share in total output - is a worrying sign. This alone contributed an average annual growth in unit cost by 5 per cent during 1989-97 period. Main reasons for inefficiency could be the improper mix of factors and the continuance of the sick units in the business. A flexible labour policy and easy entry-exit norms for the firms could help solve this problem to a great extent.

The decomposition of the factor prices into various sources show that the growth in materials' price contributed maximum to the unit cost growth in all the three industries. There is a need for rationalization of the prices of materials used in textiles. In the garment sector, the increase in unit cost due to labour is more than that due to capital, suggesting a scope for improving the factor mix in favour of capital.

It can be concluded that the mill sector, which produces almost the entire cotton yarn, requires level playing field at par with handloom and powerloom sectors. There is also a need to encourage large-scale production, particularly in man-made and garment sectors. Disbursement of credit, cheaper raw materials, higher availability of electricity at reasonable rates, promoting better capacity utilization, flexible labour laws, easy entry-exit norms for the firms are some of the basic policy measures which would help the Indian textile and garment industry become more cost effective. Further, it would be prudent to focus on selected states having comparative advantage in a specific industry. Only bold measures such as these could help the post *MFA* challenges being converted into an opportunity rather than a threat.

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Appendix A: Domestic & International Prices of Man-made Fibre/Yarn

Table 1: Prices of Polyester Fibre/Yarn (Rs/Kg)

Year	Polyester Staple Fibre		Polyester Yarn (POY)	
	Domestic	International	Domestic	International
1991-92	80.1	29.9	168.6	61.0
1992-93	79.7	37.7	144.4	89.3
1993-94	78.5	36.9	146.3	57.1
1994-95	104.6	49.5	153.2	61.8
1995-96	89.1	64.3	150.3	79.3
1996-97	61.6	43.2	90.3	56.1
1997-98	51.3	39.1	89.4	69.9
1998-99	48.0	40.2	69.9	42.9
Average	**74.1**	**42.6**	**126.6**	**64.6**

Source: Report of the Expert Committee on Textile Policy, 1999.

Table 2: Domestic and International prices of Raw Materials for man-made fibre/Yarn Industry (Rs/Kg)

Year	DMT		PTA		MEG	
	Domestic	International	Domestic	International	Domestic	International
1991-92	32.5	13.4	34.2	15.1	27.3	24.9
1992-93	30.6	14.3	32.7	16.5	24.9	9.1
1993-94	29.8	16.7	32.7	20.4	21.9	10.3
1994-95	42.8	29.3	49.9	26.5	28.1	19.1
1995-96	55.3	40.7	63.5	39.1	32.5	25.1
1996-97	30.0	20.7	31.4	22.0	27.9	18.2
1997-98	28.3	20.8	26.8	21.1	31.1	22.8
1998-99	21.7	18.3	22.0	14.2	23.6	16.2
1999-00	23.0	23.1	28.2	19.5	30.9	20.2
Average	**32.7**	**21.9**	**35.7**	**21.6**	**27.6**	**18.4**

Source: Compendium of Textile Statistics, 2000.

Appendix B: Derivation of Optimum Output (Y_m) in Short-run

In order to arrive at Y_m, we first need to define the *SRAC* as:

$$SRAC = \frac{TVC}{Y} + \frac{(r \times K)}{Y} \qquad \text{-----------(A.1)}$$

If Y_m is defined as the output which minimizes the *SRAC*, then $\partial SRATC / \partial Y_m = 0$. In terms of equation (A.1):

$$\frac{\partial SRATC}{\partial Ym} = \left(\frac{1}{Y_m}\right)\left(\frac{\partial TVC}{\partial Y_m}\right) - \left(\frac{TVC}{Y_m^2}\right) - \left(\frac{r \times K}{Y_m^2}\right) = 0 \qquad \text{------------ (A.2)}$$

Since $(\partial \ln TVC / \partial \ln Y_m) = (\partial TVC / \partial Y_m)(Y_m / TVC)$, the expression $\partial TVC / \partial Y_m$ in equation (A.2) can be substituted with $(\partial \ln TVC / \partial \ln Y_m)(TVC / Y_m)$:

$$\frac{\partial SRATC}{\partial Ym} = \left(\frac{1}{Y_m}\right)\left(\frac{\partial \ln TVC}{\partial \ln Y_m}\right)\left(\frac{TVC}{Y_m}\right) - \left(\frac{TVC}{Y_m^2}\right) - \left(\frac{r \times K}{Y_m^2}\right) = 0 \qquad \text{-------------(A.3)}$$

Since Y_m and $\ln Y_m$ both appear in equation (A.3), an iterative procedure is employed to solve for Y_m.

Appendix C: Summary of Important Results

Sr. No.	Characteristics & Variables	Cotton Yarn (235)	Man-made (247)	Garments (260+265)
	Basic Production Characteristics			
1.	Non-homothetic (Scale)	Energy, labour saving	Energy, labour saving	Energy, labour saving
2.	Hicks-neutrality (Technology)	√	Labour-saving	√
	Unit Cost Growth (in % per annum)			
3.	Unit Cost Growth at Constant Prices (in Rs)	3.2	-2.2	1.3
4.	Unit Cost Growth at Constant prices (in US $)	-6.5	-11.4	-8.2
5.	Unit Cost Growth at Current Prices (in Rs)	12.6	6.8	10.6
	Factors Contributing to the Unit Cost Growth at Current Prices (in % per annum)			
6.	Productivity	1.9	-0.6	1.5
6.1.	Technology	1.6	-1.6	-6.1
6.2.	Scale	0.1	1.1	7.0
6.3.	Efficiency	0.2	-0.2	0.5
7.	Input Prices	8.9	6.9	7.8
7.1.	Labour	1.1	0.7	1.0
7.2.	Capital	1.3	1.1	0.7
7.3.	Energy	1.1	1.0	0.3
7.4.	Materials	5.5	4.2	5.9
	Growth in Partial Factor Productivity of Factors (in % per annum)			
8.	Labour	2.6	8.2	0.5
9.	Capital	-6.2	-5.0	-9.5
10.	Energy	-1.1	3.5	-2.2
11.	Materials	-1.3	1.5	-0.3
	Determinants of Productivity Growth (TFPG)			
12.	Capacity Utilization	√	√	√
13.	Availability of Electricity	√	√	√
14.	Nominal Rates of Protection	√	√	
15.	Non-Tariff Barriers		√	√
16.	Output Per Firm		√	√
17.	Credit Disbursement		√	√
18.	Road-Density	√		

Note: Figures are averaged across states for 1989-90 to 1997-98 period.