CHAPTER III
DATA BASE AND METHODOLOGY

In this chapter, sources of data and methodology used in the study have been discussed in detail.

DATA BASE

The study mainly covers the period from 1985 to 2007. Nature of the study was such that it required secondary data which was collected from the following sources:

1. Data on various aspects of Indian textile industry and its two groups ‘Textiles’ and ‘Textile Products’ like number of factories, gross value added, number of persons employed, capital stock, total emoluments and labor cost were collected from various issues of Annual Survey of Industries (Summary Results for Factory Sector), Central Statistical Organization (CSO), Government of India.

2. Data on wholesale price index of India were obtained from Office of Economic Advisor, Ministry of Commerce and Industry.

3. Data on consumer price index of India were obtained from Handbook of Statistics on Indian Economy, Reserve Bank of India.

4. Data on exports of textiles using Harmonized System of Commodity Description and Classification (HS 1996) at two-digit and four-digit levels were obtained from UN Comtrade Database, United Nations.

5. Data on exchange rate in terms of dollars and real effective exchange rate were obtained from Handbook of Statistics on Indian Economy, Reserve Bank of India.
METHODOLOGY

As CSO adopted National Industrial Classification-1987 (NIC-87), therefore, to arrive at a consistent dataset at the two-digit level, concordance tables published by Central Statistical Organization (given in Appendix 4.1) were used to reclassify the data according to NIC-1987 classification. Indian textile industry was regrouped by adding the NIC-87 two digit codes of manufacture of cotton textiles (23), manufacture of wool, silk and manmade fiber textiles (24), manufacture of jute and other vegetable fiber textiles (except cotton) (25) and textile products (including wearing apparel) (26). Indian textile industry was divided into two groups: ‘Textiles’ (by adding NIC-87 codes 23, 24 and 25) and ‘Textile Products’ (NIC-87 Code 26).

Following variables were considered for the analysis:

**Output** was measured in terms of real gross value added, i.e. gross value added at 1993-94 prices.

**Labour** input was measured in terms of number of persons employed.

**Capital** input was measured by subtracting depreciation from gross fixed capital and deflating the resultant value by wholesale price index for industrial machinery for textiles.

**Total emoluments** were deflated by the consumer price index for industrial workers (with 1993-94 as base).

**Employment Elasticity**

To analyze whether change in output leads to a change in employment, employment elasticity of output was calculated for Indian textile industry and its groups ‘Textiles’ and ‘Textile Products’ during pre-WTO sub-period (1985-86 to 1994-95), post-WTO sub-period (1995-96 to 2005-06) and whole period (1985-86 to 2005-06) by using the following formula:

\[ \ln L_t = a_0 + a_1 \ln Y_t \]

Where
L = No. of Employees
Y = Gross Value Added
$a_0$ = Constant
$a_1$ = Elasticity of Employment w.r.t. Output

**Productivity Analysis**

Productivity growth is recognized as the dominant determinant of growth of industrial sector of an economy, including the textile sector.

There are two measures of productivity: partial factor productivity and total factor productivity (TFP).

**Partial Factor Productivity**

Partial factor productivity measures the ratio of output to one of the inputs setting aside interdependence of use of other inputs. Theoretically, there are as many partial productivity indices as there are factors of production. However, most important and most often used are the partial productivity indices of labour and capital.

1. **Labour Productivity (V/L)**
   It is measured as the ratio of gross value added (at constant prices) to the number of persons employed.

2. **Capital Productivity (V/K)**
   It is measured as the ratio of gross value added (at constant prices) to capital stock (at constant prices).

**Capital Intensity**

Besides computing partial productivity indices of labour and capital, the most famous structural ratio, namely capital intensity, which throws light on the process of capital deepening in the manufacturing sector, was also calculated. It is measured as the ratio of capital stock (at constant prices) to the number of persons employed.
Total Factor Productivity (TFP)

TFP may be defined as the ratio of output to a weighted combination of inputs (Goldar, 1986). TFP was measured in terms of (1) Kendrick Index, (2) Solow Index and (3) Translog Index.

(1) Kendrick Index

In Kendrick Index, it is assumed that there is one homogeneous output denoted by V and there are two factors of production, i.e. labour, denoted by L and capital, denoted by K (Kendrick, 1961). Relative shares of labour (L) and capital (K) in national income during base year are generally taken to be the respective weights: w₀ and r₀. However, the weights need not necessarily be for the base year only (Krishna, 1970). In fact, it is generally more appropriate to take average of shares over several periods as weights (Denison, 1962). Kendrick Index for the year ‘t’ may be computed as:

$$A_t = \frac{V_t}{w_0L_t + r_0K_t}$$

where w₀ and r₀ are the average of shares over several years.

Under the assumptions of constant returns to scale, perfect competition and payment to factors according to their marginal product, the total earnings of labour and capital in the base year exactly equal to output of that year, so that A₀ is equal to unity by definition. Although, the Kendrick index is easy to understand and calculate, but it suffers from a serious drawback that it involves a linear production function and thus, fails to allow for the possible diminishing marginal productivity of factors.

(2) Solow Index

This index is based on Cobb-Douglas (C-D) production function and also assumes that the factors of production are rewarded according to their marginal products and that there is neutral technical progress which implies shift in production function leaving the marginal rate of substitution between factors unchanged (Solow, 1957). The functional form is:
\[ V/L = A(t) \cdot (K/L) ^ {b} \]

where \( V/L \) is output per employee,
\( K/L \) is capital per employee and
\( A \) & \( b \) are constants

Expressing the above equation in logarithmic form, we get

\[ \log V/L = \log A(t) + b \cdot \log (K/L) \]

Putting this relation in incremental form by taking derivative

\[ \frac{d (V/L)}{(V/L)} = \frac{d A(t)}{A(t)} + b \frac{d(K/L)}{K/L} \]

or

\[ \frac{d A(t)}{A(t)} = \frac{d (V/L)}{(V/L)} - b \frac{d(K/L)}{(K/L)} \]

where \( \frac{d (V/L)}{(V/L)} \) is the rate of change of output per employee and \( \frac{d (K/L)}{(K/L)} \) is the rate of change of capital per employee and \( b \) is capital’s share of output. Therefore, the rate of change of total factor productivity is the difference between the rate of change of output and rate of change of capital per employee multiplied by capital’s share of output. This yields \( \frac{dA(t)}{A(t)} \) series from which \( A(t) \) series can be derived by assuming the initial value of \( A(t) \) as one. The \( A(t) \) series is the series of productivity change. If the series goes on increasing, then the productivity is increasing, otherwise not.

Both these measures of TFP implicitly assume a homogeneous production function. Under competitive equilibrium, the Kendrick and Solow measures are equivalent.

(3) **Translog Index**

The Divisia index of technical change was introduced by Solow (1957) and discussed by Jorgenson and Griliches (Jorgenson and Griliches, 1967). The properties of Divisia index, which make its application highly desirable, have been discussed by Christensen and Jorgenson (Christensen and Jorgenson, 1970) and by the other economists. An aggregate production function on which Divisia index depends, has been discussed here with two factors of production and is given by:

\[ V = F(K, L, t) \]
where $V$ represents the aggregate value added, $K$ aggregate capital, $L$ aggregate labour and $t$ time. Denoting the price of value added by $P_V$, the price of capital input by $P_K$ and price of labour input by $P_L$, we can define the share of capital and labour input in value added, $S_K$ and $S_L$

$$S_K = \frac{P_K K}{q_v V}, \quad S_L = \frac{P_L L}{q_v V}$$

Necessary conditions for producer’s equilibrium are given by equalities between each value share and the elasticity of output with respect to the corresponding input:

$$S_K = \frac{\partial \ln V}{\partial \ln K}(K, L, t)$$

$$S_L = \frac{\partial \ln V}{\partial \ln L}(K, L, t)$$

Under the constant returns to scale, the elasticities and the value shares sum up to unity.

The rate of technical change or total factor productivity $P(t)$ can be obtained by partially differentiating the production function with respect to time, holding capital and labour input constant:

$$P(t) = \frac{\partial \ln V}{\partial t}(K, L, t)$$

Under constant returns to scale, the rate of technical change can be expressed as the rate of growth of output less a weighted average of the rates of growth of capital and labour input, where the weights are given by the corresponding value shares:

$$P(t) = \frac{d \ln V}{dt} - \frac{\partial \ln V}{\partial \ln K} \frac{d \ln K}{dt} - \frac{\partial \ln V}{\partial \ln L} \frac{d \ln L}{dt}$$

or

$$\frac{d \ln V}{dt} = S_K \frac{d \ln K}{dt} + S_L \frac{d \ln L}{dt}$$

or

$$\dot{V} = \dot{V} - S_K \frac{\dot{K}}{K} - S_L \frac{\dot{L}}{L}$$

where $P(t)$ is Divisia quantity index of technical change.
**Growth Rates**

To study growth performance of Indian textile industry, compound annual growth rates were calculated for Indian textile industry and its two groups ‘Textiles’ (by adding NIC-87 codes 23, 24 and 25) and ‘Textile Products’ (NIC-87 code 26) for three periods of time, i.e. whole period (from 1985-86 to 2005-06), pre-WTO sub-period (from 1985-86 to 1994-95) and post-WTO sub-period (from 1995-96 to 2005-06). Compound annual growth rates for the variables like number of factories, gross value added, number of persons employed, capital stock, total emoluments, average number of employees (obtained by dividing number of persons employed by number of factories), partial productivities of labour and capital and total factor productivities (in terms of Kendrick Index, Solow Index and Translog Index) were calculated by the following formula:

\[ Y = AB^t \]

where \( Y \) = Value of the variable

\[
\text{Growth Rate} = \left( \frac{\hat{B}}{B} - 1 \right) \times 100
\]

\( t \) = time period

where \( \hat{B} \) is estimated value of \( B \)

Due to the difficulty of converting US dollar figures at constant prices (as no suitable price deflator was available), the growth rates in such cases were estimated at current prices, while in all other cases, these were worked out at constant prices.

**Export Performance**

To analyze the performance of India’s textile exports, compound annual growth rates of textile exports at aggregated level (two-digit level, taking 14 product-groups) and at disaggregated level (four-digit level, taking 149 products in all) were worked out for whole period (from 1988 to 2007) and also for two sub-periods, i.e. pre-WTO period (from 1988 to 1995) and post-WTO period (from 1996 to 2007).

**Percentage Shares**

To examine the structural changes in commodity composition of India’s textile exports at aggregated level (two-digit level, taking 14 product groups) and at
disaggregated level (four-digit level, taking 149 products in all), average percentage shares were worked out for whole period (from 1988 to 2007), for pre-WTO period (from 1988 to 1995) and post-WTO period (from 1996 to 2007). Direction of India’s textile exports was studied by calculating percentage shares of exports of 14 product-groups for 39 countries at three points of time 1988, 1995 and 2005.

**Trend Values**
To study changes in composition of India’s textile exports, trend values of textile exports at aggregated level (for 14 product-groups) and disaggregated level (for 149 products) for whole period, pre-WTO period and post-WTO period were worked out by fitting equation of the type

\[ Y = A + Bt \]

where \( Y \) = Value of exports of a product-group/product
\( t \) = time period.

**Commodity Concentration Index**
In order to measure commodity concentration/diversification of India’s textile exports, Hirschman Index of Commodity Concentration was calculated, which is defined as:

\[
\text{COM}_x = 100 \sqrt{\sum_{t=1}^{n} \left( \frac{X_{it}}{X_t} \right)^2}
\]

where \( \text{COM}_x \) = Commodity Concentration Index

\( X_{it} \) = Value of exports of \( i^{th} \) product group in year \( t \)

\( X_t \) = Value of total textile exports in year \( t \)

14 product groups were considered to calculate \( \text{COM}_x \).

**Geographic Concentration Index**
In order to measure geographic concentration of textile exports, Hirschman Index of Geographic or regional concentration was calculated as under:
\[ \text{GEO}_x = 100 \sqrt{\sum_{i=1}^{n} \left( \frac{X_{it}}{X_t} \right)^2} \]

Where \( \text{GEO}_x \) = Geographic Concentration Index

\( X_{it} \) = India’s textile exports to country \( i \) in time \( t \)

\( X_t \) = India’s exports of textiles in time \( t \)

The index was calculated for 14 product groups for 39 countries at three points of time 1988, 1995 and 2005.

**Indicators of Export Competitiveness of Indian Textile Industry**

Three indicators of export competitiveness, namely share of India’s textile exports in world textile exports, share of India’s textile exports in its total exports and ratio of India’s textile exports to its output (Export Propensity of Indian textile industry) were calculated. However, to know the effect of variables on export competitiveness, we have defined export competitiveness as the share of India’s textile exports in its total output which is a relatively better indicator as it reflects the capacity of the country to export textiles out of its domestic production.

**Determinants of Export Competitiveness of Indian Textile Industry**

To examine the determinants of export competitiveness of Indian textile industry and its groups ‘Textiles’ and ‘Textile Products’, multiple step-wise regression analysis was carried out for the period 1988-89 to 2005-06 which was dictated by comparability on account of NIC classification (as data for textile exports was taken using HS).

The specific variables, which were considered as determinants of export competitiveness, are given below:

1. **Export Profitability Index (EPI)**

   The ratio of unit value index of manufactured exports to domestic wholesale price index of textile captures the profitability. Domestic wholesale price indices and export unit value index were taken with base 2000=100.
2. **Labour Productivity (LP)**

3. **Capital Productivity (CP)**

4. **Total Factor Productivity (TFP)**
   Total factor productivity, as measured by Translog index, was used.

5. **Unit Labour Cost (ULC)**
   Unit labour cost was measured as the quotient of labour cost per employee to value added per employee. Labour cost was taken as the sum of wages and salaries, employer's contribution as provident fund and other funds and staff welfare expenses.

6. **Exchange Rate (ER)**
   The exchange rate of rupee was taken in terms of dollars.

7. **Real Effective Exchange Rate (REER)**
   Real effective exchange rate indices (36-currency bilateral weight) were recalculated with base 1993-94 = 100.

**Correlation Analysis**
In order to study the inter-correlation amongst different determinants of textile exports, correlation matrices were constructed. To test the significance of correlation coefficients, t-test was applied as under:

\[ t = \frac{r_{ij}}{\sqrt{1-(r_{ij})^2}} \sqrt{n-2} \]

where ‘n’ is the number of observations (number of years in the present study) and \( |r_{ij}| \) is the correlation coefficient between \( i^{th} \) and \( j^{th} \) variables, ignoring signs.

**Regression Analysis**
In the simple regression analysis, the equations were estimated for each of the explanatory variables. However, to take care of the problem of autocorrelation, the variable time was included in all the equations. The major problem likely to be faced
in the multiple regression analysis is that of multi-collinearity, i.e. correlation among
the independent variables. Existence of this problem leads to inconsistent and
incorrect results. In order to overcome the problem, step-wise regression technique
was applied.

The equation for multiple (step-wise) regression analysis can be written as follows:

\[ Y = a + b_1 EPI + b_2 LP + b_3 CP + b_4 TFP + b_5 ULC + b_6 ER + b_7 REER \]

It is hypothesized that \( b_1, b_2, b_3, b_4, b_6 > 0 \) and \( b_5, b_7 < 0 \)

Here, \( Y \) is the dependent variable, i.e. the share of textile exports to output and \( a \) is the
intercept which gives the autonomous change in \( Y \) (the dependent variable). The
regression coefficients like \( b_1, b_2, b_3, b_4, b_5, b_6 \) and \( b_7 \) give the measure of change in \( Y \)
for a unit change in the corresponding independent variable, i.e. EPI, LP, CP, TFP,
ULC, ER and REER respectively.

Adjusted coefficient of determination (\( \overline{R^2} \)) was also calculated for each regression
equation for comparing the explanatory power of different sets of multiple regression
equation.

\[
\overline{R^2} = 1 - \left[ \frac{(n-1)/(n-k)}{(1-R^2)} \right]
\]

Here \( n = \) number of years

\( k = \) number of explanatory variables

Explanatory variables were entered in the step-wise regression model according to the
correlation with the dependent variables and also taking into account the collinearity
as well as explanatory power in view. To estimate the relative contribution of such
variables, different combinations of these explanatory variables were tried and the
results obtained through the regression analysis were interpreted accordingly. The
explanatory variable which reduced the value of \( R^2 \) or \( \overline{R^2} \) was excluded and another
variable was tried.