CHAPTER 6
Factor Productivity of Small Scale Industries in Himachal Pradesh
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FACTOR PRODUCTIVITY OF SMALL SCALE INDUSTRIES IN HIMACHAL PRADESH

6.1 INTRODUCTION

In a general sense, ‘productivity’ is the volume of output produced by a given quantity of factor(s) of production. It is a measure of efficiency of production. Productivity is the ratio of production of a given quantity of commodity to a given quantity of input required to produce it. Productivity is the rate at which the output is produced with the help of a unit of input, say labour. For instance, the productivity of a food processing industry is the volume of output produced by it per unit of labour or capital or any other factor or combination of factors of production. It indicates the degree of efficiency of an activity or an organization.

6.2 MEASUREMENT OF PRODUCTIVITY GROWTH

In the production function approach, a shift in the production function over a period of time is attributed to the technological progress. There are a variety of functional forms that can be used to describe production relationship between input and output. However, the Cobb-Douglas production function is widely used to represent the relationship of an output to the inputs used in producing it.

In the present study, the Cobb-Douglas specification of the production function is used for measuring the factor productivity.

In its general form, the Cobb-Douglas specification of production function is written as:

\[ V = A_0 L^\alpha K^\beta M^\gamma \]  ... (I)

Where, ‘V’, ‘L’, ‘K’ and ‘M’ refer to output, labour, capital and material consumed. ‘\( \alpha \)’, ‘\( \beta \)’ and ‘\( \gamma \)’ give factor shares of labour, capital
and material consumed respectively. $A_0$ the efficiency parameter and describes initial conditions. The elasticity of substitution between labour and capital is assumed to be one.

However, after introducing the time trend, the Cobb Douglas production function takes the form as under:

$$V = A_0 e^{A t} L^\alpha K^\beta M^\gamma$$  \hspace{1cm} \ldots \hspace{1cm} (II)

'\(e\)' is the error (or disturbance term) which capture the effects of exogenous and endogenous variables. 't' refers to the time period. Technological changes take place at a constant rate of '\(\lambda\)'.

The Cobb-Douglas production function, being a non-linear relationship, could not be estimated directly by regression technique. The equation must be in a linear form in order to estimate its various parameters through ordinary least square regression method of estimation. As such, the equation can be linearized by taking the logarithm of each term.

The Log-linear form of above CD function is derived as under:

$$\log V = A + \alpha \log L + \beta \log K + \gamma \log M + \lambda t$$  \hspace{1cm} \ldots \hspace{1cm} (III)

The OLS estimation of this equation yields the estimation of $\alpha$, $\beta$, $\gamma$ and $\lambda$. The estimated value of $\lambda$ provides the measure of technological progress, which is identified with the growth of total factor productivity.

The sum of the estimates of $\alpha$, $\beta$ and $\gamma$ is a measure of the degree of homogeneity of the production function. Thus, the sum of the constants ($\alpha + \beta + \gamma$) determines the return to scale. That is,

- $(\alpha + \beta + \gamma) > 1$ implies increasing return to scale.
- $(\alpha + \beta + \gamma) = 1$ implies constant return to scale.
- $(\alpha + \beta + \gamma) < 1$ implies decreasing return to scale.
6.3 DATA SOURCE AND METHODOLOGY FOR THE PRODUCTIVITY STUDY

The data generated by Annual Survey of Industries (ASI) in the State of Himachal Pradesh for different industrial groups have been taken for studying the productivity trends of select industrial activities in the State. Productivity is measured through Cobb-Douglas Production Function, as per research design of the study.

Considering the industrial activities in the State of Himachal Pradesh and the availability of the continuous Annual Survey of India data to facilitate comparison between pre and post reform periods, the following nine (9) industrial activities have been selected for the purpose of productivity study:

(i) Production, processing and preservation of fruits and vegetables,
(ii) Manufacture of beverages (distilling),
(iii) Printing and allied activities,
(iv) Manufacture of plastic products,
(v) Manufacture of non-metallic mineral products,
(vi) Basic Metals and Alloys – Iron & Steel – semi finished products,
(vii) Manufacture of special purpose machinery,
(viii) Manufacture of watches and clocks,
(ix) Manufacture of furniture and fixtures,

6.4 ESTIMATION OF TOTAL FACTOR PRODUCTIVITY THROUGH COBB DOUGLAS PRODUCTION FUNCTION

The time series Annual Survey of Industries data for Pre and Post Reform Periods for the State of Himachal Pradesh have been analysed with reference to the Cobb-Douglas Production Function. The parameters of production function have been estimated and their significance levels tested as under.
6.4.1 Estimation of Total Factor Productivity during Pre Reform Period

The factor productivity is studied with three variable, viz., capital, labour and raw material. The analysis of the various estimates of Cobb-Douglas production function shows mixed results in the pre reform period with regard to the variation in the dependent variable, i.e., output, due to the variation in the independent variables, i.e., capital, labour, raw material and factor productivity taken together. More than 90 percent of the variation in the dependent variable is explained by the variation in the independent variables in ‘production, processing and preservation of fruits and vegetables’ and ‘Non-metallic mineral products’, whereas the independent variables in industries, such as, ‘manufacture of beverages (distilling)’, printing & allied activities’, ‘manufacture of plastic products’, ‘manufacture of special purpose machinery’ and ‘watches and clocks’ explains 80 percent to 90 percent variation in dependent variable. 70 percent to 80 percent variation in dependent variable is explained in ‘iron and steel – semi finished products’ in pre reform period in Himachal Pradesh. However, about 53 percent of variation in dependent variable could be accounted for by the independent variables in ‘furniture and fixtures’ industry as well as total Annual Survey of Industries Sector in Himachal Pradesh in the pre reform period. The R square has been found significant in all the industrial activities, except manufacture of furniture and fixtures.
### Table 6.1
Estimated coefficients of Cobb Douglas Production Function during pre reform period (1972-73 to 1990-91)

<table>
<thead>
<tr>
<th>Industry</th>
<th>Degree of Freedom</th>
<th>Constant</th>
<th>LN(K) (α)</th>
<th>LN(L) (β)</th>
<th>LN(M) (γ)</th>
<th>Time (λ)</th>
<th>R²</th>
<th>Return to scale (α + β + γ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production, processing and preservation of fruits and vegetables</td>
<td>18</td>
<td>2</td>
<td>(1.742)</td>
<td>(0.010@)</td>
<td>(0.680@)</td>
<td>(0.306@)</td>
<td>0.085**</td>
<td>0.955</td>
</tr>
<tr>
<td>Manufacture of beverages (distilling)</td>
<td>18</td>
<td>(-0.037@)</td>
<td>(0.054)</td>
<td>(0.054)</td>
<td>(2.396)</td>
<td>(1.978)</td>
<td>0.061**</td>
<td>0.883</td>
</tr>
<tr>
<td>Printing and allied activities</td>
<td>14</td>
<td>(-6.688@)</td>
<td>(1.375)</td>
<td>(0.052@)</td>
<td>(2.093**)</td>
<td>(0.070@)</td>
<td>0.211@</td>
<td>0.887</td>
</tr>
<tr>
<td>Manufacture of plastic products</td>
<td>15</td>
<td>4</td>
<td>(2.517)</td>
<td>(1.567)</td>
<td>(0.137@)</td>
<td>(0.216@)</td>
<td>0.046**</td>
<td>0.884</td>
</tr>
<tr>
<td>Manufacture of non-metallic mineral products #</td>
<td>15</td>
<td>1</td>
<td>(1.048@)</td>
<td>(1.216)</td>
<td>(0.134@)</td>
<td>(0.381*)</td>
<td>0.073*</td>
<td>0.921</td>
</tr>
<tr>
<td>Basic Metals and Alloys – Iron &amp; Steel – semi finished products</td>
<td>16</td>
<td>(-0.009@)</td>
<td>(0.005)</td>
<td>(0.487*)</td>
<td>(1.907)</td>
<td>(0.085@)</td>
<td>0.063@</td>
<td>0.796</td>
</tr>
<tr>
<td>Manufacture of special purpose machinery $</td>
<td>15</td>
<td>3</td>
<td>(1.454)</td>
<td>(1.728)</td>
<td>(0.027@)</td>
<td>(0.145@)</td>
<td>(0.030@)</td>
<td>0.832</td>
</tr>
<tr>
<td>Manufacture of watches and clocks</td>
<td>12</td>
<td>(-6.880@)</td>
<td>(1.061)</td>
<td>(1.229**)</td>
<td>(-0.039@)</td>
<td>(0.537@)</td>
<td>(-0.058@)</td>
<td>0.821</td>
</tr>
<tr>
<td>Manufacture of furniture and fixtures</td>
<td>14</td>
<td>(-0.012@)</td>
<td>(0.032)</td>
<td>(-0.179@)</td>
<td>(0.978@)</td>
<td>(0.531@)</td>
<td>(0.061@)</td>
<td>0.528</td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>1</td>
<td>(1.544)</td>
<td>(2.737)</td>
<td>(2.727**)</td>
<td>(-0.314@)</td>
<td>(-0.256**)</td>
<td>0.852</td>
</tr>
</tbody>
</table>

*Figures in parenthesis are calculated ‘t’ values*

<table>
<thead>
<tr>
<th>£</th>
<th>Log Linear</th>
</tr>
</thead>
<tbody>
<tr>
<td>*</td>
<td>Significant at 90 percent level of significance</td>
</tr>
<tr>
<td>**</td>
<td>Significant at 95 percent level of significance</td>
</tr>
<tr>
<td>***</td>
<td>Significant at 99 percent level of significance</td>
</tr>
<tr>
<td>@</td>
<td>insignificant</td>
</tr>
<tr>
<td>#</td>
<td>Includes products such as glass and glass products, ceramic ware, bricks, tiles, articles of concrete, cements and lime, cutting, shaping and finishing of stones, etc.</td>
</tr>
<tr>
<td>$</td>
<td>Includes products such as agricultural and forestry machinery, machine tools etc.</td>
</tr>
</tbody>
</table>
INDUSTRIAL ACTIVITY: I - PRODUCTION, PROCESSING AND PRESERVATION OF FRUITS AND VEGETABLES

The capital coefficient was found negative (-0.019) and insignificant in ‘production, processing and preservation of fruits and vegetables’. The negative productivity of capital would be due to availability and under-utilization of excess capital by these units as well as their inability to utilize the credit as well as other Government measures in an efficient manner. Further there may be a lack of demand for the products of these industrial units due to the introduction of new substitutes, insufficient quality and unfavourable cost conditions in the market.

The labour coefficient was observed positive (0.680) and significant in the pre reform period in Himachal Pradesh in ‘production, processing and preservation of fruits and vegetables’. It implies the labour intensive character of this industrial activity. The productivity of material consumed was found positive (0.306) but insignificant in the production, processing and preservation of fruits and vegetables which shows that this sector has not been able to integrate well with the farmers and the quality of raw material was also insufficient. The time coefficient was found positive (0.085) and significant during the pre reform period. However, there is lower capacity utilization and non adoption of cost effective technology, infrastructural constraints, weak linkages between farmers and industry and dependence on intermediaries. The smallness of units and their inability for market promotion is the handicap leading to the inadequate expansion of the domestic market. The production, processing and preservation of fruits and vegetables industrial activity exhibited decreasing return to scale (0.967), which implied that this activity had started employing factors of production, mainly capital, beyond the optimum scale of production.
INDUSTRIAL ACTIVITY: II - MANUFACTURE OF BEVERAGES – DISTILLING

The capital coefficient was observed negative (-0.054) and insignificant in ‘manufacture of beverages (distilling)’ which shows that under-utilization of capital mainly due to lack of demand on account of market competition, cost and quality constraints as well as insufficient automation in this industrial activity. The labour coefficient was observed positive (0.818) and significant in the pre reform period in Himachal Pradesh in the ‘manufacture of beverages (distilling)’. As such, the labour was found to be more efficient and major contributor to the total factor productivity growth. The productivity of material consumed was found positive (0.522) and significant in ‘manufacture of beverages (distilling)’. The time coefficient was positive (0.061) and significant, yet the total factor productivity was relatively low, ‘mainly due to the under-utilization of installed capacity. The ‘manufacture of beverages - distilling’ industrial activity showed increasing return to the scale (1.286). The manpower employed in this activity is skilled and contributed positively to the production process.

INDUSTRIAL ACTIVITY: III - PRINTING AND ALLIED ACTIVITIES

The capital coefficient was negative (-0.052) and insignificant in ‘printing and allied activities’. The overall use of credit is very low and there has been under utilization of capacity, mainly due to competition of larger units, low quality and high cost factors in the market. The excessive credit stems from the tendency on the part of entrepreneurs to get as much credit as possible without considering the actual requirement and efficacy in the productive use of capital. The labour coefficient was observed positive (2.093) and significant in the pre reform period in Himachal Pradesh in ‘printing and allied activities. The labour is the main factor in the production process and its performance has been found quite efficient. The productivity of material consumed
was found positive (0.070) but insignificant in ‘printing & allied activities’. The quality of raw material used by this industrial activity was not very high which is reflected in the low productivity of this input. The time coefficient was positive (0.211) but insignificant. The total factor productivity was relatively high, mainly due to the skilled and trained labour which could make use of capital and other inputs relatively more efficiently. The ‘printing & allied activities’ exhibited increasing returns to the scale (2.111) which shows the specialized manpower was able to make relatively more effective use of capital resources despite bottlenecks in the capacity utilization.

INDUSTRIAL ACTIVITY: IV - MANUFACTURE OF PLASTIC PRODUCTS

The capital coefficient was observed positive (0.312) and significant in ‘manufacture of plastic products’, whereas the labour coefficient was positive (0.137) but insignificant in the ‘manufacture of plastic products’. It shows that this industrial activity is relatively more capital intensive and that the skilled and trained labour is not available for the production process. The productivity of material consumed was found positive (0.216) and significant in the ‘manufacture of plastic products. The time coefficient was positive (0.046) and significant. The positive but low total factor productivity is accounted by the low productivity of factor inputs, which may be due to the inappropriate allocation of resources. The ‘manufacture of plastic products’ industrial activity displayed decreasing return to the scale (0.665), as the allocation of factors of production had moved beyond the optimal scale.

INDUSTRIAL ACTIVITY: V - MANUFACTURE OF NON-METALLIC MINERAL PRODUCTS

The capital coefficient was negative (-0.134) and insignificant in ‘non-metallic mineral products’, which may have resulted due to the
under-utilization of this factor on account of adverse market conditions. The labour coefficient was observed positive (0.958) and significant in the pre reform period in Himachal Pradesh in 'non-metallic Mineral Products'. The productivity of material consumed was found positive (0.381 and significant in the 'manufacture of 'non-metallic mineral products'. The time coefficient was found to be positive (0.073) and significant. There was low a mechanization of this industrial activity, leading to the insufficient use of capital resource. The availability of skilled and trained labour led to the high labour productivity. Due to low automation, the total factor productivity growth was not commensurate with the high productivity of labour. The ‘manufacture of ‘non-metallic mineral products’ exhibited increasing returns to the scale (1.205).

INDUSTRIAL ACTIVITY: VI - BASIC METALS AND ALLOYS – IRON & STEEL – SEMI FINISHED PRODUCTS

The capital coefficient was observed positive (0.487) and significant in ‘basic metals and alloys – iron & steel – semi finished products’. The labour coefficient was observed positive (0.694) and significant in the pre reform period in Himachal Pradesh in 'Basic Metals and Alloys – Iron & Steel – semi finished products'. The productivity of material consumed was found positive (0.085) but insignificant in ‘basic metals and alloys – iron & steel – semi finished products'. The time coefficient was observed positive but insignificant. The coefficients of all the factors of the production were found positive, which had contributed to the positive growth of total factor productivity (0.063). The ‘manufacture of basic metals and alloys – iron & steel – semi finished products’ industrial activity had shown increasing returns to the scale (2.031) which implied the availability of skilled manpower were able to make effective use of productive capital resources.
INDUSTRIAL ACTIVITY: VII - MANUFACTURE OF SPECIAL PURPOSE MACHINERY

The capital coefficient was found positive (0.684) and significant in pre reform period in Himachal Pradesh in 'manufacture of special purpose machinery'. The labour coefficient was also positive (0.027) but insignificant in ‘manufacture of special purpose machinery’. The productivity of material consumed was found positive (0.145) but insignificant, whereas the time coefficient was observed negative [(-) 0.030] and insignificant in the ‘manufacture of special purpose machinery’. This industrial activity was found to be relatively more capital intensive, yet the capacity utilization was low. The quality of the labour and the raw material was also not sufficient which led to the negative total factor productivity. The return to the scale in the ‘manufacture of special purpose machinery’ was found decreasing (0.856), necessitating the re-allocation of factors of production.

INDUSTRIAL ACTIVITY: VIII - MANUFACTURE OF WATCHES AND CLOCKS

The capital coefficient was observed positive (1.229) and significant in ‘manufacture of watches and clocks’. The labour coefficient was negative [(-)0.039)] and insignificant in ‘watches & clocks’. The productivity of material consumed was found positive (0.537) but insignificant in the ‘manufacture of watches & clocks’. The time coefficient was observed negative [(-)0.058)] and insignificant. Despite high capital coefficient, the total factor productivity was negative mainly due to the non-availability of the skilled and trained workers which can use the installed capacity more productively. Further, low quality of raw material also contributed to the negative total factor productivity. The return to the scale in the 'manufacture of watches & clocks' was observed increasing (1.727) due to the mechanization of the production process, which could further be augmented by training of
existing manpower and by supplying the skilled labour to the production activity.

**INDUSTRIAL ACTIVITY: IX - MANUFACTURE OF FURNITURE AND FIXTURES**

The capital coefficient was negative [(-0.179)] and insignificant in 'manufacture of furniture and fixtures'. The labour coefficient was positive (0.978) but insignificant in 'furniture & fixtures'. The productivity of material consumed was found positive (0.531) but insignificant in 'manufacture of furniture & fixtures'. Consequently, the time coefficient was observed positive (0.061) but insignificant. The 'manufacture of furniture & fixtures' is beset with the problems of low level of capital utilization and excess credit. However, the productivity of labour is high, which corroborated the predominantly labour intensive character of this industrial activity. The return to the scale in the 'manufacture of furniture & fixtures' was found to be increasing (1.33) which is due to use of specialized labour in the production process.

**TOTAL ANNUAL SURVEY OF INDUSTRIES SECTOR**

The capital coefficient was observed positive (1.404) and significant in pre reform period in 'total Annual Survey of Industries Sector'. The labour coefficient was observed positive (2.727) and significant in the pre reform period in Himachal Pradesh in Total Annual Survey of Industries Sector. The productivity of material consumed was negative [(-0.314)] and thus insignificant in the 'total Annual Survey of Industries Sector' during pre reform period in Himachal Pradesh. The time coefficient was observed negative [(-0.256)] and significant. It is implied that the installed capacity was either not commensurate with the actual needs of the industries or not utilized in a desired manner. The policy of protectionism and absence of competition had also induced a sense of complacency in the small scale enterprises which led to the
low total factor productivity growth. Further the high inflationary
tendencies in the late eighties also contributed to the low factor
productivity due to low real income and consequent adverse impact on
demand. The return to the scale was found increasing (3.817) in the
total Annual Survey of Industries sector.

6.4.2 Estimation of Total Factor Productivity during Post Reform
Period

During the post reform period more than 90 percent variation in
the dependent variable is explained by independent variables in most of
the industries, i.e., 'production, processing and preservation of fruits and
vegetables', 'manufacture of plastic products' 'non-metallic mineral
products', 'basic metals and alloys – iron & steel – semi finished
products', 'manufacture of special purpose machinery', watches &
clocks' and 'furniture & fixtures' as well as total Annual Survey of
Industries Sector in Himachal Pradesh. Further, 'manufacture of
beverages (distilling)' explains about 83 percent variation in the
dependent variable. However, a meager 45 percent of variation is
explained in case of 'printing & allied activities'.

INDUSTRIAL ACTIVITY: I - PRODUCTION, PROCESSING AND
PRESERVATION OF FRUITS AND VEGETABLES

The capital coefficient was found positive (0.072) and insignificant in
'production, processing and preservation of fruits and vegetables' in the
post reform period, as compared to the pre reform period mainly due to
the competitive pressure of the reform period and consequent emphasis
on the modernization, this industrial activity has started to using the
installed capacity, although in a very moderate manner.
<table>
<thead>
<tr>
<th>Industry</th>
<th>Degree of Freedom</th>
<th>Constant 1</th>
<th>Ln(K) (α)</th>
<th>Ln(L) (β)</th>
<th>Ln(M) (γ)</th>
<th>Time (Λ)</th>
<th>R²</th>
<th>Return to scale (α + β + γ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production, processing and preservation of fruits and vegetables</td>
<td>21</td>
<td>1.395@ (0.681)</td>
<td>0.072@ (1.080)</td>
<td>1.032* (1.323)</td>
<td>0.197** (2.311)</td>
<td>0.104@ (1.068)</td>
<td>0.941</td>
<td>1.301</td>
</tr>
<tr>
<td>Manufacture of beverages (distilling)</td>
<td>21</td>
<td>1.620@ (0.885)</td>
<td>0.138* (1.457)</td>
<td>-0.158@ (0.371)</td>
<td>0.870*** (4.174)</td>
<td>-0.010@ (0.358)</td>
<td>0.834</td>
<td>0.85</td>
</tr>
<tr>
<td>Printing and allied activities</td>
<td>17</td>
<td>5.628* (1.781)</td>
<td>1.137* (1.725)</td>
<td>-0.117@ (0.224)</td>
<td>-0.649** (2.001)</td>
<td>0.029@ (0.190)</td>
<td>0.455</td>
<td>0.371</td>
</tr>
<tr>
<td>Manufacture of plastic products</td>
<td>18</td>
<td>1.789@ (2.442)</td>
<td>0.077@ (0.610)</td>
<td>0.024@ (0.133)</td>
<td>0.792** (7.171)</td>
<td>(2.023)</td>
<td>0.991</td>
<td>0.893</td>
</tr>
<tr>
<td>Manufacture of non-metallic mineral products #</td>
<td>17</td>
<td>-0.3146** (2.307)</td>
<td>0.015@ (0.114)</td>
<td>0.515* (1.567)</td>
<td>1.064*** (5.299)</td>
<td>-0.055** (1.759)</td>
<td>0.990</td>
<td>1.594</td>
</tr>
<tr>
<td>Basic Metals and Alloys – Iron &amp; Steel – semi finished products</td>
<td>17</td>
<td>1.214* (1.458)</td>
<td>0.254@ (1.171)</td>
<td>0.479* (1.438)</td>
<td>0.427*** (3.709)</td>
<td>0.073** (2.170)</td>
<td>0.983</td>
<td>1.16</td>
</tr>
<tr>
<td>Manufacture of special purpose machinery #</td>
<td>13</td>
<td>2.679** (2.389)</td>
<td>0.630*** (6.196)</td>
<td>(-0.453** (2.531)</td>
<td>0.487** (2.199)</td>
<td>0.005@ (0.136)</td>
<td>0.973</td>
<td>0.664</td>
</tr>
<tr>
<td>Manufacture of watches and clocks</td>
<td>17</td>
<td>2.109@ (1.270)</td>
<td>0.029@ (0.165)</td>
<td>0.054@ (0.224)</td>
<td>0.806*** (9.273)</td>
<td>0.042** (1.948)</td>
<td>0.980</td>
<td>0.889</td>
</tr>
<tr>
<td>Manufacture of furniture and fixtures</td>
<td>16</td>
<td>4.712*** (3.945)</td>
<td>0.133* (1.374)</td>
<td>-0.240@ (0.809)</td>
<td>0.406*** (4.005)</td>
<td>0.227*** (3.547)</td>
<td>0.967</td>
<td>0.515</td>
</tr>
<tr>
<td>Total</td>
<td>21</td>
<td>9.032*** (3.799)</td>
<td>0.188@ (1.021)</td>
<td>-0.007@ (0.075)</td>
<td>0.26*** (2.973)</td>
<td>0.101*** (4.787)</td>
<td>0.966</td>
<td>0.442</td>
</tr>
</tbody>
</table>

Figures in parenthesis are calculated ‘t’ values.

- Log Linear
- Significant at 90 percent level of significance
- Significant at 95 percent level of significance
- Significant at 99 percent level of significance
@ insignificant
# Includes products such as glass and glass products, ceramic ware, bricks, tiles, articles of concrete, cements and lime, cutting, shaping and finishing of stones, etc.
$ Includes products such as agricultural and forestry machinery, machine tools etc.
The labour coefficient was positive (1.032) and significant in ‘production, processing and preservation of fruits and vegetables’ during the post reform period as compared to the pre reform period mainly due to the availability of skilled and trained manpower under the policy of linking industrial requirement of manpower to the technical training institutions. During the post reform period, the productivity of material consumed was positive (0.197) and significant. The time coefficient was positive (0.104) and insignificant. The provision of easy finance and increasing automation has led to the increase in the productivity of industrial units engaged in the production, processing and preservation of fruits and vegetables. The productivity has increased during the post reform period as compared to the pre reform period due to technological upgradation and smoothening of supply chain and increasing automation. The efficient utilization of the inputs has also resulted in the overall increase in the productivity. The return to the scale in ‘production, processing and preservation of fruits and vegetables during post reform period was observed increasing (1.301) which has been able to translate into the total factor productivity growth.

INDUSTRIAL ACTIVITY: II - MANUFACTURE OF BEVERAGES – DISTILLING

The capital coefficient was observed positive (0.138) and significant in post reform period in Himachal Pradesh in ‘manufacture of beverages (distilling)’ mainly due to the moderate utilization of the excess capacity. The labour coefficient was negative [(-)0.158]) and thus insignificant ‘manufacture of beverages (distilling)’ as compared with the pre reform period as qualified manpower which could harness the modern technology was not available for this industrial activity. During the post reform period, the productivity of material consumed was positive (0.870) and significant due to the supply of relatively qualitative raw material and direct approach with the farmers by the
entrepreneurs. However, the time coefficient was negative \((-0.010)\) and insignificant. It is observed that the performance of the ‘manufacture of beverages - distilling’ may have declined during the post reform period as compared with the pre reform period mainly because this industrial activity has not been able to keep pace with the modernization of the production process. Besides, the absence of appropriate linkages with the technical institutions for supply of trained manpower and lack of entrepreneurial skills led to the decline in the total factor productivity during the post reform period. The return to the scale in the ‘manufacture of beverages - distilling’ has decreased \((0.85)\) during the post reform period, which is also showcased in the negative total factor productivity growth. The returns to the scale have deteriorated during the post reform period as compared to the pre reform period mainly due to the non-availability of quality manpower, and consequent negative labour coefficient, for this industrial activity.

**INDUSTRIAL ACTIVITY: III - PRINTING AND ALLIED ACTIVITIES**

The capital coefficient was observed positive \((1.137)\) and significant in Himachal Pradesh in ‘printing and allied activities’ in the post reform period in comparison with the pre reform period because of the use of installed capacity and modernization of the production process in order to meet the demand. The labour coefficient was negative \((-0.117)\) and thus insignificant in the ‘printing and allied activities’ as compared to the pre reform period because of the shortage of capable manpower which could use the modern techniques of production in a productive manner. During the post reform period, the productivity of material consumed was negative \((-0.649)\) and insignificant, as this industrial activity was not able to get the sufficient quantity of quality raw material due the scarcity of material inputs which might have been put to other alternative use. The time coefficient was also observed found positive \((0.029)\) and insignificant. This industrial
activity has been able to mechanize its production processes during the post reform period under the impact of liberalization, yet the non-availability of trained manpower and poor quality of raw material led to the decline in the total factor productivity. The return to the scale in the ‘printing and allied activities’ had deteriorated (0.371) considerably during the post reform period in comparison to the pre reform period primarily due to the negative labour coefficient.

INDUSTRIAL ACTIVITY: IV - MANUFACTURE OF PLASTIC PRODUCTS

The capital coefficient was found positive (0.077) and insignificant in the ‘manufacture of plastic products’. However, the capital coefficient has deteriorated in the post reform period in comparison with the pre reform period (0.312) due to the presence of excess and under-utilization of installed capacity. The labour coefficient was positive (0.024) and insignificant in ‘manufacture of plastic products’, though there was a decline in labour coefficient during the post reform period as compared to the pre reform period (0.137) due to the non-availability of trained labour for this industrial activity. During the post reform period, the productivity of material consumed was positive (0.792) and significant. The time coefficient was also found to be positive (0.041) and significant. The ‘manufacture of plastic products’ has witnessed a marginal decline in the total factor productivity due to the decline in the productivity of capital and labour employed during the post reform period in comparison to the pre reform period. This industrial activity has not been able to modernize itself sufficiently, both in terms of mechanization as well as supply of quality manpower, to deal with the impact the economic reforms. The return to the scale in the ‘manufacture of plastic products’ was found decreasing (0.893) during the post reform period, though there had been some improvement in the scale of production as compared to the post reform period.
INDUSTRIAL ACTIVITY: V - MANUFACTURE OF NON-METALLIC MINERAL PRODUCTS

The capital coefficient was found positive (0.015) and insignificant in 'Non-Metallic Mineral Products' which is a marginal increase as compared to the pre reform period (-0.134), though it indicates that there has been some inclination on the part of this industrial activity to modernize itself. In post reform period, the labour coefficient was positive (0.515) and significant in 'Non-Metallic Mineral Products, though it has deteriorated in comparison with the pre reform period (0.958) mainly due to the shortage of trained manpower which could use the modern machinery and equipments. During the post reform period, the productivity of material consumed was positive (1.064) and significant. The time coefficient was found negative [(-0.055)] but significant. The manufacture of 'non-metallic mineral products' has not been able to keep pace with the economic reforms. The law capacity utilization, lack of modernization and non-availability of trained manpower has led to the low productivity of capital and labour and consequently the negative total factor productivity during the post reform period. The return to the scale in the manufacture of 'non-metallic mineral products' was found increasing (1.594) during the post reform period mainly due to the timely supply of material consumed in comparison to the pre reform period.

INDUSTRIAL ACTIVITY: VI - BASIC METALS AND ALLOYS – IRON & STEEL – SEMI FINISHED PRODUCTS

The capital coefficient was found positive (0.254) and insignificant in 'basic metals and alloys – iron & steel – semi finished products'. However, a comparison of capital coefficient during the post reform period to that in the pre reform period (0.487) revealed that this industrial activity has not been able to use the existing capacity and that the modernization of the production process in this activity has not
taken place in a desired manner during the post reform period. In post reform period, the labour coefficient was positive (0.479) and significant in 'Basic Metals and Alloys – Iron & Steel – semi finished products', yet there has been a decline in the quality of manpower available with this industrial activity as compared with the pre reform period (0.694). During the post reform period, the productivity of material consumed was positive (0.427) and significant. The time coefficient was found positive (0.073) and significant. There has been a marginal increase in the total factor productivity, as the capital and labour inputs could combine together with the quality material consumed in order to generate a moderate increase in the total productivity. The total productivity of the manufacture of 'basic metals and alloys – iron & steel – semi finished products' has increased during the post reform period as compared with the pre reform period, yet there has been lack of modernization of production techniques and bottlenecks in the supply of skilled manpower. However, the productivity of raw material consumed has increased mainly due to mobility and timely supply of quality material. The ‘manufacture of basic metals and alloys – iron & steel – semi finished products’ has shown increasing return to the scale (1.16), though it has deteriorated if we compare it with the return to the scale of the pre reform period (2.031).

INDUSTRIAL ACTIVITY: VII - MANUFACTURE OF SPECIAL PURPOSE MACHINERY

The capital coefficient was observed positive (0.630) and significant, whereas the labour coefficient was found negative [(-)0.453)] but significant in post reform period in Himachal Pradesh in the ‘manufacture of special purpose machinery’. The labour productivity has decreased during the post reform period as compared with the pre reform period primarily because of the lack of industry-institutional linkages, whereby the manpower demand could be foreseen and met in
an appropriate manner. It implies that the sufficiently trained and skilled labour was not available for this industrial activity which could make use of the installed capacity and the other inputs being used in the production process. The productivity of material consumed was positive (0.487) and significant. The time coefficient was found positive (0.005) and insignificant. The performance of the ‘manufacture of special purpose machinery’ has been marred by the excess capacity and lack of modernization. This industrial activity has not been able to remove the bottlenecks in the production process, which explains the insignificant marginal increase in the total factor productivity during the post reform period in comparison with the pre reform period [(−)0.030]]. The return to the scale in the ‘manufacture of special purpose machinery’ had decreased (0.664) during the post reform period mainly because of the negative labour coefficient.

**INDUSTRIAL ACTIVITY: VIII - MANUFACTURE OF WATCHES AND CLOCKS**

The capital coefficient (0.029) was found positive and insignificant in ‘manufacture of watches and clocks’ during post reform period. However, if we compared it with the capital coefficient of the pre reform period (1.229), it is amply clear that this industrial activity has not been able to use its capital resources in a reasonable manner. There has been decline in the productivity of capital in ‘watches and clocks’ which may be due to the inability to modernize the productive capacity during the post reform period. The labour coefficient was positive (0.054) and insignificant in the ‘manufacture of watches & clocks’. During the post reform period, the productivity of material consumed was positive (0.806) and significant. The time coefficient was also found positive (0.042) and significant. The total factor productivity has increased during the post reform period mainly because this industrial activity has been able to obtain trained manpower and quality raw material. The
return to the scale in the 'watches and clocks' has decreased (0.889) in the post reform period in comparison with the pre reform period (1.727) mainly because of the low capital coefficient.

INDUSTRIAL ACTIVITY: IX - MANUFACTURE OF FURNITURE AND FIXTURES

The capital coefficient was observed positive (0.133) and significant in post reform period in Himachal Pradesh in 'manufacture of furniture and fixtures' mainly because of relatively better utilization of installed capacity and modernization of production process as compared with the pre reform period. The labour coefficient was negative [(−)0.240)] and thus insignificant in the 'furniture & fixtures' during the post reform period mainly because of non-availability of quality manpower. During the post reform period, the productivity of material consumed was positive (0.406) and significant. The time coefficient was also found positive (0.227) and significant. The total factor productivity has increased during the post reform period in comparison with the pre reform period (0.227) mainly because of use of installed capacity due to the increase in demand and pressure of competition of post reform period. The return to the scale has decreased (0.515) in the 'furniture & fixtures' industrial activity during the post reform period, which is due to the negative labour coefficient.

TOTAL ANNUAL SURVEY OF INDUSTRIES SECTOR

The capital coefficient was found positive (0.188) and insignificant in 'total Annual Survey of Industries sector during post reform period. However, a comparison of capital coefficient of the post reform period with that of pre reform period (1.404) revealed that the overall Annual Survey of Industries sector has not been able to modernize its production process on one hand and use the installed capacity in a productive manner during the post reform period. This could further be
corroborated by the negative \((-0.007\) and insignificant labour coefficient during the post reform period which implied that the supply of sufficiently trained and skilled manpower has been a matter of concern and various policy measures to link modern industrial requirement of labour with the educational and technical institutions has not resulted in supply of quality manpower. Further, there has not been the appropriate mechanism for the training of existing labour in the modern techniques of production and upgradation of entrepreneurial skills to make appropriate allocation of factors of productions. During the post reform period, the productivity of material consumed was positive \((0.261)\) and significant. The time coefficient was also found positive \((0.101)\) and significant. The total factor productivity of total Annual Survey of Industries sector is observed to be low during the post reform period in the State of Himachal Pradesh. The marginal increase in the total factor productivity may be due to the initial efficiency parameter which could have impacted upon the production processes, despite the low capital and labour coefficients. The return to the scale in the total Annual Survey of Industries sector has decreased \((0.442)\) considerably during the post reform period, mainly because of the negative labour coefficient.

6.5 COMPARATIVE ANALYSIS OF PRE AND POST REFORM PERFORMANCE

The analysis of the various estimates of Cobb-Douglas production function shows mixed results in the pre reform period with regard to the variation in the dependent variable, i.e., output, due to the variation in the independent variables, i.e., capital, labour, raw material and factor productivity taken together. More than 90 percent of the variation in the dependent variable is explained by the variation in the independent variables in 'production, processing and preservation of fruits and vegetables' and 'Non-metallic mineral products', whereas the
independent variables in industries, such as, ‘manufacture of beverages (distilling)’, printing & allied activities’, ‘manufacture of plastic products’ ‘manufacture of special purposed machinery’ and ‘watches and clocks’ explains 80 percent to 90 percent variation in dependent variable. 70 percent to 80 percent variation in dependent variable is explained in ‘iron and steel – semi finished products’ in pre reform period in Himachal Pradesh. However, about 53 percent of variation in dependent variable could be accounted for by the independent variables in ‘furniture and fixtures' industry as well as total Annual Survey of Industries Sector in Himachal Pradesh in the pre reform period. The scenario is found to be quite positive in the post reform period with more than 90 percent variation in the dependent variable is explained by independent variables in most of the industries, i.e., ‘production, processing and preservation of fruits and vegetables’, ‘manufacture of plastic products’ ‘non-metallic mineral products’, ‘basic metals and alloys – iron & steel – semi finished products’, ‘manufacture of special purpose machinery’, watches & clocks’ and ‘furniture & fixtures’ as well as total Annual Survey of Industries Sector in Himachal Pradesh. Further, 'manufacture of beverages (distilling)’ explains about 83 percent variation in the dependent variable. However, a meager 45 percent of variation is explained in case of ‘printing & allied activities’.

The return to the scale had deteriorated in ‘manufacture of beverages (distilling)’ [1.286 to 0.85], ‘printing and allied activities’ [from 2.111 to 0.371] ‘Basic Metals and Alloys – Iron & Steel – semi finished products’ [from 2.031 to 1.16], ‘Manufacture of special purpose machinery’ [from 0.856 to 0.664], ‘Manufacture of watches and clocks’[from 1.727 to 0.889], ‘Manufacture of furniture and fixtures’[from 1.33 to 0.515] and ‘Total Annual Survey of Industries Sector’[from 3.817 to 0.442] during the post reform period in comparison to the pre reform period. The capital coefficient has become insignificant due to over-capitalization and under-utilization of the installed capacity. The capital plays major role in
output growth and the coefficient of capital needs to be significant in order to augment the production process. Further, the insignificant coefficient of labour implies that the labour has negatively influenced the output growth. The significant elasticity of labour showed that the substitution possibilities in favour of skilled labour are quite high and it may increase the output though optimum combination of inputs. The insignificant time trend entails that the neutral technological progress has not been able to contribute much to the output growth. This also implies that the appropriate technology may not be accessible to the industries or that they do not have the necessary skill and knowledge to apply the modern technological advancement in an efficient manner.

The total factor productivity as measured through Cobb Douglas production function has improved marginally in 'Production, processing and preservation of fruits and vegetables' [from 0.085 to 0.104], Basic Metals and Alloys – Iron & Steel – semi finished products('[from 0.063 to 0.073], ‘Manufacture of `special purpose machinery’ [from (-)0.030 to 0.005], ‘Manufacture of watches and clocks’ [from (-)0.058 to 0.042], ‘Manufacture of furniture and fixtures'][from 0.061 to 0.227], and total Annual of Survey Industries Sector [from (-)0.256 to 0.101] during the post reform period, mainly due to availability of access to the modern technology and latest techniques of production. However, there is still lower capacity utilization, infrastructural constraints and weak linkages between the input market and the industrial units as well as their inability to undertake measures for promotional activities in a reasonable manner. However, the total factor productivity has declined in 'Manufacture of beverages –distilling' [from 0.061 to (-)0.010], ‘Printing and allied activities’ [from 0.211 to 0.029], ‘manufacture of plastic products’ [from 0.046 to 0.041] and ‘Manufacture of non-metallic mineral products’ [from 0.073 to (-)0.055] during post reform period as compared to the pre reform period, as this industrial activity has not been able to keep pace with modernization of production process and take appropriate
advantages of various policy measure, such as credit facilities and training of labour, declared by the Government for development of small scale industries.

During the pre reform period the productivity was relatively low due to the policy of protectionism pursued by the Government with regard to the small scale sector. As a result of reservation of items exclusively for the production by the small scale industries and various incentives in terms of cheap financial assistance, land on concessional rates, tax rebates and tax holidays, the competitiveness and adequate technological interface of these industries had not progressed in the desired manner. The lack of viable entrepreneurial development programmes may also have led to the inability of these units to put the economic resources to the optimum productive use. Besides, various educational and technical institutions have not been able to supply the skilled manpower as per the requirements of the modern industrial activity.

While a positive rate of total factor productivity growth entails efficient use of existing technology, paving way for augmentation of the productive capacity and consequent higher output growth, the changes in the total factor productivity in different industries in Himachal Pradesh, though somewhat encouraging, are not sufficient and the specific policy formulation and vigorous implementation are needed. Further, the optimization of the allocation of various factors of production has not taken place during the post reform period, which may be due to the lack of entrepreneurial skills to make the best use of productive resources available with the various industrial activities.

Thus, it can be concluded that the 'production, processing and preservation of fruits and vegetables', 'printing and allied activities', 'basic metals and alloys – iron & steel – semi finished products', 'manufacture of special purpose machinery', watches & clocks',
'furniture & fixtures' and 'total Annual Survey of Industries Sector' had witnessed improvement in total factor productivity during the post reform period in Himachal Pradesh. The 'manufacture of beverages (distilling)', 'manufacture of plastic products', 'non-metallic mineral products' reflected downwards trend in the total factor productivity during post reform period as compared to the pre reform period. The return to the scale has deteriorated during the post reform period.