PRODUCTIVITY IN SELECTED INDIAN INDUSTRIES
A REGIONAL ANALYSIS

PRODUCTIVITY IN SELECTED INDIAN INDUSTRIES
A REGIONAL ANALYSIS

Dissertation submitted to the Jawaharlal Nehru University
in partial fulfilment of the requirements for
the Degree of
MASTER OF PHILOSOPHY

M. SAILAJA

CENTRE FOR THE STUDY OF REGIONAL DEVELOPMENT
SCHOOL OF SOCIAL SCIENCES
JAWAHARLAL NEHRU UNIVERSITY
NEW DELHI-110067
1981

JAWAHARLAL NEHRU UNIVERSITY
CENTRE FOR THE STUDY OF REGIONAL DEVELOPMENT
SCHOOL OF SOCIAL SCIENCES

Gram : JAYENU
Telephone : 652282
652114
New Mehrauli Road,
NEW DELHI-110067.

August 1981

I certify that the dissertation entitled "Productivity in Selected Indian Industries - A Regional Analysis" submitted by Miss M. Sailaja, in fulfilment of six Credits out of the total requirements of twentyfour credits for the degree of Master of Philosophy (M. Phil) of the University, is, to the best of my knowledge, a bonafide work and may be placed before the examiners for evaluation.

(DR. A.K. MATHUR)
SUPERVISOR

27-8-81
(PROF. G.S. BHALLA)
CHAIRMAN

ACKNOWLEDGEMENTS

I am indeed very grateful to Dr. Ashok Mathur, under whose supervision this work has been done. The encouragement and guidance extended by him has been of great help. I thank Prof. G.S. Bhalla for his kind help especially during the Course work. Grateful acknowledgements are due to Prof. K.L.Krishna who has not only aroused my interest in the subject but also offered incisive comments at every stage of the work. I wish to thank Mr. Jayasimha of the Electronics Commission for helping me with the Computer work. Mr. Suresh Badola has patiently typed the manuscript for which I am thankful to him.

New Delhi-57
24.8.1981

M. SAILAJA

C O N T E N T S

C O N T E N T S

LIST OF TABLES

.....(iv)

LIST OF TABLES

LIST OF APPENDIX TABLES

CHAPTER I

INTRODUCTION, DATA BASE AND METHODOLOGY

Section 1.1 Purpose and Plan of the Study

Productivity growth has been found to be an important determinant of economic growth even in economies with high rates of capital formation. Productivity has potentially a more important role in developing economies with relatively low rates of capital formation. In India, growth of industry has displayed considerable inter-state diversity. It is instructive to analyse the role of productivity in this context. Very few Indian studies have addressed themselves to the analysis of inter-state disparities in productivity.

Productivity may be defined as output per unit of input. Two types of productivity measures, namely, partial productivity and total factor productivity may be distinguished. Labour productivity, that is, output per unit of labour and capital productivity, that is, output per unit of capital are of the first type. In the measure of total factor productivity output is related to a weighted combination of factor inputs rather than individual inputs.

The study is an attempt to analyse the inter-state disparities in the levels and growth of labour productivity

in the Manufacturing sector as a whole and in twenty two selected industries. We have focussed attention on eight of the most important of these twenty two industries, namely, Cotton Textiles, Iron and Steel (Metal), Sugar, Drugs and Pharmaceuticals, Art Silk, Printing and Hydraulic Cement. The study covers the period 1960-71. It also seeks to explain the observed inter-state inter-temporal differences in the levels of labour productivity in terms of capital intensity, scale economies, state and time effects. Growth of labour productivity over the period 1960-71 is explained in terms of the scale effect measured by the growth rate of employment and level of labour productivity in 1960. The main data source for our study is the Annual Survey of Industries (Census Sector).

Many studies have attempted an analysis of industrial productivity at the All India level. Beri[1] took time series data from 1948 to 1955 on Indian Manufacturing. His data shows positive association between labour productivity and capital intensity and also economies of scale. Rajkrishna and Mehta[2] and Reddy and Rao[3] also find positive association of capital

---

1. Beri, G.C.: Measurement of Production and Productivity in Indian Industry, Asia Publishing House, 1962.

2. Rajkrishna & Mehta, S.S.: 'Productivity Trends in Large-Scale Indian Industries', Economic and Political Weekly, October 16, 1968.

3. Reddy, M.G.; and Rao, G.P.: 'Functional Distribution in Large-Scale Manufacturing Sector in India', Artha Vijnana, 4, No.5, 1962.

intensity but constant returns to scale. Banerji[4] takes the Cotton and Jute Textiles, Sugar, Paper and Bicycle industries and Total Manufacturing for the period 1946-64. Time series of inter-state cross section data are employed. He explains inter-state disparities for value added in terms of capital-intensity, economies of scale, time and state specificities. Mehta[5] has taken 27 major industries for the period 1946 to 1970 and concludes that there is no significant association between labour productivity and capital intensity. He also shows that till the fifties most of the industries showed constant returns to scale in Indian industry. Most of these studies do not consider the regional aspect.

Very few studies have been undertaken at the regional level. Chalapati Rao[6] has analysed inter-state variations in labour productivity, capital productivity and total factor productivity in the Basic Metal industries for the years 1960, 1962, 1964 and 1966. His study shows that regional disparities

---

4. Banerji, A: Capital Intensity and Productivity in Indian Industry, The Macmillan Company of India Ltd., 1975.

5. Mehta, S.S.: Productivity, Production Function and Technical Change, Concept Publishing Company, New Delhi, 1980.

6. Chalapati Rao, K.S.: Measurement of Regional Variations in Industrial Productivity - a case study of Basic Metals Industries (unpublished M.Phil Thesis, Jawaharlal Nehru University, 1976).

measured in terms of coefficient of variation decreased or remained more or less constant over time except in Iron and Steel (structurals) industry. He concludes that labour productivity increased mainly because of increase in capital intensity. Also constant returns to scale are observed in the Basic Metal industries. Mahendra Dev[7] compares labour productivity in Andhra Pradesh with that of All India for Total Manufacturing, Cotton Textiles and Sugar industries over the period 1956-70.

Chalapati Rao's study is limited to Basic Metal industries and covers only the period 1960-66. On the other hand, Mahender Dev's study is confined to a comparison of a single state Andhra Pradesh with All India in respect of only two industries. Our study has a much wider industrial and regional coverage. It relates to the period 1960-71. We have not been able to consider a later year as Annual Survey of Industries (Census Sector) volumes are available only till 1971. Also, unlike the above two studies, we have tried to explain labour productivity in terms of not only capital-intensity and scale but also factors specific to states and years. Another interesting feature of our study is that explanation of the growth of labour productivity is provided in terms of (i) growth rate of employment to assess the scale effect and (ii) level of labour productivity in 1960 to see whether inter-state disparities have

---

7. Mahendra Dev: Productivity in organised industry in Andhra Pradesh and All India: A Comparative Analysis (Unpublished M.Phil Thesis, Delhi University, 1981).

a tendency to be lower or higher over time.

The study is divided into five Chapters including the present one. In this Chapter we have discussed the purpose and plan of our study. Section two describes the data source, coverage and concepts. The third section discusses the measure of inter-state variations in labour productivity. The methodology for the explanation of labour productivity differences is presented in the fourth section. The last section deals with the measurement of inter-state disparities in the growth of labour productivity. It also explains the growth of labour productivity in terms of growth of employment and level of labour productivity in the initial year.

The second Chapter deals with the inter-state variations in the levels of labour productivity. Explanation of the levels of labour productivity in terms of state and time effects, capital intensity and scale economies is attempted in the third Chapter. We have also presented the inter-state disparities in the levels of total factor productivity. Inter-state differences in the growth rates of labour productivity and their explanation in terms of growth rate of employment and levels of labour productivity in the initial year are discussed in Chapter Four. The last Chapter presents the summary and conclusions of our study.

Section 1.2 Data, Coverage and Concepts

Data Source

The data source for this study is the various volumes of Annual Survey of Industries (ASI) (Census sector) for the years 1960, 1964, 1966 and 1971. All the factory establishments employing 50 or more workers with power and 100 or more workers without power are included in the Census Sector. However, the ASI data suffer from certain limitations. For any given industry the data for all the individual states are not reported in the ASI volumes. Because of the Secrecy Clause, the states with very few units in any given industry are clubbed together and the clubbing changes from year to year for some industries. ASI data on capital are not readily suited for economic analysis. Depreciation figures are also not reliable.

Coverage

Our analysis covers twenty two selected industries. For comparative purposes, the manufacturing sector as a whole is also analysed. Inter-state disparities in these industries are discussed. Out of the 22, we have focussed on the eight most important industries, namely, Cotton Textiles, Iron and Steel (Metal), Sugar, Drugs and Pharmaceuticals, Art Silk, Tea Manufacturing, Printing and Hydraulic Cement industries for the analysis in Chapters 2, 3 and 4. Explanation of inter-state

differences are provided for these eight industries. The proportion of value added by these twenty two industries in total value added for manufacturing (Census Sector) in 1971 was 31.7 per cent. These industries are selected so as to give representation to the four broad groups of Basic, Capital, Intermediate and Consumer Goods industries as classified by the Reserve Bank of India. Basic Goods include primary metals, cement, etc. Capital Goods industries comprise industries which do not need further processing and are necessary for the manufacture of finished products. All Industries which are not classified under Basic Goods and which require further processing before their conversion into consumption goods are classified as Intermediate Goods. All items which are finished products and are mainly used for house-hold consumption are grouped under Consumer Goods Category. The proportion of value added by Basic, Capital, Intermediate and Consumer Goods industries selected for this study in total value added for manufacturing are 7, 1.3, 1.5 and 21.9 per cent respectively. The industries under the four categories are given in Table 1.1.

Table 1.1

The Twenty Two Industries Under Major Industry Groups

Serial No.	Code No. in ASI	Name of the Industry
I.	Basic Goods Industries	
1.	311-2.1	Inorganic Heavy Chemicals
2.	334	Hydraulic Cement
3.	341-1	Iron and Steel (Metal)
4.	341-3	Iron and Steel(Castings and Forgings)
II.	Capital Goods Industries	
5.	360-4.1	Textile Machinery
6.	360-7	Machine Tools
7.	360-8.2	Agricultural Implements
III.	Intermediate Goods Industries	
8.	239-1	Cotton Ginning
9.	331-4	Tiles
10.	333-1	Chinaware and Pottery
11.	339-2	Hume Pipes
12.	350-3	Bolts, Nuts, etc.
IV.	Consumer Goods Industries	
13.	205-1	Flour Mills
14.	205-2	Rice Mills
15.	207-1.2	Sugar
16.	209-2	Edible oils
17.	209-4	Tea Manufacturing
18.	231-1	Cotton Textiles
19.	231-5	Art Silk
20.	280-1	Printing
21.	319-5	Drugs and Pharmaceuticals
22.	385	Manufacture of Motorcycles and Bicycles.

States are considered as regions. All the above industries are fairly well distributed regionally. For each industry only states for which data are available for the four years, namely 1960, 1964, 1966 and 1971 are considered. States that have been clubbed together are mostly omitted except when the same clubbing is adopted for all the four years. One important case of clubbing relates to Punjab and Haryana. Levels of productivity for All India are also presented for facilitating inter-state analysis.

Years subsequent to 1971 could not be considered as ASI (Census Sector) volumes for individual industries were available only up to 1971 at the time the study was planned. The year 1965 is not considered because it was an abnormal year. Levels of labour productivity are analysed for each of these years as also growth of labour productivity over the periods 1960-64, 1966-71 and 1960-71. It would have been better if a three yearly average around each year was considered to smooth out any cyclical fluctuations. But this would have meant loss in the number of observations in terms of states as ASI does not publish data for some of the states or there has been variation in the clubbing of states from year to year.

Concepts

Labour productivity is defined as output per unit of labour input. Output can be measured in terms of gross output/gross value added or net output/value added. The

difference between 'gross' and 'net' lies in depreciation. Net output and net value added may be preferred to gross output or gross value added on theoretical grounds. But in developing economies like India, the data on depreciation are not reliable. Therefore, gross output/gross value added can be taken as two alternative measures of output. Gross value added is preferred over gross output, for output attributed to an industry is value added rather than production. Moreover, taking output would involve double counting as intermediate products are taken seperately as well as in the measurement of output. Value added is the difference between the output produced and intermediate inputs consumed in the process of production. It is distributed between labour and capital, the two factors of production.

Labour input is usually measured in terms of persons employed or man-hours worked. If the number of persons is taken as a measure of labour, then changes in the number of working days are not taken into account. Man-hours is not a satisfactory measure of total labour input because the figures of man-hours in the ASI data relate only to production workers. The breakdown of labour according to age, sex, or level of skills is not available in ASI. The present study takes number of persons employed as a measure of labour input, for it includes both production and non-production workers. Man-hours is, however, also taken to see the

pattern of labour productivity in different states.

Capital input can be measured in terms of fixed capital or total capital (that is, fixed plus working capital). Data given by ASI on fixed capital are the book values of capital assets. These book value figures "represent a simple aggregation of the actual money values of annual additions to capital stock over a period of time without making any adjustments for price changes over the period".[8] Figures on depreciation are arbitrary, as they are calculated according to the income-tax laws. The widely used method for arriving at real gross fixed assets is the 'perpetual inventory method'.[9] This method requires time series data on fixed assets. This involves detailed calculations which are outside the scope of this study. Therefore, the book-value of fixed assets are taken as a measure of capital-input.

---

8. Dholakia, B.H.: 'Measurement of capital input and estimation of time series production functions in Indian Manufacturing'. The Indian Economic Journal, Vol.24, No.3, 1977.

9. Some of the Indian studies which use this method are:-
   (a) Banerjee, A: Capital Intensity and Productivity in Indian Industry, op.cit.
   (b) Hashim and Dadi: 'An Adjusted Capital Series in Indian Manufacturing 1960-64', Anvesak, Dec. 1971.
   (c) Dholakia, B.H: Sources of Economic Growth in India, Good Companions, Baroda, 1974.
   (d) Dholakia, B.H.: 'An Inter-state Analysis of Capital and output in the Registered Manufacturing Sector' in Indian Journal of Industrial Relations', Vol. 15, No.1, 1979.

The concepts of gross value added, number of persons employed, man-hours worked and fixed capital in ASI are defined as follows:

Value Added: It is obtained by deducting value of material inputs from gross output.

Number of Persons Employed: The average number of persons employed by each factory under various heads such as workers, other than workers etc., is computed by taking the total attendance of persons in all the shifts on all working days and dividing it by the number of days worked. These averages are aggregated for all factors in the State or Industry as the case may be, and the aggregate is taken as the number of persons employed in the State or Industry, respectively. It includes persons attending and on leave with pay, such as sick leave, or paid vacation and also those engaged in welfare activities.

Man-hours Worked: It is computed by multiplying the number of workers employed in each shift by the number of hours in each shift and aggregating the figures for all shifts on all the working days in the year.

Fixed Capital: It comprises land, buildings, including those under construction, improvement to land and other construction, plant, machinery and tools, transport equipment and other fixed assets like furniture, fixtures, etc. As stated above, this is a book value measure, with the limitations pointed above.

To arrive at a comparable figure of output and value added measures over the years, 1971 is considered as the base year. 'Single Deflation' method is used for value added. The 1960, 1964 and 1966 series are inflated by the All India wholesale Price Index for these years (with base 1971 = 100).[10] The inflation for any specific industry is carried out with the wholesale price index for the major groups in which the industry falls. For example, the figures of 1960, 1964 and 1966 for Textile Machinery are inflated by the index of Non-electrical Machinery. The All India Index is used even in the case of individual states. Thus value added measures are expressed in constant prices, namely the All India prices for the year 1971.

Section 1.3 Measures of Regional Variations in Labour Productivity.

The measure of labour productivity considered is value added per employee. Changes in labour productivity may arise on account of greater efficiency in the production of goods or on account of substitution of capital for labour.

Let Y_{ist} represent the labour productivity in the i^{th} industry, s^{th} state and t^{th} year. Then it is obtained by

$$Y_{ist} = \frac{V_{ist}}{L_{ist}}$$

$i = 0, 1, 2 \ldots 22$
$s = 0, 1, 2 \ldots S$
$t = 1960, 1964, 1966, 1971$

---

10. These prices indices are obtained from Chandhok, H.L. Wholesale Price Statistics, India 1947-78, Vol.I, Economic and Scientific Research Foundation, Delhi, 1978.

$i = 0$ for Total Manufacturing and $s = 0$ for All India. V_{ist} is the value added in the i^{th} industry, s^{th} state and t^{th} year and L_{ist} is the number of persons employed in the i^{th} industry, s^{th} state and t^{th} year.

Inter-regional disparities in levels of labour productivity can be measured with the help of coefficient of variation. The average labour productivity for a given industry i, in year t, is given by

$$\bar{Y}_{i.t} = \sum_{s=1}^{S} \left(Y_{ist} / s \right)$$ where s is the number of States.

The corresponding coefficient of variation of labour productivity is given by

$$C_{it} = \frac{\sqrt{\sum_{s} \left(Y_{ist} - \bar{Y}_{i.t} \right)^2 / s}}{\bar{Y}_{i.t}} \qquad \begin{array}{l} i=0, 1, \ldots 22 \\ t= 1960, 1964, 1966, 1971. \end{array}$$

If coefficient of variation in the i^{th} industry in year t is higher than that in year t^1, the inter-regional disparities are higher in year t then in t^1. Thus inter-regional disparities in labour productivity for Total Manufacturing as well as for the twenty two industries in the four years may be compared. Inter-industry differences in disparities are to be expected as the production functions for the different industries are different. Comparison of C_{it} for different i for a given t reveals these differences. However a limitation of this method is that it gives equal weights to

all the states.

Section 1.4: Explanation of Labour Productivity

For the explanation of the levels of labour productivity, we assume a Cobb-Douglas Production Function. This is considered for convenience as its parameters are easy to estimate and interpret. Moreover, the various econometric tests in literature have not conclusively rejected this form of the production function. In the present context, the production function may be written as

$$V_{ist} = A_{ist} K_{ist}^{\alpha_i} L_{ist}^{\beta_i} \quad \ldots\ldots \quad (1)$$

$i = 0, 1, 2, \ldots 22$
$s = 0, 1, \ldots S$
$t = 1960, 1964, 1966, 1971$

where V_{ist} is the value added in i^{th} industry, s^{th} state and t^{th} year and K and L are fixed capital and number of persons employed respectively. α_i and β_i and A_{ist} are different for different industries. A_{ist} captures factors like locational advantages enjoyed by a state as well as cyclical influences for a given industry.

Dividing (1) by L_{ist}, we obtain labour productivity Y_{ist} in i^{th} industry, s^{th} state and t^{th} year, and we have,

$$Y_{ist} = \frac{V_{ist}}{L_{ist}} = A_{ist} \left(\frac{K_{ist}}{L_{ist}}\right)^{\alpha_i} L_{ist}^{\alpha_i+\beta_i-1} \quad \ldots\ldots(2)$$

For a given industry i, dropping the subscript i, we have

$$A_{st} = \frac{V_{st}}{K_{st}^{\alpha} L_{st}^{\alpha}} = \frac{\left(V_{st} / L_{st}\right)}{\left(\frac{K_{st}}{L_{st}}\right)^{\alpha} L_{st}^{\alpha+\beta-1}}$$

It may be observed that A_{st} is a measure of total factor productivity (TFP) in state s and year t.

Equation (2) for a given industry is

$$Y_{st} = A_{st} \left(\frac{K_{st}}{L_{st}}\right)^{\alpha} L_{st}^{\alpha+\beta-1}$$

$s = 0, 1, \ldots S$
$t = 1960, 1964, 1966, 1971$

Taking logarithms of both sides

$$\log Y_{st} = \log A_{st} + \alpha \log \left(\frac{K_{st}}{L_{st}}\right) + (\alpha+\beta-1) \log L_{st}$$

i.e. $$\log Y_{st} = \log A_{st} + \alpha \log k_{st} + h \log L_{st} \quad \ldots\ldots \quad (3)$$

where $k_{st} = \frac{K_{st}}{L_{st}}$ is a measure of capital intensity

and $h = \alpha + \beta - 1$.

α measures the elasticity of labour productivity with respect to capital intensity, h measures the scale economies (diseconomies). In case h is equal to zero, there are constant returns to scale in that industry. $h>0$ implies economies of scale and $h<0$ implies diseconomies of scale.

Equation (3) shows the relationship between labour productivity on the one hand, and capital intensity, scale and TFP on the other. As already pointed out, $\log A_{st}$ represents the influence on value added or labour productivity of factors specific to a year and/or state. We can decompose TFP into state and time effects. In our study, state and year dummy variables are used to estimate these two influences.

We assume an additive model

$$\log A_{st} = \delta + \mu_s + \theta_t \quad \ldots\ldots (4)$$

with μ_s as the state effect for state s and θ_t as the year effect for year t. With assumption (4) and the addition of a disturbance term, equation (3) becomes

$$\log Y_{st} = \delta + \mu_s + \theta_t + \alpha \log k_{st} + h \log L_{st} + \varepsilon_{st} \quad \ldots\ldots (5)$$

For the purpose of statistical estimation of (5) we assume that $\mu_1 = \theta_1 = 0$.

The complete model in our analysis, with time and state dummies is given as follows:

$$\log Y_{st} = \delta + \theta_2 Z^{(1)}_{st} + \theta_3 Z^{(2)}_{st} + \theta_4 Z^{(3)}_{st} + \mu_2 W^{(1)}_{st}$$

$$+ \mu_3 W^{(2)}_{st} + \ldots + \mu_s W^{(s-1)}_{st} + \alpha \log k_{st} + h \log L_{st} + \varepsilon_{st} \quad \ldots\ldots(6)$$

where $Z^{(j)}_{st} = 1$ if $t = j-1$ $\quad j = 1964, 1966, 1971$

$= 0$ otherwise $\quad t = 1960, 1964, 1966, 1971$

$s = 0, 1, 2 \ldots S$

and $W^{(\ell)}_{st} = 1$ if $s = \ell - 1$ $\quad \ell = 1, \ldots S$

$= 0$ otherwise $\quad s = 0, 1, \ldots S$

$t = 1960, 1964, 1966, 1971.$

Equation (6) can be written as

$$\log Y_{st} = \delta + \sum_{j=1}^{3} \theta_{j+1} Z^{(j)}_{st} + \sum_{\ell=1}^{s-1} \mu_{\ell+1} W^{(\ell)}_{st}$$

$$+ \alpha \log k_{st} + h \log L_{st} + \varepsilon_{st}$$

This regression is estimated for each industry i and for Total Manufacturing. Time series of inter-state cross-section data are used. This methodology leads to the estimation of the average levels of total factor productivity in different states.

Such a method takes into account the state and year effects and puts the hypothesis to more stringent tests. The disturbance term ε_{st} in the equation is net of state and year effects which are systematic. Since important systematic influences have been netted out from the disturbance term, the problem of simultaneity bias in OLS estimates is reduced. Equation (6) is estimated by the dummy variable technique. However, the use of dummy variable technique may lead to more unstable estimates. So even if R^2 is high, the dummy variable technique may not always yield satisfactory results.

In equation (6) there are three sets of variables, namely, time dummies, state dummies, and capital intensity and labour variable. We estimate various combinations of these three variables by dropping some at a time. In all seven regressions are fitted : (i) with only state dummies, (ii) with state dummies, time dummies, capital intensity and scale variable (iii) with state dummies, capital intensity and scale variable, (iv) with time dummies (v) with state and time dummies (vi) with time dummies, capital intensity and scale variable (vii) with capital intensity and scale variable.

We have also computed F-statistic for the state dummies to test the significance of inter-state variations in total factor productivity. Let $E_{(i)}$ be the error sum of squares for regression (i) and $E_{(ii)}$ be the error sum of squares for

regression (ii), then F-statistic for state dummies is

$$F_{6,(n-p-6)} = \frac{\left[E_{(i)} - E_{(ii)}\right] / p}{E_{(ii)} / n-p-6}$$

where p is the number of state dummies and n is the number of observations.

The methodology adopted here does not require the assumptions of competitive equilibrium and constant returns to scale. This is an important merit, since the indices of total factor productivity associated with the names of Kendrick and Solow make these restrictive assumptions. Another merit of our analysis is that only four observations for each state are taken.

Section 1.5 Growth of Labour Productivity and its Explanation

Compound annual growth rates of labour productivity are calculated for the periods 1960-64, 1966-71 and 1960-71. Let compound annual growth rates of labour productivity in i^{th} industry, in s^{th} state during the period t to t_2 be represented by $g_{is(t_1-t_2)}$. Then

$$g_{is(t_1-t_2)} = \left\{ \text{antilog} \left[\frac{\log Y_{ist_2} - \log Y_{ist_1}}{t_2 - t_1} \right] - 1 \right\} \times 100$$

This will help us in comparing the growth rates among different states and with All-India average.

Inter-regional disparities in the growth rate of labour productivity are measured by coefficient of variation. Let

$$\bar{g}_{i.t} = \sum_{s} g_{ist} / s$$

Then coefficient of variation for a given industry in time period ti is given by

$$c'_{it} = \frac{\sqrt{\left(g_{ist} - \bar{g}_{i.t}\right)^2 / s}}{\bar{g}_{i.t}}$$

Where s is the number of states.

Regional disparities in the growth rate of labour productivity are explained in terms of growth rate of employment and level of labour productivity in the initial year. We regress the growth rate of labour productivity on the growth rate of employment for industries with more than nine observations. The regression equation is given by

$$g_{is(1960\text{-}71)} = a^{(1)}_{it} + b^{(1)}_{it} g^{E}_{is(1960\text{-}71)}$$

We test the convergence hypothesis on the basis of inter-state data for industries with more than nine observations, by regressing growth rate of labour productivity on the level of labour productivity in the initial year 1960.

According to this hypothesis, regional disparities tend to be lower over time. The regression equation is given by

$$g^{Y}_{is(1960\text{-}71)} = a^{(2)}_{it} + b^{(2)}_{it} \; Y_{is\ 1960}$$

We have also computed the coefficient of determination R^2 and t-statistic for the two regressions.

CHAPTER II

LEVELS OF LABOUR PRODUCTIVITY

This Chapter examines the extent of disparities in the levels of labour productivity among states in different industries in the years 1960, 1964, 1966 and 1971. In Section 1, we present some background information about the relative importance of different industries and about the contribution of the different states to value added in manufacturing. Secion 2 deals with the regional variations in labour productivity. The last section presents the summary of the Chapter.

Section 2.1 Background

This section provides a background to our analysis of labour productivity. First we discuss the share of the different industries in the value added in the manufacturing to mark out the relatively important industries. Second, we discuss the share of value added by each state in Total Manufacturing as well as in individual industries.

Table 2.1 presents the share of value added by each of the twenty two industries in total value added of the twenty two industries in 1960, 1966 and 1971. The three important industries in 1960 are the Cotton Textile, Iron and Steel (Metal) and Sugar. They contribute for 45, 11 and 9 percent of the value added respectively. Tea Manufacturing (6 per cent), Manufacture of Motorcycles and Bicycles (5 per cent), Drugs and Pharmaceuticals

Table 2.1

Shares (Percent) of Industries in Manufacturing in Terms of Value Added in Selected Years

Industry	Share of Industry in Value Added in Manufacturing		
	1960	1966	1971
1. Flour Mills	0.86	0.72	0.66
2. Rice Mills	0.62	0.41	0.35
3. Sugar	8.59	8.42	0.11
4. Edible oils	1.84	1.13	0.82
5. Tea Manufacturing	5.83	4.77	4.48
6. Cotton Textiles	44.86	35.03	37.32
7. Art Silk	2.21	5.72	6.46
8. Cotton Ginning	0.77	0.91	1.32
9. Printing	3.61	4.03	5.50
10. Inorganic Heavy Chemicals	2.03	2.35	3.83
11. Drugs and Pharmaceutical	4.13	7.65	11.80
12. Hydraulic Cement	3.20	3.95	3.44
13. Tiles	0.64	0.49	0.61
14. Chinaware and Pottery	0.41	0.19	0.26
15. Bolts,nuts, etc.	0.95	1.50	1.98
16. Rame Pipes	0.39	0.45	0.54
17. Iron & Steel(Metal)	11.23	15.06	11.96
18. Iron & Steel(Castings and Forgings)	1.07	1.67	2.84
19. Textile Machinery	1.28	1.94	2.03
20. Machine Tools	0.65	1.39	1.65
21. Agricultural Implements	0.33	0.43	0.49
22. Mfg.of Motorcycles and Bicycles	4.55	1.76	1.55
Total Manufacturing	100.00	100.00	100.00

and Printing (4 per cent), Cement (3 per cent) are some of the industries which have a substantial share in value added of the twenty two industries. The above eight industries together account for about 86 per cent of value added.

Over the period 1960-71, the share of value added increased in case of Art Silk, Cotton Ginning, Printing, Inorganic Heavy Chemicals, Drugs and Pharmaceuticals, Bolts, Nuts, etc. Hume Pipes, Iron and Steel (Castings and Forgings), Textile Machinery, Machine Tools and Agricultural Implements industries. The share has decreased in Flour and Rice Mills, Sugar, Edible oils, Tea Manufacturing, Manufacture of Motorcycles and Bicycles industries. Over the decade, important industries like Cotton Textiles, Iron and Steel (Metal), Cement industries show no clear tendency for increase or decrease in value added.

Industries that were important in 1960, continued to contribute to the major share of value added in 1971. These are Cotton Textiles, Iron and Steel (Metal), Tea Manufacturing, Drugs and Pharmaceuticals, Printing, Cement, which together account for about 74 per cent of total value added. The only exception is in case of sugar which showed a sharp decline in value added in 1971 with its share of 0.11 per cent eventhough the index of sugarcane production in 1971 is 103.6 with 1960 as the

base.[1] The decline in value added may be due to the low price of sugar in that year. On the other hand, Art Silk industry contributed about 6 per cent of value added in 1971 as compared to 2 per cent in 1960.

Thus about 8 industries, namely, Cotton Textiles, Iron and Steel (Metal), Sugar, Drugs and Pharmaceuticals, Printing, Tea Manufacturing, Cement and Art Silk industries contributed about 80 to 85 per cent of total value added by the twenty two industries over the decade 1960-71. However, the share of each of these industries showed variation in 1971 as compared to that of 1960.

Table 2.2 presents the shares of different states in value added for Total Manufacturing and for important industries in 1971. Shares of states for the remaining industries are presented in Appendix Table A-1. It is interesting to note that Maharashtra alone accounts for a little more than one fourth (26 per cent) of the value added in Total Manufacturing in 1971. Next in importance is West Bengal with a share of about 22 per cent. Gujarat, Tamil Nadu, Bihar and Uttar Pradesh each contribute about 7 to 8 per cent of value added for All India. Thus six out of the 18 states account for about 80 per cent of the total industrial activity.

---

1. Sugar Directory, Who's Who, 1978.

Table 2.2

Shares (Per cent) of the states in All India Value Added, in Important Industries, 1971.

Industry / State	Total Mfg.	Sugar	Tea Manufacturing	Cotton Textiles	Arts Silk	Printing	Drugs & Pharmaceuticals	Hydraulic Cement	Iron & Steel (Metal)
1. Andhra Pradesh	2.70	7.55		1.12		0.97	0.87	8.89	
2. Assam	2.97		52.43			0.95			
3. Bihar	7.00	13.41				2.78	1.31	16.33	35.12
4. Gujarat	8.39	0.26		28.16	15.52	2.40	20.95	9.04	
5. J&K	0.09								
6. Kerala	2.45		1.71	0.75		2.40			
7. Madhya Pradesh	2.42	1.38		4.33	3.96	1.02		9.29	13.38
8. Tamil Nadu	7.15	7.17	6.52	13.11	2.54	12.27	1.38	18.74	3.46
9. Maharashtra	27.57	15.40		35.16	48.14	39.99	62.45		9.93
10. Karnataka	3.05	6.42		2.51		1.22		7.16	
11. Orissa	0.98			0.44		0.52			10.00
12. Punjab	1.93	2.78		0.79	5.43				2.05
13. Rajasthan	1.01			0.08		0.79			
14. U.P.	6.45	43.94	0.53	6.26	5.79	6.54	2.48		4.21
15. W. Bengal	22.34		28.62	3.15	8.41	17.12	6.90		11.27
16. Delhi	1.60					8.22	1.38		
17. Himachal Pradesh	0.11								
18. Tripura	0.02		0.36						
19. All India	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

The table also brings out the fact that Maharashtra, Tamil Nadu, Gujarat, West Bengal and Uttar Pradesh have diversified industrial structures compared to other states. These are the states with relatively more industrial activity. In other words, states which have greater share in value added in manufacturing have more diversified industrial structures. This aspect has to be borne in mind in the analysis of regional disparities in industry.

Share of value added in Sugar industry is the highest in Uttar Pradesh followed by Maharashtra and Bihar. Andhra Pradesh and Tamil Nadu account for about 7 per cent and Punjab for 3 per cent. 81 per cent of the value added in Tea Manufacturing is contributed by Assam and West Bengal. In the Cotton Textiles industry, Maharashtra contributes about 35 per cent of value added followed by Gujarat with 20 per cent. The shares of Tamil Nadu and UP are also substantial. In the Art Silk industry too, Maharashtra and Gujarat account for about 64 per cent of value added.

In case of Printing industry, the share of Maharashtra is 40 per cent and that of West Bengal is 17 per cent. Tamil Nadu, Delhi and UP also have fairly high shares of value added in these industries. In Drugs and Pharmaceuticals industry, the contribution of Maharashtra is 62 per cent and that of Gujarat is 21 per cent. Shares of cement industry in Tamil Nadu and Bihar are quite high. Andhra Pradesh, Gujarat, Madhya Pradesh and Karnataka together account for about 34 per cent. Bihar contributes about 35 per cent to value added in Iron

and Steel (Metal) and West Bengal about 11 per cent. Orissa and Maharashtra too contribute about 10 per cent.

Thus Table 2.1 shows that eight ~~xx~~ industries, namely Cotton Textiles, Iron and Steel (Metal), Sugar, Tea Manufacturing, Drugs and Pharmaceuticals, Printing, Cement and Art Silk in that order, are the most important industries contributing about 80 to 85 per cent of value added in the 22 industries in 1960, 1966 and 1971. That is, relatively small number of industries account for major share of value added and therefore we shall attempt a detailed examination of these industries. The results of the remaining industries will be included in Appendix Tables.

Six out of eighteen states, namely, Maharashtra, West Bengal, Gujarat, Tamil Nadu, Bihar and UP contribute about 79 per cent of value added for All India. Thus disparties in industrial activity are quite acute.

Section 2.2: Inter-State Variations in Labour Productivity

Inter-state variations measured in terms of coefficient of variation are presented in this section. The method of computing the coefficient of variation has already been discussed in Chapter 1. First, we present the index of value added per employee in Total Manufacturing for all the states. We then move on to discuss inter-state disparities in

different industries and also in major groups of industries.

Table 2.3 presents the index numbers of value added per employee for Total Manufacturing for all the states with All India = 100 in 1960, 1964, 1966 and 1971. Index numbers of value added per man-hour for these years are given in Appendix A-Table 2.

The levels of labour productivity measured in terms of value added per employee, for Maharashtra and Bihar are above the All India level, with the difference increasing over time in case of Maharashtra. Tamil Nadu, Assam, Orissa, Delhi and Himachal Pradesh show a value added per employee higher than that of All India in 1960. West Bengal, Gujarat, UP and Punjab show the index lower than the All India Index.

Labour productivity in Maharashtra is above the All India average in all the years and has continuously increased from 1960 to 1971. Bihar, Tamil Nadu, Punjab, UP show no clear tendency for labour productivity to increase or decrease. However, when we compare the index of 1960 with that of 1971 Gujarat, Andhra Pradesh, Karnataka and Rajasthan show an increase in the index of labour productivity while it has decreased in Bihar, Tamil Nadu and U.P. Punjab shows a slight increase in the value added per employee more or less equal to that of All India.

The Table also brings out the fact that there are wide inter-state disparities in the levels of labour productivity.

Table 2.3

Index Numbers of Value Added Per Employee for Total Manufacturing in 1960, 1964, 1966 and 1971 Statewise

State	Value added per employee 1960	1964	1966	1971	Average L.P. for 1961, 1964, 1966, 1971.
1. Andhra Pradesh	54.8	54.4	58.9	65.1	3535.95
2. Assam	126.9	81.4	94.0	69.3	5491.97
3. Bihar	122.5	131.7	138.5	108.9	7526.40
4. Gujarat	86.3	92.6	101.4	100.6	5764.69
5. Jammu and Kashmir	34.9	22.8	39.4	1.6	1416.53
6. Kerala	53.6	50.9	69.4	75.0	3788.88
7. Madhya Pradesh	81.5	53.2	87.2	85.9	4644.45
8. Tamil Nadu	100.9	102.4	92.7	87.8	5768.36
9. Maharashtra	128.0	128.5	135.0	144.8	8120.37
10. Karnataka	80.2	102.0	120.5	121.9	6463.73
11. Orissa	110.0	127.3	98.2	88.9	6366.82
12. Punjab	82.2	96.1	104.6	100.9	5813.45
13. Rajasthan	67.2	70.8	75.4	101.3	4811.64
14. Uttar Pradesh	80.9	82.0	83.2	77.0	4864.63
15. W. Bengal	97.5	101.2	88.0	84.9	5561.19
16. Delhi	114.8	99.3	89.5	76.1	5671.86
17. Himachal Pradesh	206.7	58.9	50.2	138.8	6826.60
18. Tripura	60.1	3.2	20.1	27.0	1626.47
All India	100.0	100.0	100.0	100.0	6034.12

Also the indices of labour productivity whether measured in terms of value added per employee or value added per man-hour (Refer to Appendix TableA-2) show more or less the same ranking although the actual index values vary. This is true even among the industrially important states.

Table 2.4 presents a summary measure of the inter-regional disparities (the coefficient of variation) in Labour productivity for major industry groups in 1960, 1964, 1966 and 1971. At the level of Total Manufacturing there is no clear tendency for disparities to increase or decrease. Same is the case for Capital and Intermediate Goods industries. In the case of Basic Goods industries there is a declining trend from 1960 to 1971. In Consumer Goods industries regional disparities seem to have increased over the period.

It is interesting to note that coefficient of variation is highest in Capital goods industries for the years 1960, 1964, 1966. In 1971, the coefficient of variation is highest in consumer goods industries. In 1960 and 1964, Intermediate Goods industries show the lowest disparities whereas in 1966 and 1971, Basic Goods industries show lesser variations in value added per employee as compared to other major industry groups.

Table 2.5 gives the coefficient of variation of inter-state disparities of labour productivity in each of the twenty two industries for the four years. Hydraulic Cement industry has the lowest coefficient of variation followed by Cotton Textiles

Table 2.4

Inter-Regional Disparities in Labour Productivity for Major Industry Groups in 1960, 1964, 1966 and 1971.

Major Industry Group	Value Added Per Employee			
	1960	1964	1966	1971
1. Basic Goods Industry	0.51	0.47	0.37	0.37
2. Capital Goods Industry	0.61	0.52	0.79	0.38
3. Intermediate Goods Industry	0.39	0.37	0.73	0.53
4. Consumer Goods Industry	0.45	0.46	0.46	0.68
Total Manufacturing	0.39	0.41	0.34	0.38

Table 2.5

Inter-state disparities in Labour productivity for the 22 industries 1960, 1964, 1966 and 1971

Industry*	1960	1964	1966	1971	Summary measure for 1960, 1964, 1966, 1971.
1. Agricultural Imp.	1.18	0.76	0.97	0.80	0.89
2. Iron & Steel(Metal)	0.95	0.91	0.47	0.45	0.99
3. Flour Mills	0.87	0.36	0.43	0.34	0.59
4. Bolts,Nuts etc.	0.56	0.35	1.11	0.46	1.09
5. Cotton Ginning	0.57	0.44	0.81	0.96	0.90
6. Rice Mills	0.55	0.19	0.92	0.22	0.66
7. Tea Mfg.	0.54	0.74	0.80	0.86	0.85
8. Drugs and Pharmeceuticals	0.52	0.47	0.65	1.25	1.24
9. Iron & Steel(c&f)	0.51	0.26	0.50	0.33	0.44
10. Edible Oils	0.49	0.27	0.36	0.42	0.41
11. Inorganic H.Chemicals	0.49	0.57	0.35	0.36	0.46
12. Mfg. of Motorcycles and Bicycles	0.41	0.41	0.32	0.52	0.80
13. Textile Machinery	0.40	0.32	0.26	0.26	0.37
14. Machine Tools	0.38	0.63	0.89	0.33	0.77
15. Printing	0.37	0.37	0.28	0.21	0.35
16. Sugar	0.35	0.38	0.28	0.55	0.59
17. Chinaware,Pottery	0.34	0.48	0.33	0.27	0.45
18. Tiles	0.30	0.50	1.27	0.63	1.22
19. Hume pipes	0.28	0.22	0.20	0.51	0.42
20. Art Silk	0.24	0.55	0.38	1.04	0.51
21. Cotton Textiles	0.23	0.21	0.27	0.25	0.25
22. Hydraulic Cement	0.19	0.21	0.17	0.30	0.29
Total Mfg.	0.40	0.43	0.35	0.39	0.43

*Industries are ranked according to the coefficient of variation in 1960.

and Art Silk industries in 1960. Sugar and Printing industries also show fairly low regional disparities. On the other hand, Agricultural Implements industry shows a coefficient of variation, as high as 1.18. Wide disparities also prevail in the Iron and Steel (Metal) industry with the coefficient of variation of 0.95. Tea Manufacturing and Drugs and Pharmaceutical industries are somewhat in the middle with coefficient of variation of 0.54 and 0.52 respectively.

Over the decade 1960-71, Iron and Steel (Metal), Textile Machinery, Printing industries show decrease in the inter-state disparities. On the other hand, disparities have increased in case of Tea Manufacturing, Drugs and Pharmaceuticals industries. Cotton Textiles, Cement, Art Silk, Sugar and Tiles industries show no steady tendency for disparities to increase or decrease. However, it is interesting to note that in all these industries the coefficient of variation is higher in 1971 as compared to that of 1960, specially so in the case of Art Silk industry.

The position in 1971 has changed substantially with highest inter-state disparities in the Drugs and Pharmaceuticals industry, followed by that of Art Silk industry. Tea Manufacturing too has a fairly high coefficient of variation (0.86). On the other hand, lowest regional disparities prevail in the Printing industry followed by Cotton Textiles, Cement, Iron and Steel (Metal) and Sugar industries.

Thus Cotton Textiles, Hydraulic Cement, Sugar, Printing, Rcno Pipes, Textile Machinery and Edible Oils industries have lower regional disparities compared to other industries in all the 4 years. In other words, for seven out of the 22 industries, the extent of disparities remained somewhat constant. Iron and Steel (Metal), Tea Manufacturing, Drugs and Pharmaceuticals, Agricultural Implements, Bolts, nuts, etc. Cotton Ginning are some of the industries with relatively high regional disparities. Inter-state disparities changed considerably over time in these industries.

Section 2.3: Summary

A summary of the Chapter is presented in this section. Eight of the twenty two industries contribute about 80-85 per cent of value added in the 22 industries during the period 1960-71. These industries are Cotton Textiles, Iron and Steel (Metal), Sugar, Drugs and Pharmaceuticals, Printing, Tea Manufacturing, Art Silk and Hydraulic Cement. Except for Iron and Steel (Metal) and Cement, the six industries belong to the Consumer Goods industries. The remaining two are from the Basic Goods Category.

Six out of 18 states, namely, Maharashtra, West Bengal, Tamil Nadu, Gujarat, UP and Bihar account for about 80 per cent of All India Value added in 1971. These states have more diversified industries than other states, accentuating the already existing regional disparities.

Labour productivity, that is, value added per employee is higher in Maharashtra and Bihar than All India in all the years. It has shown an increase from 1960 to 1971 in Maharashtra, Gujarat, AP, Karnataka and Rajasthan. There is no clear tendency for increase or decrease in labour productivity in Bihar, Tamil Nadu, Punjab and UP. Another interesting observation is that whether labour productivity is measured in terms of value added per employee or value added per man-hour, the pattern is the same xxx even for the industrially important states.

Regional disparities measured in terms of coefficient of variation show no clear tendency for increase or decrease in Total Manufacturing. Same is true for Capital and Intermediate Goods industries. Disparities have decreased in Basic Goods industries while Vice Versa is true for Consumer Goods industries.

With regard to individual industries, for seven out of the twenty two industries regional disparities have remained somewhat constant. These industries are Cotton Textiles, Hydraulic Cement, Sugar, Printing, Hume Pipes, Textile Machinery and Edible oils. On the other hand, disparities have increased considerably in Drugs and Pharmaceuticals, Iron and Steel(Metal), Tea Manufacturing, Agricultural Implements, Cotton Ginning, Bolts, nuts, etc. industries.

Thus inter-state disparities in labour productivity are

quite high. At the level of Total Manufacturing they do not show any clear tendency for increase or decrease for the period 1960 to 1971. In case of individual industries, however, quite a few important industries have shown a decrease in inter-state disparities.

CHAPTER III

EXPLANATION OF THE LEVELS OF LABOUR PRODUCTIVITY

This Chapter makes an attempt to explain the inter-state variations in labour productivity in terms of capital intensity, economies of scale, state and time specificities according to the methodology developed in Section Four of Chapter One. This analysis is carried out for Total Manufacturing and eight important industries. In Section One we outline the main features of the procedure. The Second Section of the Chapter deals with the explanation at the level of Total Manufacturing. The Third Section is devoted to the analysis for individual industries. In Section Four, we present the summary and conclusions of the Chapter.

Section 3.1: The Procedure

As explained in Section Four of Chapter One, we regress labour productivity, i.e. value added per employee, on the three sets of variables, namely, state dummies, time dummies and capital intensity and labour input. State and year dummies are employed to capture the productivity effects specific to individual states and years respectively. The rationale for this was explained in Chapter One. Time series of inter-state cross section data are used for each industry.

Various combinations of the three sets of variables are considered and seven regressions are fitted to the data. Logarithm of labour productivity is regressed on (i) state dummies only (ii) state and time dummies, log of capital intensity and log of labour input (iii) log of capital intensity and log of labour input (iv) state dummies, log of capital intensity and log of labour input (v) year dummies only (vi) state and year dummies and (vii) year dummies, log of capital intensity and log of labour input.

We, however, discuss only two of the seven regressions given above - the first and the second. The results of the remaining regressions are presented in Appendix Tables A-3 to A-14. These regressions are fitted to Total Manufacturing and eleven industries.

Out of the eleven industries we focus attention on the eight important industries. Results of other industries are presented in Appendix Tables. We give the results industry-wise. The adjusted and unadjusted coefficient of determination along with the F-statistic are computed for each regression. R^2 is the ratio of explained variation to total variation in the dependent variable. It is a measure of the goodness of fit of the regression. $\bar{R}^2$, the adjusted coefficient of determination, makes adjustment for the number of explanatory variables in the

regression. The F-statistic tests the overall statistical significance of the estimated regression. Also an F-test for the state dummies is carried out. This is intended to test the significance of the differences of the state effects. The method of calculation of this F-statistic is already described in Chapter One.

As already pointed out, we focus attention on the results of two sets of regressions: (1) with state dummies,

$$\log Y_{st} = \delta + \mu_s + \varepsilon_{st}$$

and (2) with state and year dummies, log of capital intensity and labour input.

$$\log Y_{st} = \delta + \mu_s + \theta_t + \alpha \log k_{st} + h \log L_{st} + \varepsilon_{st}$$

Intercept in regression one gives the average of the logarithms of labour productivity in the state of reference, the average being taken over the years 1960, 1964, 1966 and 1971. Thus the intercept is an estimate of the logarithms of labour productivity in the state of reference over the period 1960-71. The coefficient of the dummy variable for a given state in the regression gives the deviation of the average log of labour productivity for the state in question from that for the state of reference. The second set of regressions with state and year dummies, log of capital intensity and log of labour variable are

estimates for the complete model (equation six of section Four in Chapter one). This regression provides for not only inter-state differences in productivity but also for the cyclical effects and the effect of capital intensity and scale economies on labour productivity. To the extent that the influence of capital intensity and scale economies on labour productivity are taken into account in the regression, the coefficients of the state dummies refer to log of total factor productivity (TFP) while the corresponding coefficients in regression one refer to log of labour productivity (LP). Regression two is an attempt to explain log of labour productivity in terms of log of capital intensity, scale economies, cyclical influences and the TFP associated with states.

A comparison of the coefficients of determination between the two regressions for a given industry shows the extent to which capital-intensity and scale economies together with cyclical effects explain the inter-state variations in labour productivity.

The results for each industry are presented in two tables, Table A and Table B. Coefficients of determination, F-values for the two regressions and the coefficients of the log of capital intensity, log of labour variable and of the year dummies are presented in Table A. Table B presents the coefficients of state

dummies in the two regressions. In other words, industry-wise estimates of the average of the log of productivity in the state of reference and deviations of log of productivity in the other states from this norm are shown in Table 8. The first row of the Table relates to labour productivity and the Second row to total factor productivity.

We interpret significant differences in the log of productivity to imply significant differences in productivity. This very reasonable assumption facilitates our analysis.

Because of the small number of observations for any state, namely four, the differences in productivity may not be significant in some industries. Even in such cases we shall comment upon the sign and rank order of the differences. It is worthwhile to draw attention to such differences.

Section 3.2: Total Manufacturing

We start with the analysis of the results for Total Manufacturing and then move on to the results for each of the eight important industries. Table 3.1(A and B) present the two regressions for Total Manufacturing. Both the regressions have significant F-values (See Table 3.1-A). From the first regression it may be inferred that inter-

Table 3.1(A)

Total Manufacturing

	R^2	$\bar{R}^2$	F	Coefficients of log(K/L)	log L	1964	1966	1971	F test for State dummies
With State effects	0.40	0.21	2.12*						
With States & Year Effects, Capital Intensity and scale	0.44	0.19	1.75*	-0.15	-0.42	-0.24	-0.17	-0.11	5.11*

Table 3.1(B)

	State of Reference	Level in the State of Ref.	Assam	Bihar	Gujarat	J&K	Kerala	M.P.	T.N.	Maharashtra	Karnataka
Labour productivity	A.P.	8.16	0.45	0.76	0.49	-1.36	-0.06	0.26	0.50	0.84	0.59
Total Factor productivity	A.P.	9.19	-0.02	1.13	0.71	-2.56	0.04	0.02	0.69	1.39	0.50

cont

contd..	Orissa	Punjab	Rajasthan	U.P.	W.B.	Delhi	M.P.	Tripura
Labour productivity	0.60	0.50	0.29	0.33	0.41	0.48	0.50	-1.17
Total Factor productivity	-0.10	0.11	-0.21	0.43	1.04	0.04	-1.02	-2.88

*significant at 5 per cent level of significance.

state variations in labour productivity are statistically significant in the case of Total Manufacturing. The second regression does not yield satisfactory results. It has lower explanatory power than the first regression as the adjusted R^2 shows. The coefficient of the capital intensity and scale variables are perverse or implausible. They are negative though insignificant. Cyclical effects, too, are negative showing that labour productivity was lower in all the three years 1964, 1965 and 1971 in relation to 1960. Inspite of the fact that the second regression has lower explanatory power than the first, the F test for the state dummies is significant at 5 per cent level of significance.

Referring to Table 3.1(8), we see that the coefficient for Andhra Pradesh is 8.16 (row 1). This means that the average (Over the years 1960, 1964, 1965 and 1971) of log of labour productivity in Andhra Pradesh is 8.16. The other coefficients in row 1 show that all the states except J&K and Tripura have higher average labour productivity than Andhra Pradesh over the period 1960 to 1971. With regard to total factor productivity (row 2 of the Table 8), we observe that Maharashtra, Bihar, West Bengal, Gujarat, Tamil Nadu, Karnataka, Uttar Pradesh, Punjab, Orissa, Kerala, Delhi and Madhya Pradesh, in that order, are above the state of reference, Andhra Pradesh. This appears plausible from what is generally known about the relative

efficiency of the manufacturing sector in the different states during the period 1960-71.

Thus the exercise for Total Manufacturing gives some interesting and plausible results. But the impact of capital intensity on labour productivity does not appear to be positive or significant. In view of the inter-state differences in industrial composition, much reliance should not be placed on the analysis at the level of Total Manufacturing. Better results could be expected from an analysis at the level of individual industries, which is attempted below.

Section 3.3 Individual Industries

Cotton Textiles

Cotton Textile industry which contributes about 35 per cent of value added in 1966 in the twenty two industries in India, is taken up first. The F-values are insignificant and adjusted R^2 is negative for both the regressions (See Table 3.2-A). Coefficients of capital intensity and scale variable are very low but positive. F-test for the state dummies in regression Two is significant. Cyclical effects are positive showing an increase in labour productivity in all the three years, namely, 1964, 1966 and 1971 as compared to 1960. Thus while inter-state differences in labour productivity are not significant, inter-state differences in total factor productivity

Table 3.2(A)

Cotton Textiles

	R^2	$\bar{R}^2$	F	Coefficients of log(K/L)	Coefficients of log L	Coefficients of 1964	Coefficients of 1966	Coefficients of 1971	F test for state dummies
With state effect	0.17	-0.08	0.67						
With state and year effects, capital intensity and scale	0.29	-0.06	0.79	0.01	0.02	0.28	0.07	0.19	2.39*

Table 3.2(B)

	State of Ref.	Level in the State of ref.	Gujarat	Kerala	M.P.	T.N.	Maharashtra	Karnataka	Orissa	Punjab	Rajasthan	U.P.	W.Bengal
Labour productivity	A.P.	8.23	0.35	-0.31	-0.06	0.19	0.28	-0.19	-0.08	-0.04	-0.16	-0.01	-0.22
Total factor productivity	A.P.	8.01	0.31	-0.31	-0.07	0.16	0.23	-0.20	-0.06	-0.02	-0.16	-0.03	-0.24

*significant at 5 per cent level of significance.

are significant. Referring to Table 3.2(B), we note that labour and total factor productivities in Gujarat, Maharashtra and Tamil Nadu, in that order, are above the level in Andhra Pradesh, the state of reference.

Iron and Steel (Metal)

Iron and Steel (Metal) with a contribution of about 15 per cent to total value added by the twenty two industries is the second most important industry. Inter-state variations in labour productivity, as measured by the coefficient of variation appears to be quite high that is, 0.99 (Refer Table 2.5). But these variations are not statistically significant as shown in Table 3.3(A). Furthermore, the observed differences are not explained by capital intensity and scale economies as the F-value is not significant and R^2 is quite low, in regression (2). The coefficient for capital intensity variable is negative and very mild economies of scale seem to prevail in the industry. Coefficients of the three year dummies, are all negative with a progressive decline from 1964 to 1971. This shows that cyclical effects have lead to decrease in labour productivity, more so in 1971. The F-test for the state dummies is also not significant (See Table 3.3(B). Thus neither the differences in labour productivity nor the differences in total factor productivity are significant. The state of reference is Bihar. Maharashtra is the only state with higher labour and total factor productivities than Bihar.

Table 3.3(A)

Iron and Steel (Metal)

	R^2	$\bar{R}^2$	F	Coefficients of log(K/L)	log L	1964	1966	1971	F test for state dummies
With state effects	0.06	-0.21	0.22						
With state and year effects, capital intensity and scale	0.14	-0.40	0.26	-0.05	0.04	-0.07	-0.52	-0.58	1.99*

Table 3.3(B)

	State of reference	Level in the State of ref.	M.P.	T.N.	Maharashtra	Orissa	Punjab	U.P.	W. Bengal
Labour productivity	Bihar	9.37	-0.73	-0.93	0.27	-0.33	-0.36	-0.56	-0.38
Total factor Productivity	Bihar	10.00	-0.68	-0.85	0.22	-0.26	-0.34	-0.58	-0.39

Sugar

In the sugar industry, inter-state variations are not very high as shown by the coefficient of variation which is 0.59 (Refer to Table 2.5). They are explained well in terms of capital intensity, scale variables and cyclical effects as shown in Table 3.4(A). The adjusted R^2 has increased considerably from regression (1) to (2). Capital intensity is positively associated with labour productivity though the coefficient is very low (0.06). There is evidence of diseconomies of scale. The coefficients of year dummies for 1964 and 1966 are positive but that for 1971 is very high and negative. In other words, labour productivity improved between 1960 and 1966 but fell precipitously in 1971. This is also shown by the fact that in Sugar industry, value added in 1971 is very low. The F-test for the state dummies is not significant. Thus neither the differences in labour productivity, nor the differences in total factor productivity are significant. However, all the states except Madhya Pradesh have higher labour productivity than the state of reference, Andhra Pradesh (Refer to Table 3.4-B). With regard to total factor productivity, Utter Pradesh which contributes about 44 per cent of value added in Sugar (See Table 2.2), has the highest total factor productivity followed by Maharashtra, Karnataka and Bihar. Gujarat, Madhya Pradesh and Tamil Nadu have lower total factor productivity than Andhra Pradesh.

Table 3.4(A)

Sugar

	R^2	$\bar{R}^2$	F	Coefficient of log(K/L)	Coefficient of log L	Coefficient of 1964	Coefficient of 1966	Coefficient of 1971	F test for state dumm
With state effects	0.01	-0.29	0.003						
With state and year effects, capital intensity and scale	0.68	0.46	3.36*	0.06	0.02 -0.23	0.05	0.16	-2.82	1.65

Table 3.4(B)

	State of ref.	Level in the state of ref.	Bihar	Gujarat	M.P.	T.N.	Maharashtra	Karnataka	U.P.
Labour productivity	A.P.	7.75	0.17	0.49	-0.03	0.17	0.40	0.40	0.37
Total factor productivity	A.P.	8.34	0.18	-0.12	-0.52	-0.04	0.35	0.23	0.72

*significant at 5 per cent level of significance

Drugs and Pharmaceuticals

In the Drugs and Pharmaceuticals industry, coefficient of variation is as high as 124 per cent (Refer Table 2.5). Inter-state differences are not statistically significant and $\bar{R}^2$ is low in the first regression of Table 3.5(A). It has slightly improved in the second regression though the F-value is insignificant. Capital intensity and scale variables have negative though insignificant coefficients. Coefficients for the three dummies are positive which means cyclical influences have contributed to increase in labour productivity. The F-test for the state dummies is significant. Thus inter-state differences in labour productivity are not significant but inter-state differences in total factor productivity are significant. Andhra Pradesh is taken as the state of reference. Labour productivity in Maharashtra, Gujarat, Tamil Nadu, Delhi and Bihar are above that of Andhra Pradesh. Uttar Pradesh and West Bengal are below the level of Andhra Pradesh.

Art Silk

Art Silk industry which contributes about 6 per cent to value added by the 22 industries has low $\bar{R}^2$ for the first regression (refer Table 3.6(A). The fit improved slightly when time dummies, capital intensity and scale economies are introduced, though F-statistic is not significant. Coefficients of both capital intensity and labour are

Table 3.5(A)

Drugs and Pharmaceuticals

	R^2	$\bar{R}^2$	F	Coefficients of log(K/L)	log L	1964	1966	1971	F test for state dummies
With state effects	0.34	0.15	1.77						
With state and year effects, capital intensity and scale	0.56	0.28	2.02	-0.41	0.54	0.14	0.17	0.46	10.84*

Table 3.5(B)

	State of reference	Level in state of reference	Bihar	Gujarat	T.N.	Maharashtra	U.P.	W.B.	Delhi
Labour Productivity	A.P.	8.63	0.44	1.15	0.97	1.31	-0.39	0.01	0.73
Total Factor productivity	A.P.	11.93	0.39	0.47	0.78	0.10	-1.12	-1.18	1.08

*significant at 5 per cent level of significance.

Table 3.6(A)

Art Silk

	R^2	$\bar{R}^2$	F	Coefficients of log(K/L)	Coefficients of log L	Coefficients of 1964	Coefficients of 1966	Coefficients of 1971	F test for state dummies
With state effects	0.29	0.09	1.47						
With state and Year effects, capital intensity of scale	0.64	0.36	2.31	0.20	0.13	0.01	0.22	0.33	7.08*

Table 3.6(B)

	State of Ref.	Level in State of Ref.	M.P.	T.N.	Maharashtra	Punjab	West Bengal
Labour productivity	Gujarat	8.28	0.91	0.59	0.63	0.02	0.21
Total factor productivity	Gujarat	6.30	0.92	0.45	0.29	0.13	0.07

*significant at 5 per cent level of significance.

positive but small. The coefficients of all the year dummies are positive. F-test for the state dummies is significant. The state of reference is Gujarat and labour and total factor productivities in all the other five states are above that of the state of reference.

Tea Manufacturing

Inter-state variations in the Tea Manufacturing industry are substantial with coefficient of variation of 85 per cent. (Refer Table 2.5). They are, however, not statistically significant as shown by Table 3.7(A). Introduction of time dummies, capital intensity and scale economies have improved the fit considerably. The coefficients are high and positive. The time dummy coefficients are negative. The F-test for the dummies is not significant for the second regression. Labour productivity in all the states except for that of Uttar Pradesh and Tripura are above that of Assam. All the states are above that of Assam, in case of total factor productivity.

Printing

Both the regressions are significant in the printing industry and the better fit is for the second regression. Here the adjusted coefficient of determination is 0.75. (See Table 3.8-A). The coefficient of capital intensity is negative and that of scale variable is very low and positive. All the year dummies are positive and F-statistic

Table 3.7(A)

Tea Manufacturing

	R^2	$\bar{R}^2$	F	Coefficients of log(K/L)	log L	1964	1966	1971	F test for state dummies
With state effects	0.30	0.18	1.54						
With state & year effects, capital intensity & scale	0.76	0.58	4.12*	1.07	1.89	-0.05	-0.01	0.01	1.00

Table 3.7(B)

	State of reference	Level in the State of ref.	Kerala	T.N.	U.P.	W.Bengal	Tripura
Labour productivity	Assam	8.24	0.33	1.08	-0.37	0.12	-1.09
Total factor productivity	Assam	-8.38	4.53	5.71	8.56	1.56	7.90

*significant at 5 per cent level of significance.

Table 3.8(A)

Printing

	R^2	$\bar{R}^2$	F	Coefficients of log(K/L)	log L	1964	1966	1971	F test for State dummies
With State Effect	0.42	0.24	2.34*						
With State and time effect, capital intensity scale	0.83	0.75	10.04*	-0.09	0.01	0.12	0.31	0.56	18.86*

Table 3.8B)

	State of ref.	Level in State of ref.	Assam	Bihar	Gujarat	Kerala	M.P.	T.N.	Karnataka	Orissa	Maharashtra.
Labour productivity	A.P.	8.03	0.02	0.26	0.13	0.17	-0.39	0.45	0.36	-0.19	0.58
Total factor productivity	A.P.	8.51	0.02	0.20	0.17	0.19	-0.40	0.47	0.38	-0.16	0.61

contd...

contd...

	Rajasthan	U.P.	W.Bengal	Delhi.
Labour Productivity	-0.33	-0.21	0.34	0.56
Total factor productivity	-0.37	-0.24	0.34	0.61

*significant at 5 per cent level of significance.

for the state dummies is highly significant. Andhra Pradesh is taken as the state of reference and labour and total factor productivities in all the states are higher than Andhra Pradesh except for Madhya Pradesh, Orissa, Rajasthan and Uttar Pradesh (See Table 3.8-B).

Cement

In the cement industry, inter-state variations are not high (Refer Table 2.5). Both the regressions are insignificant with negative values of adjusted R^2 (See Table 3.9). Capital intensity is positively associated with labour productivity and diseconomies of scale prevail in the industry. The coefficients of all the year dummies are positive showing improvement in labour productivity. The F-test for state dummies is not significant. Andhra Pradesh is taken as the state of reference. Labour productivity in Bihar and Madhya Pradesh is lower than that in Andhra Pradesh (Table 3.9-B). In case of total factor productivity, Karnataka is below Andhra Pradesh. All other states are above the state of reference.

Section 3.4 Summary

We have presented a summary of the results in Table 3.10 and 3.11. As far as labour productivity is concerned, there are statistically significant inter-state differences at the level of Total Manufacturing and only in one (Printing

Table 3.9(A)

Cement

	R^2	$\bar{R}^2$	F	Coefficients of log(K/L)	Coefficients of log L	Coefficients of 1964	Coefficients of 1966	Coefficients of 1971	F test for state dummies
With state effects	0.02	-0.25	0.07						
With state and Year effects, Capital intensity and Scale	0.40	-0.06	0.87	0.38	-0.45	0.27	0.52	0.24	2.06*

Table 3.9(B)

	State of reference	Level in state of reference	Bihar	Gujarat	M.P.	T.N.	Karnataka
Labour productivity	A.P.	9.20	-0.23	0.04	-0.02	0.15	0.04
Total factor productivity	A.P.	5.61	0.18	0.16	0.13	0.38	-0.10

*significant at 5 per cent level of significance.

Industry) of the eight important industries studied in this Chapter. The statistical insignificance of the differences in seven out of the eight industries appears to be due to the limited number of observations (four) on which the comparisons are based. With regard to total factor productivity, we observe that the inter-state differences are statistically significant in Total Manufacturing and four individual industries, namely, Cotton Textiles, Drugs and Pharmaceuticals, Printing, and Art Silk. The difference between states turns out to be greater in the case of the more comprehensive measure of productivity, namely, total factor productivity. In other words productivity differences between states appear to be greater, after correction for the effects of capital intensity and scale, than before the correction.

Among the different states, Maharashtra has the highest labour productivity and total factor productivity in total Manufacturing and in two industries, Iron and Steel(Metal) and Printing (Table 3.10). Besides, it has the highest labour productivity in Drugs and Pharmaceuticals. Gujarat has the best performance, in terms of labour productivity, in two important industries, namely, Cotton Textiles and Sugar. Tamil Nadu ranks highest, in terms of labour productivity in Tea Manufacturing and Cement industries. Madhya Pradesh is above all other states in respect of both labour productivity and total factor productivity in Art Silk industry.

Table 3.10

Summary of Results

	Whether inter-state differences are significant		State with Highest		State with lowest	
	LP	TFP	LP	TFP	LP	TFP
1. Total Manufacturing	Yes	Yes	Maharashtra	Maharashtra	Jammu and Kashmir	Tripura
2. Cotton Textiles	No	Yes	Gujarat	Gujarat	Kerala	Kerala
3. Iron and Steel(Metal)	No	No	Maharashtra	Maharashtra	Tamil Nadu	Tamil Nadu
4. Sugar	No	No	Gujarat	Uttar Pradesh	Madhya Pradesh	Madhya Pradesh
5. Drugs and Pharmaceuticals	No	Yes	Maharashtra	Delhi	Uttar Pradesh	West Bengal
6. Art Silk	No	Yes	Madhya Pradesh	Madhya Pradesh	Punjab	West Bengal
7. Tea Manufacturing	No	No	Tamil Nadu	Uttar Pradesh	Tripura	West Bengal
8. Printing	Yes	Yes	Maharashtra	Maharashtra	Madhya Pradesh	Madhya Pradesh
9. Cement	No	No	Tamil Nadu	Tamil Nadu	Bihar	Karnataka

Judging by the more comprehensive measure of productivity in terms of total factor productivity, Maharashtra comes out best in Total Manufacturing, Iron and Steel (Metal), and Printing, Uttar Pradesh in Sugar and Tea Manufacturing, Gujarat in Cotton Textiles, Tamil Nadu in Cement, Delhi in Drugs and Pharmaceuticals, and Madhya Pradesh in Art Silk industries. This reveals the comparative advantage of the different states in respect of the eight industries analysed.

In Table 3.11, we present the coefficient of capital intensity and nature of scale economies. For Total Manufacturing, coefficient of capital intensity is negative, and there exist diseconomies of scale. This finding is rather suspect. In case of individual industries coefficient of capital intensity is positive in Cotton Textiles, Sugar, Art Silk, Tea Manufacturing, and Hydraulic Cement industries. It is negative for other industries. Economies of scale prevail in Cotton Textiles, Iron and Steel (Metal), Drugs and Pharmaceuticals, Art Silk and Tea Manufacturing industries. On the other hand, diseconomies of scale exist in Sugar, Printing and Cement industries.

Some of the limitations of our results are given below. In the measurement of capital, we have taken the book-value figures and have not been able to adjust for price changes in the limited time available. The use of book value as a measure of capital input might have resulted

Table 3.11

Summary of Results

	Coefficient of Capital Intensity*	Nature of Scale Economies*
1. Total Manufacturing	Negative	Diseconomies
2. Cotton Textiles	Positive	Economies
3. Iron & Steel(M)	Negative	Economies
4. Sugar	Positive	Diseconomies
5. Drugs & Pharmaceuticals	Negative	Economies
6. Art silk	Positive	Economies
7. Tea Manufacturing	Positive	Economies
8. Printing	Negative	Diseconomies
9. Cement	Positive	Economies.

*The coefficients are statistically insignificant.

in biased and in some cases implausible estimates of the coefficient of the capital intensity variable. Our results should be regarded as tentative. However, with only four observations on states we have been able to arrive at fairly reasonable conclusions. Another merit of our study is that unlike Kendrick's and Solow's measures of total factor productivity, we do not assume perfect competition and constant returns to scale.

The results for most of the industries show that R^2 is low and F-statistic measuring the overall goodness of fit of the regression, is not significant. Such low values of R^2 and F occur when the dependent variable is the function of a ratio, in this case labour productivity. Our analysis is based on the Cobb-Douglas form of production function. By estimating the production function with log of value added rather than log of labour productivity as the dependent variable, we could have obtained high R^2s but the same estimates of total factor productivity, coefficient of capital intensity and scale variables (Refer Appendix Table A-15).

Variables like public investment in infrastructure, incentive for investment in industries at the state level could be considered in the explanation of inter-state differences in labour productivity. But for want of data we have not included these variables in our analysis.

The study does not cover the years after 1971, because detailed data were not available at the time the study was undertaken.

CHAPTER IV

GROWTH OF LABOUR PRODUCTIVITY

This Chapter examines the inter-state disparities in the growth of labour productivity in different industries over the period 1960-71 and in the sub-periods 1960-64, 1966-71. In Section one, we present and discuss the disparities in Total Manufacturing and in individual industries. An explanation of the disparities in the growth of selected industries is attempted in Section Two. This is done by studying the relationship between growth of labour productivity and (i) growth of employment (ii) level of labour productivity in the initial year 1960. A summary of the Chapter is presented in the last section.

Section 4.1: Disparities in Growth

Annual compound growth rates of labour productivity are calculated for the three periods 1960-64, 1966-71 and 1960-71. The growth rates for any period presented in this Chapter are based on the data for the initial and terminal years only. The data for the intervening years are not taken into account. For this reason the growth rates might be affected by short-term fluctuations. Also, the period 1960-64 is one of rapid growth of industrial production, while a certain degree of deceleration of growth was in evidence during the second period 1966-71. The growth rate

for 1960-71 may not be even roughly equal to the average of the growth rates for 1960-64 and 1966-71. These points have to be kept in mind in interpreting the figures on growth rates.

Table 4.1 presents for Total Manufacturing, the annual compound growth rates of labour productivity for individual states and the coefficient of variation for the periods 1960-64, 1966-71 and 1960-71.

The All India annual compound growth rate of labour productivity was 2.3 per cent during 1960-64. It increased to 3.5 per cent during the deceleration period of 1966-71. For the entire period of 1960-71, the annual compound growth rate is about 2 per cent. The inter-state variations around the All India average are very substantial for all the three periods. The variations appear to be more marked in the deceleration phase, 1966-71.

Inter-state disparities in growth rates for Total Manufacturing as measured by the coefficient of variation is relatively low for the entire decade 1960 to 1971. However, they appear to be high in the two sub-periods. The coefficient of variation has a value of about 5 per cent for the first sub-period. It increased in the second half to 7 per cent.

During 1960-64, Karnataka, Punjab, Orissa, Gujarat, Bihar, Rajasthan, West Bengal, Tamil Nadu, Uttar Pradesh, Maharashtra, Andhra Pradesh and Kerala in that order, exp

Table 4.1

Annual Compound Growth Rates (%) of Labour Productivity in Total Manufacturing State-wise 1960-71

State	Annual Growth Rate of Labour Productivity		
	1960-66	1966-71	1960-71
1. Andhra Pradesh	2.14	5.63	3.66
2. Assam	-8.45	-2.60	-3.42
3. Bihar	4.14	-1.35	0.95
4. Gujarat	4.14	3.36	3.48
5. Jammu & Kashmir	-8.00	-45.49	-22.18
6. Kerala	1.01	5.11	5.20
7. Madhya Pradesh	-8.05	3.20	2.52
8. Tamil Nadu	2.68	2.40	0.76
9. Maharashtra	2.42	4.98	3.19
10. Karnataka	8.67	3.73	5.99
11. Orissa	6.10	1.47	0.09
12. Punjab	6.37	2.78	3.95
13. Rajasthan	3.66	9.80	5.91
14. Uttar Pradesh	2.65	1.91	1.58
15. West Bengal	3.26	2.78	0.77
16. Delhi	-1.26	0.21	-1.70
17. Himachal Pradesh	-25.26	26.84	-1.59
18. Tripura	-50.73	9.82	-5.10
All India	2.31	3.51	2.04
Standard Deviation	13.91	13.08	5.07
Coefficient of Variation	-4.75*	6.83	1.34

*The coefficient of variation is negative because the mean of the series is negative.

enced positive rate of growth of labour productivity. All these states except Andhra Pradesh and Kerala had higher growth rate than the All India one. On the other hand, Assam, Jammu and Kashmir, Madhya Pradesh, Delhi, Himachal Pradesh and Tripura record a negative growth rate of labour productivity. During 1966-71, except Assam, Bihar and Jammu and Kashmir, other states show positive growth rates of labour productivity.

For the entire decade 1960 to 1971, Karnataka records the highest growth rate of 6 per cent followed by Rajasthan, Kerala, Punjab, Andhra Pradesh, Gujarat, Maharashtra, Madhya Pradesh, Uttar Pradesh, Bihar, West Bengal, Tamil Nadu and Orissa in that order. Thus states with a high share of value added in Manufacturing like Maharashtra, West Bengal, Tamil Nadu, Gujarat, Bihar, Uttar Pradesh (Table 2.2) have positive growth rates though lesser than that of states like Karnataka, Punjab and Rajasthan.

In order to examine the relationship between the growth rates for the two sub-periods, we have regressed growth rate of labour productivity in 1966-71 on the growth rate for that of 1960-64. The regression equation is

$$g^{Y}_{1966-71} = \underset{(2.80)}{2.50} + \underset{(0.56)}{0.20}\, g^{Y}_{1960-64} \qquad R^2 = 0.10,\ t = 1.20$$

The growth rate of labour productivity in 1966-71 is positively associated with that in 1960-64. But the

relationship is weak and it is not statistically significant. Thus high (low) growth rate in 1966-71 in a given state, does not appear to correspond to high (low) growth rate in 1960-64. This appears to be reflected in relatively less disparities over the period 1960-71 as a whole.

We now consider important individual industries. Table 4.2 presents the annual compound growth rates of labour productivity in the different states and the coefficient of variation for eight important industries for 1960-71. Appendix Table A-16 gives the annual compound growth rates for the remaining industries. On the basis of the coefficient of variation, the eight industries may be classified into three groups:-

I	:	Low disparities - Sugar and Printing
II	:	Moderate disparities - Cotton Textiles, Art Silk and Cement
III	:	High disparities - Iron and Steel (Metal), Tea Manufacturing and Drugs and Pharmaceuticals.

The Annual Compound Growth rate of the labour productivity in sugar industry is markedly negative in all the states without exception. The performance of Gujarat, Uttar Pradesh, and Bihar is above average. Printing and Art Silk industries record substantial improvement in labour productivity in all the states.

Table 4.2

Annual Compound Growth Rates of Labour Productivity in Important Industries, State-wise, 1960-71

States / Industries	Sugar	Tea-Manufacturing	Cotton Textiles	Art-Silk	Printing	Drugs & Pharmaceuticals	Hydraulic Cement	Iron & Steel (Metal)
1. Andhra Pradesh	-29.42		1.04		7.49	6.51	7.84	
2. Assam		-0.60			3.80			
3. Bihar	-9.47				7.26	-1.59	-3.07	-1.76
4. Gujarat	-5.39		2.80	4.4	4.91	2.07	5.40	
5. Kerala		16.33	3.69		5.84			
6. Madhya Pradesh	-14.10		-1.61	10.46	8.28		6.28	2.23
7. Tamil Nadu	-17.46	6.53	1.43	6.29	0.95	29.27	1.65	4.72
8. Maharashtra	-16.65		1.36	9.62	4.09	7.32		-9.97
9. Karnataka	-14.92		23.44		4.70		6.68	
10. Orissa			3.42		9.11			-13.93
11. Punjab			1.26	40.24				-15.07
12. Rajasthan			4.19		8.65			
13. Uttar Pradesh	-8.58	20.33	-1.20		4.95	-5.16		7.74
14. West Bengal		3.98	2.57	3.62	1.13	10.78		-11.28
15. Delhi					5.83	1.47		
16. Tripura		-1.71						
All India	-12.07	1.20	1.00	8.92	3.85	5.86	2.60	-2.97
Coefficient of Variation	-0.41	1.44	0.97	1.05	0.51	1.66	1.22	1.90

Tea Manufacturing shows improvement in labour productivity in most states and for India as a whole. In the Cotton Textile Industry, except for Madhya Pradesh and Uttar Pradesh, all the states have positive growth rates. The states of Maharashtra, Gujarat, Tamil Nadu, West Bengal, which are important for this industry in terms of value added, do not show high growth rates.

Drugs and Pharmaceuticals industry shows positive growth rate in all the states except Bihar and Uttar Pradesh. The growth rate in Tamil Nadu is quite high (29 per cent). Cement industry shows a fall in labour productivity only for Bihar. In the Iron and Steel (Metal), the All India growth rate is negative (-3 per cent). Punjab, Orissa, West Bengal, Maharashtra and Bihar show negative growth rates. Uttar Pradesh, Tamil Nadu and Madhya Pradesh show positive growth rates.

Thus two points clearly emerge from the analysis of Table 4.2. The first is that in all the eight industries there are wide inter-state variations in the growth rates of labour productivity for the period 1960-71. The second is that the growth rates of labour productivity appear to be small in thosestates with greater share in value added. In other words, states like Maharashtra, Gujarat, West Bengal, Tamil Nadu, Uttar Pradesh and Bihar have lower growth rates

in respect of most of the industries as compared to Karnataka, Punjab and Rajasthan, during the period 1960-71.

We present in Table 4.3, the coefficient of variation, a summary measure of the inter-state disparities in the growth rates of labour productivity in the twenty two industries. Inter-state disparities in the growth rate of labour productivity are highest in the sugar industry for the period 1960-64. Other industries with high disparities are Iron and Steel (Metal), Art Silk, Inorganic Heavy Chemicals, Bolts, Nuts, etc. Inter-state variations in the rate of growth of labour productivity are lowest in Machine Tools, Textile Machinery, Manufacture of Motorcycles and Bicycles, Cotton Textiles, Rice Mills, Iron and Steel (Castings and Forgings), Tea Manufacturing, Printing, Drugs and Pharmaceuticals and Hydraulic Cement industries have coefficient of variation of about 2 per cent.

In the second half of the decade, that is 1966-71, inter-state disparities in the growth rate of labour productivity in Sugar industry have come down drastically. Other industries with low inter-state variations are Machine Tools, Printing, Textile Machinery, Inorganic Heavy Chemicals, Cotton Textiles, Iron and Steel (Castings and Forgings), Tea Manufacturing, Art Silk, Drugs and Pharmaceuticals and Cement continue to have coefficient of variation of about 2 per cent. There is no change in the disparities in

Table 4.3

Inter-state Disparities in the Growth of Labour Productivity(Coefficient of Variation) in Industries, 1960-71

	Industry	1960-64	1966-71	1950-71
1.	Flour Mills	1.37	-6.66	15.84
2.	Rice Mills	0.67	-4.69	5.24
3.	Sugar	193.80	-0.35	-0.41
4.	Edible oils	2.95	-1.64	-2.53
5.	Tea Manufacturing	2.40	2.20	1.44
6.	Cotton Textiles	0.64	1.39	0.97
7.	Art Silk	8.14	2.05	1.05
8.	Cotton Ginning	0.76	2.79	0.84
9.	Printing	1.87	0.64	0.51
10.	Inorganic H.Chemicals	-6.22	0.85	2.55
11.	Drugs & Pharmaceuticals	1.18	2.31	1.66
12.	Hydraulic Cement	1.04	-2.24	1.22
13.	Tiles	1.39	-5.30	6.48
14.	Chinaware & Pottery	-1.67	3.62	-3.17
15.	Bolts, nuts etc.	7.57	-11.50	1.24
16.	Hume Pipes	-1.03	18.20	-1.84
17.	Iron & Steel(Metal)	11.01	-11.86	1.90
18.	Iron & Steel(C&F)	0.97	2.03	0.73
19.	Textile Machinery	0.49	0.81	0.66
20.	Machine Tools	0.28	0.62	0.49
21.	Agricultural implements	1.08	3.16	1.17
22.	Mfg. of Motorcycles & Bicycles	-0.64	-2.59	-0.52
Total Manufacturing		-4.75	6.37	1.34

the Iron and Steel (Metal) industry as compared to the first half of the decade.

For the period 1960-71, regional disparities in labour productivity in terms of coefficient of variation at the Total Manufacturing level is 1.34 per cent. Rice Mills industry has a very high coefficient of variation of 16 per cent. Disparities are lower in Machine Tools, Printing, Textile Machinery, Cotton-Ginning, Cotton Textiles industries. Tea Manufacturing, Art Silk, Drugs and Pharmaceuticals, Cement, Iron and Steel (Metal) have coefficient of variation of about one to two percent for the entire decade of 1960-71.

To sum up, the states with a high share in value added show lesser growth of labour productivity in Total Manufacturing as well as in individual industries. There seems to be week association between the growth rates of labour productivity in the two sub-periods, 1960-64 and 1966-71. Inter-state disparities in the growth rates of labour productivity are relatively low in Cotton Textiles, Printing and Cement industries. They are, however, high in Iron and Steel (Metal), Tea Manufacturing and Art Silk industries for the entire decade. In the sugar industry there is a drastic decline in the inter-state disparities.

Section 4.2: Explanation of the Disparities

In this section, the growth rate of labour productivity over the period 1960-1971 is explained in terms of growth

rate of employment and level of labour productivity in 1960. This is done for nine industries each with atleast 9 observations. We first examine the association of the growth rate of labour productivity with the growth rate of employment.[1]

According to Fabricant[2] growth rate of employment may lead to positive or negative growth rate of labour productivity. Positive growth rate of labour productivity may be caused through increase in the growth rate of employment and a still greater increase in the growth rate of output. On the other hand, increase in the growth rate of employment, without any growth of output may lead to lower growth rate of labour productivity. Salter's[3] analysis suggests 'expansionary' effect in majority of the cases.

Table 4.4 presents the regression results with growth rate of labour productivity as the dependent variable and growth rate of employment as the independent variable for five industries with significant t-values. Appendix Table A-17 gives the results for the other industries and Total

---

1. We have also regressed growth rate of labour productivity on the growth rate of capital intensity but the results are not significant. This may probably be because we have taken a tentative measure of capital.

2. Fabricant, S.: A Primer on Productivity. Prentice-Hall, 1973, ch.10.

3. Salter, W.E.G.: Productivity and Technical Change? Cambridge University Press, 1966.

Table 4.4

Regression Results with growth rate of Labour Productivity (g^Y) as the dependent variable and growth rate of employment(g^E) as the independent Variable*

Industry	No.of obs.	(1) a_{it}	(1) b_{it}	R^2	t
1. Flour Mills	10	3.29 (1.96)	-1.28 (0.40)	0.56	4.66*
2. Sugar	9	-26.72 (11.28)	0.41 (0.51)	0.39	2.11*
3. Edible Oils	10	-2.58 (1.70)	1.26 (0.40)	0.45	2.56*
4. Cotton Textiles	13	1.79 (0.95)	1.02 (0.27)	0.79	6.43*
5. Cotton Ginning	9	7.84 (0.41)	-1.51 (0.16)	0.40	2.16

* The Regression equation is $g^Y_{1960-71} = a_{it}^{(1)} + b_{it}^{(1)} g^E_{1960-71}$

*significant at 5 per cent level of significance.

Manufacturing.

Growth rate of employment is positively associated with growth rate of labour productivity in Sugar, Edible Oils and Cotton Textile industries. In the Cotton Textile industry increase in the growth rate of employment by one percentage point is associated with nearly the same amount of increase in the growth rate of labour productivity. Growth rate of employment is negatively associated with growth rate of labour productivity in Flour Mills and Cotton Ginning industries. The regression coefficients are statistically significant. R^2's, however, are not quite high.

We have tested the convergence hypothesis by regressing growth rate of labour productivity on the levels of labour productivity in the initial year, 1960. According to this hypothesis, regional disparities tend to be lesser over time. The results are given in Table 4.5. Flour Mills, Sugar, Printing, Iron and Steel (Metal), Iron and Steel (Castings and Forgings) show significant t-values. The regression coefficients are negative in all the industries. This implies that states with higher level of labour productivity in 1960, tend to have lower growth rates. This confirms the convergence hypothesis. The standard errors are low making the regression coefficients significant in quite a few cases.

Table 4.5

Regression Results with Growth of Labour Productivity (g^Y) as the dependent variable and Labour Productivity in 1960(Y) as the Independent Variable+

Industry	$a_{it}^{(2)}$	$b_{it}^{(2)}$	R^2	t
1. Flour Mills	8.50 (2.00)	-0.0001 (0.0002)	0.77	5.18*
2. Sugar	19.48 (13.60)	-0.002 (0.003)	0.25	2.33*
3. Edible Oils	2.68 (0.09)	-0.001 (0.0000)	0.29	1.81
4. Cotton Textiles	3.47 (1.86)	-0.0004 (0.008)	0.05	0.76
5. Cotton Ginning	10.85 (0.001)	-0.004 (0.004)	0.13	1.02
6. Printing	10.13 (0.37)	-0.002 (0.004)	0.74	6.09*
7. Drugs & Pharmaceuticals	12.39 (20.30)	-0.001 (0.002)	0.11	0.93
8. Iron & Steel (Metal)	1.84 (6.18)	-0.0004 (0.0003)	0.54	3.06*
9. Iron & Steel (Casting & Forging)	14.30 (9.34)	-0.003 (0.0004)	0.60	3.67*
Total Manufacturing	-2.06 (16.89)	0.0005 (0.003)	0.02	0.59

+The regression equation is $g^Y_{1960-71} = a^{(2)}_{it} + b^{(2)}_{it} Y_{it\,(1960)}$

* Significant at 5 per cent level of significance.

Section 4.3: Summary

As far as Total Manufacturing is concerned, states with relatively high shares of value added, namely, Maharashtra, West Bengal, Gujarat, Tamil Nadu, Uttar Pradesh and Bihar show lower growth of labour productivity over the period 1960-71, as compared to states with low share like Karnataka, Punjab, Rajasthan. On the other hand, states like Assam, Jammu and Kashmir, Delhi, Himachal Pradesh, Tripura show decline in labour productivity. Inter-state disparities in terms of coefficient of variation seem to have increased slightly from first half to the second half of the decade. There appears to be weak association between the growth rates in labour productivity for the periods 1960-64 and 1966-71. As a result the disparities in growth are less for the decade as a whole than for the two sub periods.

An analysis of growth rates of labour productivity for individual industries shows that there are wide regional disparities. And as already pointed out for Total Manufacturing, growth rates in important states are not high in the case of individual industries too. Also inter-state disparities measured in terms of coefficient of variation are low in Sugar and Printing, moderate in Cotton Textiles, Art Silk, Cement and high in Iron and Steel(Metal), Drugs and Pharmaceuticals and Tea Manufacturing.

Inter-state disparities in the growth rates of labour productivity, measured in terms of coefficient of variation are relatively low in Cotton Textiles, Printing, Cement and Drugs and Pharmaceuticals industries. They are quite high in case of Tea Manufacturing, Art Silk, Iron and Steel (Metal). Sugar industry stands out as an exceptional case where disparities in the growth rates of labour productivity is as high as 194 per cent in the first half of the decade and it is lowest in the second half with coefficient of variation of 0.35 per cent.

In an attempt to explain the observed disparities, growth rate of labour productivity is regressed on the growth rate of employment for individual industries, with states as the units of observation. Three of the five industries with significant t-values show 'expansion' effect; that is, growth rate of labour productivity is positively associated with growth rates of employment. These industries are Cotton Textiles, Sugar, and Edible oils. On the other hand, Flour Mills and Cotton Ginning show significant negative regression coefficients.

Growth rates of labour productivity over the period 1960-71, is regressed on the levels of labour productivity in the initial year 1960. The regression coefficients in all the industries is negative, showing that states with higher level of labour productivity in 1960 tend to have a lower growth rate. Thus the convergence hypothesis is supported by our data. Some of the limitations of the present exercise are indicated in section one of this Chapter.

CHAPTER V

SUMMARY AND CONCLUSIONS

In this study, we have analysed inter-state disparities in the levels of labour productivity for the years 1960, 1964, 1966 and 1971 for the total manufacturing sector and for twenty two individual industries. Disparities in the growth of labour productivity for these industries are also analysed for the periods 1960-64, 1966-71 and 1960-71. The selected industries are well distributed regionally. We have, however, focussed attention on eight of the twenty two industries, namely, Cotton Textiles, Iron and Steel (Metal), Sugar, Drugs and Pharmaceuticals, Tea Manufacturing, Art Silk, Printing and Hydraulic Cement. These industries contribute about 85 per cent of value added of the total value added by the twenty two industries in 1971. Explanation of levels of labour productivity in terms of state and time effects, capital-intensity and scale economies is attempted for total manufacturing sector and for these eight industries. This explanation involved the analysis of inter-state differences in total factor productivity. We have tried to explain the growth of labour productivity for the period 1960-71(1) in terms of the growth of employment, in order to measure the scale effect on growth and (2) in terms of the level of labour productivity in the initial year 1960 in order examine the convergence hypothesis. The main data source for the study is the Annual Survey of Industries(Census Sector).

Regional disparities in the levels and growth of labour productivity are measured by the coefficient of variation. We attempt to explain the levels of labour productivity in terms of capital intensity and scale variable, state and time dummies. We do this in the framwork of the Cobb-Douglas form of production function. The equation estimated for an industry i, is of the form

$$\log Y_{st} = \delta + \Theta_t + \mu_s + \alpha \log k_{st} + h \log L_{st}$$

where Y_{st}, k_{st} and L_{st} are the labour productivity, capital-intensity and labour for s^{th} state and t^{th} year. $_t$ and $_s$ are the year and state effects respectively. To estimate this equation we use the dummy variable technique. Inter-state cross-section data for the four years 1960, 1964, 1966 and 1971 are used to estimate the equation.

Inter-state variations in the growth of labour productivity over the period 1960-71 in selected industries is sought to be explained by growth in labour input using the regression Analysis. To examine whether there is any tendency for levels of labour productivity in different states to converge, we have regressed growth in labour productivity on the level of labour productivity in the initial year 1960.

A summary of our findings are given below:

Levels

(1) Labour productivity whether measured in terms of value added per employee or value added per man-hour shows more or less the same ranking among states.

(2) As far as total manufacturing sector is concerned, level of labour productivity is high in Maharashtra and Bihar and is above the All India average in all the four years, 1960, 1964, 1966 and 1971. Gujarat, Andhra Pradesh, Karnataka and Rajasthan show an increase in labour productivity from 1960 to 1971. Bihar, Tamil Nadu, Punjab and Uttar Pradesh show no clear tendency for increase or decrease in the levels of labour productivity.

(3) Inter-state disparities for total manufacturing, measured by the coefficient of variation, show no clear tendency to increase or decrease. Same is the case with Capital and Intermediate Goods industry groups. Disparities seem to have increased in the Consumer Goods industries group and decreased in the Basic Goods industries group.

(4) Coming to Individual industries, we observe that Cotton Textiles, Hydraulic Cement, Sugar, Printing, Iron Pipes, Textile Machinery and Edible Oils show

approximately constant disparities in labour productivity over time. That is, seven out of the twenty two industries show somewhat constant regional disparities. On the other hand, Drugs and Pharmaceuticals, Iron and Steel (Metal), Tea Manufacturing, Agricultural Implements, Cotton Ginning, Bolts, Nuts, etc., industries show an increase in inter-state disparities.

(5) Significant inter-state differences in total factor productivity are observed in Total Manufacturing as well as in Cotton Textiles, Printing, Art Silk, Drugs and Pharmaceuticals industries.

(6) Inter-state disparities in total factor productivity are wider compared to labour productivity. That is, productivity differences are greater after the correction for capital intensity and scale effects than before the correction.

(7) Maharashtra has the highest labour productivity and total factor productivity in Total Manufacturing and in Iron and Steel (Metal), Printing industries. In the Drugs and Pharmaceuticals industry, it has the highest labour productivity. Gujarat ranks first in terms of labour productivity in Cotton Textiles and Sugar industries. Tamil Nadu has the highest labour productivity in Tea Manufacturing and Cement industries.

Madhya Pradesh comes out best in Art Silk industry, both in terms of labour productivity and total factor productivity.

(8) In terms of the more comprehensive measure of total factor productivity, Maharashtra shows the best performance in Total Manufacturing, Iron and Steel (Metal) and Printing industries. Gujarat comes out to be the best in Cotton Textiles, Uttar Pradesh in Sugar and Tea Manufacturing, Tamil Nadu in Cement, Delhi in Drugs and Pharmaceuticals, Madhya Pradesh in Art Silk industry. Thus comparative advantage of different states for the eight industries is analysed.

(9) In the regressions, the coefficient of capital-intensity is positive in Cotton Textiles, Sugar, Art Silk, Tea Manufacturing and Hydraulic Cement industries. In Iron and Steel (Metal), Drugs and Pharmaceuticals, Printing and Total Manufacturing, this coefficient is negative. This seems to be quite implausible and may be due to the poor quality of the data on capital input.

(10) Economies of scale prevail in the Cotton Textiles, Iron and Steel (Metal), Drugs and Pharmaceuticals, Art Silk and Tea Manufacturing industries. Our

data show that diseconomies of scale exist in Total Manufacturing and in Sugar, Printing and Hydraulic Cement industries.

Growth

(1) Measured in terms of the coefficient of variation, inter-state disparities in the growth rate of labour productivity seem to be lower in the first half of the decade, that is 1960-64 as compared to second half that is 1966-71.

(2) There is a weak association between the growth rates in labour productivity for the periods 1960-64 and 1966-71. As a result, disparities for the decade as a whole, i.e. 1960-71, are less compared to the two sub-periods.

(3) The annual compound growth rates of labour productivity in Total Manufacturing and in individual industries show an interesting pattern. States with high shares of value added in All India, namely, Maharashtra, West Bengal, Gujarat, Tamil Nadu, Uttar Pradesh and Bihar show lower growth rate of labour productivity as compared to states like Karnataka, Punjab and Rajasthan which have low share in value added.

(4) Growth disparities are lower in Sugar and Printing, moderate in Cotton Textiles, Art Silk, Cement and high in Iron and Steel (Metal), Drugs and Pharmaceuticals and Tea Manufacturing industries for the period 1960 to 1971.

(5) Growth rate of labour productivity is positively associated with growth rate of employment in Cotton Textiles, Sugar and Edible Oils industries showing the scale effect. On the other hand, diseconomies of scale prevail in Flour Mills and Cotton Ginning industries.

The main limitation of our study is that we have not been able to construct an accurate capital series. For this reason, the estimates of total factor productivity worked out in this series are not entirely reliable. Also we have not taken into account all relevant variables. Capacity utilization, rate of investment, infrastructural facilities are some such variables for explaning the level and growth rate of productivity.

Notwithstanding the above limitations, our analysis has thrown much light on the question of inter-state disparities in the level and growth of industrial productivity. It brings out the comparative advantage of various states over others in total manufacturing and in individual industries.

One of the merits of our approach is that with only four yearly observations on each state, we have been able to arrive at fairly reasonable conclusions. Also, in our analysis, we have not assumed the conditions of competitive equalibrium nor constant returns to scale implicit in the productivity indices associated with the names of Kendrick and Solow.

APPENDIX TABLES

Table A-1

Shares(%) of the States in Value Added by Each State, Industry-wise, 1971

Industry / State	Flour Mills	Rice Mills	Edible Oils	Art Silk	Cotton Ginning	Inorganic Heavy Chemicals	Tiles	Chinaware & Pottery	Bolts, nuts etc.	Pipes	Iron and Steel (Castings forgings)
1. A.P.		20.19	5.28		2.64						
2. Assam					0.29						
3. Bihar	3.14	5.66				4.41					3.56
4. Gujarat	4.04		15.07	15.52	20.68	21.63	5.70	10.98		5.85	2.02
5. J&K											
6. Kerala						4.71	47.18				
7. M.P.	5.49	14.74	2.05	3.96	3.78		1.03	10.39			0.41
8. T.N.	9.73	6.65	3.30	2.54	16.80	15.51	2.56		2.96	3.86	1.67
9. Maharashtra.	42.83		42.39	48.14	18.98	9.77	5.40		19.30	46.18	25.63
10. Karnataka		1.65	5.44		1.87		29.76				1.51
11. Orissa											0.95
12. Punjab	4.19	16.13	4.17	5.43	24.45				7.85		
13. Rajasthan			0.30		3.22						
14. UP	3.12		13.35	5.79		1.01		1.11		5.50	0.68
15. West Bengal	28.64			4.41		38.92		61.02	6.88	3.12	61.92
16. Delhi	2.13							5.04		25.76	
All India	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

contd....

contd...Table A-1

State / Industry	Textile Machinery	Machine Tools	Agricultural Implements	Manufacturing of motorcycles and bicycles
1. A.P.				
2. Assam				
3. Bihar			45.59	
4. Gujarat	17.64			0.71
5. J&K				
6. Kerala			11.15	
7. M.P.				
8. T.N.	13.83	1.08		9.09
9. Maharashtra	39.42	11.06	22.38	
10. Karnataka		70.07	4.29	
11. Orissa				
12. Punjab		1.87	4.28	25.03
13. Rajasthan				
14. U.P.			4.10	
15. W. Bengal	22.48	4.98	0.74	6.17
16. Delhi				24.36
All India	100.00	100.00	100.00	100.00

~~Appendix~~ Table A-2

Index Numbers of Value added per Man-hour in 1960, 1964, 1966 and 1971, Statewise

	State	Value added per Man-hour			
		1960	1964	1966	1971
1.	Andhra Pradesh	75.9	65.1	69.8	80.4
2.	Assam	127.4	82.4	112.8	68.2
3.	Bihar	120.0	134.6	136.2	104.7
4.	Gujarat	78.5	89.3	89.6	98.6
5.	Jammu & Kashmir	40.4	87.2	38.6	1.7
6.	Kerala	59.3	53.6	75.5	90.5
7.	Madhya Pradesh	84.8	55.4	131.9	90.5
8.	Tamil Nadu	97.8	104.8	92.6	87.2
9.	Maharashtra	127.0	132.2	135.6	142.7
10.	Karnataka	88.5	110.7	133.2	137.2
11.	Orissa	104.8	143.6	92.6	75.1
12.	Punjab	80.7	101.7	107.7	106.4
13.	Rajasthan	67.4	77.2	80.5	110.9
14.	Uttar Pradesh	80.0	79.6	80.2	69.0
15.	West Bengal	94.8	91.3	85.6	79.3
16.	Delhi	109.3	100.3	84.9	80.4
17.	Himachal Pradesh	204.1	63.0	47.3	148.6
18.	Tripura	71.1	31.5	19.1	28.2
	All India	100.0	100.0	100.0	100.0

Table A-3

Summary Statistics Relating to Regressions
Total Manufacturing

Independent Variables	R^2	$\bar{R}^2$	F	Coefficients of $\log(K/L)$	Coefficients of log L	Coefficients of 1964	Coefficients of 1966	Coefficients of 1971	F^1
1. Capital intensity and lab input	0.06	0.03	1.47	0.11	0.19	-	-	-	5.55*
2. State effect, capital intensity, lab input	0.46	0.26	2.33*	0.12	-0.49	-	-	-	
3. Year effects	0.0003	-0.04	0.01	-	-	-0.28	-0.14	-0.10	2.12
4. State and year effects	0.42	0.19	1.85*	-	-	-0.28	-0.14	-0.10	
5. Year effects, Capital intensity, lab input	0.12	0.05	1.80	0.35	0.17	-0.75	-0.79	-0.90	

*significant at 5 per cent level of significance.

Table A-4

Sugar

Independent Variables	R^2	$\bar{R}^2$	F	Coefficients of log(K/L)	Coefficients of log L	Coefficients of 1964	Coefficients of 1966	Coefficients of 1971	F^1
1. Capital intensity and input lab	0.31	0.26	6.51*	0.91	0.40	-	-	-	2.96
2. State effect, Capital Intensity, input lab	0.50	0.30	2.46*	1.14	0.51	-	-	-	
3. Year Effects	0.61	0.57	14.60*	-	-	0.04	0.11	-2.37	8.93*
4. State and Year Effects	0.66	0.50	4.08*	-	-	0.04	0.11	-2.37	
5. Year Effects, Capital Intensity, lab input	0.63	0.56	8.85*	0.17	0.01	-0.01	0.07	-2.24	

*significant at 5 percent level of significance.

Table A-5

Tea Manufacturing

Independent Variables	R^2	$\bar{R}^2$	F	Coefficients of log(K/L)	Coefficients of log L	1964	1966	1971	F^1
1. Capital intensity and lab input	0.37	0.31	6.16*	1.23	-0.03	-	-	-	22.85*
2. State effect, capital intensity, lab input	0.42	0.17	1.66	0.02	-0.14	-	-	-	
3. Year effects	0.01	-0.14	0.07	-	-	0.02	0.08	0.67	15.95*
4. State and Year effect	0.42	0.11	1.36	-	-	0.02	0.08	0.67	
5. Year effects, capital intensity, lab input.	0.63	0.36	8.85*	1.25	-0.09	1.08	1.92	4.59	

*significant at 5 per cent level of significance.

Table A-6

Cotton Textiles

Independent Variables	R^2	$\bar{R}^2$	F	Coefficients of log(K/L)	Coefficients of log L	Coefficients of 1964	Coefficients of 1966	Coefficients of 1971	F^1
1. Capital intensity and lab input	0.08	0.04	1.96	0.13	0.14	-	-	-	1.42
2. State effect, capital intensity, lab input	0.20	-0.11	0.65	0.10	0.23	-	-	-	-
3. Year effects	0.02	-0.05	0.30	-	-	0.28	0.08	0.20	4.33*
4. State and Year effects	0.30	0.003	1.01	-	-	0.28	0.08	0.20	-
5. Year effects, capital intensity, lab input	0.13	0.13	0.03	0.10	0.13	0.22	0.01	0.09	-

*significant at 5 per cent level of significance.

Table A-7

Art silk

Independent Variables	R^2	$\bar{R}^2$	F	Coefficients of log(K/L)	log L	1964	1966	1971	F^1
1. Capital intensity and lab input	0.16	0.08	2.00	0.41	0.04	-	-	-	2.81
2. State effect, capital intensity and lab input	0.35	0.07	1.23	-0.02	-0.24	-	-	-	
3. Year effects	0.06	-0.08	0.43	-	-	0.24	0.46	0.61	10.65*
4. State and Year effects	0.61	0.40	2.93*	-	-	0.24	0.46	0.61	
5. Year effects, capital intensity, lab input	0.22	0.09	1.02	+0.35	0.02	-0.02	0.19	0.30	

*significant at 5 per cent level of significance.

Table A-8

Printing

Independent Variables	R^2	$\bar{R}^2$	F	Coefficients of log (K/L)	Coefficients of log L	Coefficients of 1964	Coefficients of 1966	Coefficients of 1971	F^1
1. Capital intensity and lab input	0.16	0.11	5.05*	0.28	0.16	-	-	-	2.38
2. State effect, capital intensity, lab input	0.59	0.25	2.88*	0.16	0.31	-	-	-	
3. Year effects	0.07	0.02	1.30	-	-	0.09	0.28	0.50	17.13*
4. State and Year effects	0.82	0.75	11.10*	-	-	0.09	0.28	0.50	
5. Year effects, capital intensity, lab-input	0.25	0.18	3.33*	0.17	0.16	-0.02	0.15	0.30	

*Significant at 5 per cent level of significance.

Table A-9

Drugs and Pharmaceuticals

Independent Variables	R^2	$\bar{R}^2$	F	Coefficients of log(K/L)	Coefficients of log L	Coefficients of 1964	Coefficients of 1966	Coefficients of 1971	F^1
1. Capital intensity and lab input	0.002	-0.07	0.03	0.01	0.13	-	-	-	8.28*
2. State effect, capital intensity, lab input	0.56	0.38	3.11*	1.03	-0.63	-	-	-	..
3. Year effects	0.006	-0.10	0.06	-	-	0.21	0.19	0.58	1.56
4. State and year effects	0.44	0.17	2.48*	-	-	0.21	0.19	0.58	..
5. Year effects, capital intensity, lab input	0.01	-0.18	0.05	-0.05	0.11	0.17	0.15	0.51	..

*significant at 5 per cent level of significance.

Table A-10

Hydraulic Cement

Independent Variables	R^2	$\bar{R}^2$	F	Coefficients of log(K/L)	Coefficients of log L	Coefficients of 1964	Coefficients of 1966	Coefficients of 1971	F^1
1. Capital intensity and lab input	0.02	-0.07	0.21	0.26	-0.18	-	-	-	5.67*
2. State effect, capital intensity, lab input	0.11	-0.28	0.28	-0.01	-0.80	-	-	-	
3. Year effects	0.14	0.01	1.09	-	-	0.26	0.51	0.39	9.22*
4. State and year effects	0.26	-0.13	0.66	-	-	0.26	0.51	0.39	
5. Year effects, capital intensity, lab input	0.27	0.07	0.27	0.30	-0.18	0.25	0.52	0.22	

*significant at 5 per cent level of significance.

Table A-11

Iron and Steel (Total)

Independent Variables	R^2	$\bar{R}^2$	F	Coefficients of log(K/L)	log L	1964	1966	1971	F^1
1. Capital intensity and lab input	0.01	-0.06	0.15	-0.16	0.11	-	-	-	1.97
2. State effect, capital intensity, lab input	0.08	-0.30	0.21	-0.07	-0.09	-	-	-	-
3. Year effects	0.02	-0.09	0.19	-	-	-0.10	-0.57	-0.62	3.08*
4. State and year effects	0.14	-0.27	0.34	-	-	-0.10	-0.57	-0.62	-
5. Year effects, capital intensity, lab input	0.05	-0.13	0.27	-0.12	0.15	-0.08	-0.52	-0.60	-

*significant at 5 per cent level of significance.

Table A-12(A)

Tiles

Independent Variables	R^2	$\bar{R}^2$	F	Coefficients of log(K/L)	log L	1964	1966	1971	F^1
1. State effects	0.36	0.16	1.85	-	-	-	-	-	7.04*
2. State and time effects, capital intensity and lab input	0.76	0.58	4.12*	0.86	-0.01	-0.32	-0.59	-0.37	-
3. Capital intensity, lab input	0.40	0.34	7.00*	0.75	0.15	-	-	-	25.87*
4. State effect, capital intensity and lab input	0.40	0.14	1.52	0.05	-0.06	-	-	-	-
5. Year effects	0.002	-0.15	0.01	-	-	-0.05	0.29	0.03	17.05*
6. State and Year effects	0.38	0.05	1.15	-	-	-0.05	0.29	0.03	-
7. Year effects, capital-intensity and lab input	0.53	0.40	4.06*	0.89	0.18	-0.51	-0.61	-0.49	-

*significant at 5 per cent level of significance.

Table A-12(B)

Tiles

	Independent Variables	State of Reference	Level in State of Ref.	Kerala	M.P.	T.N.	Maharashtra	Karnataka
1.	Labour Productivity	Gujarat	7.95	-0.36	-1.00	-0.48	0.54	0.37
2.	Total factor productivity	Gujarat	1.60	0.13	-0.54	-0.81	-0.25	0.21

Table A-13(A)

Textile Machinery

	Independent Variables	R^2	$\bar{R}^2$	F	Coefficients of log(K/L)	log L	1964	1966	1971	F^1
1.	State effects	0.002	-0.25	0.01	-	-	-	-	-	11.25*
2.	State and time effects, capital intensity and lab input	0.70	0.36	2.04	0.30	-0.43	0.62	0.48	0.54	-
3.	Capital intensity Lab input	0.21	0.15	1.86	0.32	0.38	-	-	-	19.82*
4.	State effect, capital intensity, lab input	0.26	-0.004	0.98	0.37	0.29	-	-	-	-
5.	Year effects	0.14	-0.07	0.65	-	-	0.39	0.36	0.56	27.94*
6.	State & year eff.	0.52	0.30	2.35	-	-	0.39	0.36	0.56	-
7.	Year effects, capital intensity lab input.	0.44	0.16	1.57	0.32	0.23	0.39	0.26	0.39	-

*significant at 5 per cent level of significance.

Table A-13(B)

Textile Machinery

Independent variables	State of Reference	Level in state of ref.	T.N.	Maharashtra	West Bengal
1. Labour productivity	Gujarat	8.67	-0.13	-0.15	-0.16
2. Total factor productivity	Gujarat	6.36	-0.07	0.52	-0.10

Table A-14(A)

Machine Tools

Independent Variables	R^2	$\bar{R}^2$	F	Coefficients of log(K/L)	log L	1964	1966	1971	F^1
1. State effects	0.006	-0.26	0.02	-	-	-	-	-	4.46*
2. State & time effects, capital intensity, lab input	0.70	0.43	2.59	-0.12	-0.13	0.56	-1.72	0.94	-
3. Capital intensity, lab input	0.0004	-0.06	0.006	-0.39	0.14	-	-	-	2.05
4. State effect, capital-intensity and lab input	0.02	-0.43	0.04	-0.57	0.27	-	-	-	-
5. Year effects	0.56	0.48	6.79*	-	-	0.30	-2.02	0.62	33.70*
6. State and year effects	0.69	0.51	3.82*	-	-	0.30	-2.02	0.62	-
7. Year effects, capital intensity, lab input	0.56	0.40	3.56*	0.03	0.07	0.19	-2.14	0.49	-

*significant at 5 per cent level of significance.

Table A-14(n)

Machine Tools

Independent Variables	State of Reference	Level in State of Reference	Mahar. ashtra	Karna. taka	Punjab	W.Bengal
1. Labour Productivity	T.N.	8.04	0.39	0.26	-0.57	-0.25
2. Total factor Productivity	T.N.	0.06	0.63	0.68	-0.34	-0.21

Table A-15

Regression Results with Value Added as the Dependent Variable, Capital Intensity and Labour as Independent Variables[1].

Industry	No. of observations	δ	α	h	R^2	F
1. Sugar	32	-0.93	0.95	0.32	0.82	50.13*
2. Tea Manufacturing	24	-1.82	1.22	-0.03	0.90	75.00*
3. Cotton Textiles	48	6.95	0.97	0.12	0.97	528.08*
4. Art Silk	24	6.33	0.26	-0.22	0.18	1.82
5. Printing	56	5.44	0.32	0.11	0.92	218.45*
6. Drugs and Pharmaceuticals	32	7.88	0.14	-0.86	0.46	9.36*
7. Hydraulic Cement	24	9.88	-0.04	-0.15	0.65	15.44*
8. Tiles	24	4.15	0.48	-0.07	0.32	3.92*
9. Iron & Steel(Metal)	36	9.99	-1.41	0.11	0.75	36.97*
10. Textile Machinery	20	4.61	0.41	0.19	0.78	24.60*
11. Machine Tools	20	7.67	0.27	-0.54	0.47	6.20*
Total Manufacturing	72	6.46	0.16	0.12	0.90	219.04*

1. The Regression equation is

$$\log Y_{st} = \delta + \alpha \log k + h \log L$$

* significant at 1 per cent level of significance.

Table A-16

Annual Compound Growth Rates (Percent) of Labour Productivity in Industries, State-wise, 1960-71

States / Industries	Rice Mills	Flour Mills	Edible oils	Cotton Ginning	Inorganic Heavy Chemicals	Tiles	Chinaware and Pottery	Bolts, Nuts, etc.	Hume Pipes
1. Andhra Pradesh	-8.20		-0.06	4.76					
2. Assam									
3. Bihar	1.01	-3.32			-0.13				
4. Gujarat		1.10	-4.11	7.07	4.99	0.29	3.63		-2.73
5. Kerala					6.05	2.54			
6. Madhya Pradesh	4.42	-12.51	-3.72	10.35		-3.15	-3.37		
7. Tamil Nadu	6.11	-5.63	-2.09	-3.39	0.20	-5.31		2.27	-13.82
8. Maharashtra		12.17	-2.49	16.06	3.75	6.74		5.11	-1.67
9. Karnataka	-3.93		-3.44	2.45		1.03			
10. Orissa	0.53								
11. Punjab		8.36	-3.10	13.39				-3.41	
12. Rajasthan			8.59	2.39					
13. Uttar Pradesh		9.09	-1.21		23.12		-5.87		-6.09
14. West Bengal		-11.15			-4.09		-4.99	25.91	5.32
15. Delhi		8.46					3.33		0.35
All India	2.08	- 1.70	-2.28	8.76	2.61	1.78	0.08	5.15	-2.15

contd' table...

Table A-16 contd...

States / Industries	Iron and Steel (C&F)	Textile Machinery	Machine Tools	Agricultural Implements	Manufacture of Motorcycles and Bicycles
1. Andhra Pradesh	17.36				
2. Assam					
3. Bihar	17.36			-2.76	
4. Gujarat	-1.84	3.56			-1.27
5. Kerala				-3.05	
6. Madhya Pradesh	7.79				
7. Tamil Nadu	11.69	11.99	5.39		-12.35
8. Maharashtra	9.50	5.80	5.88	8.85	-8.24
9. Karnataka	15.50		3.33	1.70	
10. Orissa	14.92				
11. Punjab			10.01	6.42	-11.19
12. Rajasthan					
13. Uttar Pradesh	9.36			14.61	-4.33
14. West Bengal	3.74	-0.09	4.59	14.65	-21.72
15. Delhi					
All India	12.97	5.70	1.80	3.97	-11.70

Table A-17

Regression Results with Growth Rate of Labour Productivity as the Dependent Variable and Growth Rate of Employment as the Independent Variable 2

Industry	No. of observations	(1) a_{it}	(1) b_{it}	R^2	t
1. Printing	15	4.54 (0.74)	0.003 (0.10)	0.001	0.00003
2. Drugs and Pharmaceuticals	9	1.82 (27.21)	0.39 (0.62)	0.05	0.61
3. Iron and Steel(Metal)	16	-4.13 (3.87)	0.01 (0.16)	0.001	0.00002
4. Iron and Steel(C&F)	11	6.20 (3.11)	0.003 (0.20)	0.002	0.13
5. Total Manufacturing	18	0.67 (2.44)	-0.06 (0.32)	0.002	0.18

2. The Regression equation is

$$g^{Y}_{is\,(1960-71)} = a^{(1)}_{it} + b^{(1)}_{it}\, g^{E}_{is\,(1960-71)}$$

BIBLIOGRAPHY

1. Banerji, A., Capital Intensity and Productivity in Indian Industry, The Macmillan Company of India Ltd., 1975.

2. Beri, G.C., Measurement of Production and ~~x~~ Productivity in Indian Industry, Asia Publishing House, 1962.

3. Bhalla, A.S.(ed.) Technology and Employment in Industry, A Case Study Approach, ILO, Geneva, 1975.

4. Bhattasali, B.N. & Bhattasali, G., Productivity and Economic Development, Asia Productivity Organization, Tokyo, 1972.

5. Bloom, G.F. & Northrup, H.R.(ed.) Economics of Labour Relations, Homewood; Richard D. Irwin, 1977.

6. Blyth, C.A. & Hamer, P., 'Output, Employment and Productivity Growth in New Zealand Manufacturing Industries', Productivity Measurement Review, No.41, May 1965.

7. Brown, M., On the Theory and Measurement of Technical Change, Cambridge University Press, 1966.

8. Bruton, H.J., 'Employment, Productivity and Income Distribution' in Cairncross, A & Puri, M.(ed)., Employment, Income Distribution and Development Strategy, Macmillan, London, 1976.

9. Chandhok, H.L., Wholesale Price Statistics: India 1947-73, Vol.I, Economic and Scientific Research Foundation, Delhi, 1978.

10. Chalapati Rao, K.S., Measurement of Regional Variations in Industrial Productivity - A Case Study of Basic Metal Industries (Unpublished M. Phil Thesis, 1976).

11. Chaterjee, A.K., 'Productivity in Selected Manufacturing Industries 1946-65' in Economic and Political Weekly, Vol.VIII, No.47, Nov. 1973.

...../

12. Denison, E.F., — Why Growth Rates Differ: Post War Experience in Nine Western Countries, The Brookings Institution, Washington D.C., 1967.

13. Dholakia, B.H. — 'Measurement of Capital Input and Estimation of Time Series Production Functions in Indian Manufacturing', The Indian Economic Journal, Vol.24, No.3, 1977.

14. ———— — The Sources of Economic Growth in India, Good Companions, Baroda, 1974.

15 Dholakia, R.H. — 'An Inter-state analysis of Capital and Output in the Registered Manufacturing Sector', Indian Journal of Industrial Relations, Vol.15, No.1, 1979.

16. Diwan, R.K. & Gujarati, D.N., — 'Employment and Productivity in Indian Industries', Artha Vijnana, Vol.X, 1968.

17. Dunlop, J.T & Diatchenko, V.P., — Labour Productivity, McGraw-Hill, New York, 1964.

18. Fabricant, S., — A Primer on Productivity, Prentice-Hall of India, 1973.

19. Goel, V.K., — Productivity Trends in the Indian Mining and Manufacturing sectors, National Productivity Council, Delhi, 1979.

20. Goel, V.K. & Nair, N.K. — 'Labour Productivity and Output Growth in Indian Mining and Manufacturing Sectors (1951-76)', Productivity Supplement, Vol.XX, No.2

21. Goldar, B.N. — Some Aspects of Technological Progress in Indian Industries (Unpublished Ph.D. Thesis), Delhi University, 1981.

22. Hashim, S.R. & Dadi, M.M. — Capital-Output Relation in Indian Manufacturing 1946-64., M.S. University, Baroda, 1973.

...../

23. Kaldor, N., Causes of the Slow Rate of Economic Growth of the U.K., Inagural Lecture, Cambridge University Press, 1966.

24. _____ Strategic Factors in Economic Growth, Cornell University, 1967.

25. Kendrick, J.W., Productivity Trends in the United States, Princeton University Press (NBER), 1961.

26. _____ Understanding Productivity An Introduction to the Dynamics of Productivity Change, John Hopkins University Press, Baltimores, 1977.

27. Kiernan, A.K., Productivity and Industrial Growth - The Irish Experience, Clarendon Press, Oxford, 1971.

28. Krishna, R & Mehta, S.S., 'Productivity Trends in Large-Scale Industries', Economic and Political Weekly, Oct., 1968.

29. Mahendra Dev. S., Productivity in Organised Industry in Andhra Pradesh and All India: A Comparitive Analysis (unpublished M. Phil Thesis), Delhi University, 1981.

30. Mehta, S.S., Productivity, Production Function and Technical Change, Concept Publishing Co., 1980.

31. Mukherjee, I.N., 'Productivity Trends in Large-Scale Manufacturing Industry: A Comparative Study', Productivity, Vol. XVI, No.1, 1975.

32. National Productivity Council., Productivity Trends in Cement Industry in India, Delhi, 1978.

33. _____ Productivity Trends in Cotton Textiles Industry in India, Delhi, 1976.

34. _____ Productivity Trends in Iron and Steel Industry, Delhi, 1976.

35. _____ Selected Papers on Productivity Measurment in Indian Industries, Delhi, 1970.

...../

36. Nayyar, D., 'Industrial Development in India', Economic and Political Weekly, Special No. 1978.

37. Pratten, C.F., Labour Productivity Differentials Within International Companies, Cambridge University Press, Occasional Papers 50, 1976.

38. Pratten, C.F., & Dean, R.M., The Economics of Large-Scale Production in British Industry: An Introductory Study, Cambridge University Press, 1965.

39. Raman, V.V., Productivity and Economic Growth, National Productivity Council, Delhi, 1972.

40. Reddy, M.G.K. & Rao, S.V., 'Functional Distribution in the Large-Scale Manufacturing Sector in India', Artha Vijnana, Vol.4, 1962.

41. Salter, W.E.G., Productivity and Technical Change, Cambridge University Press, 1966.

42. United Nations, Industrial Development Survey, Vol.II, New York, 1970.

43. ———— World Industry Since 1960: Progress and Prospects, Special Issue of the Industrial Development Survey for the third General Conference of UNIDO, New York, 1979.

44. Verma, P., 'Inter-Regional Differentials in Labour Productivity', Produc... Vol.XII, No.4, 1972.

————